INCAS - National Institute for Aerospace Research "Elie Carafoli"
(under the aegis of The Romanian Academy)

AEROSPATIAL 2014

Proceedings
of the International Conference of Aerospace Sciences
"AEROSPATIAL 2014"
18 - 19 September, 2014
Bucharest, Romania

BUCHAREST
2014

Proceedings
of the International Conference of Aerospace Sciences
"AEROSPATIAL 2014"
18 - 19 September 2014,
Bucharest, Romania

AEROSPATIAL 2014

Publisher:	**INCAS – National Institute for Aerospace Research "Elie Carafoli"** B-dul Iuliu Maniu 220, sector 6, O.P. 76, Code 061126, Bucharest, Romania Phone: +4021 4340083, Fax: +4021 4340082 E-mail: incas@incas.ro, http://www.incas.ro

Registration code:	**ISSN 2067 – 8614** **ISSN-L 2067 – 8614** **Romanian National Library** **ISSN National Center**

INCAS – National Institute for Aerospace Research "Elie Carafoli"
(under the Aegis of The Romanian Academy)

AEROSPATIAL 2014

Proceedings
of the International Conference of Aerospace Sciences
"AEROSPATIAL 2014"
18 - 19 September 2014,
Bucharest, Romania

BUCHAREST
2014

Publisher: **INCAS – National Institute for Aerospace Research "Elie Carafoli"**
B-dul Iuliu Maniu 220, 061126 Bucharest, Romania
Phone: +4021 4340083; Fax: +4021 4340082
E-mail: incas@incas.ro; http://www.incas.ro
Contact person: Elena NEBANCEA

International Conference of Aerospace Sciences

"AEROSPATIAL 2014"

Bucharest, 18-19 September 2014

GRAPHIC PROGRAM

Hour	18 September 2014			Hour	19 September 2014		
$8.^{00}$ - $9.^{00}$	REGISTRATION *Coffee Break*			$8.^{30}$ - $9.^{00}$	REGISTRATION *Coffee Break*		
$9.^{00}$-$9.^{30}$	OPENING SESSIONS			$9.^{00}$-$9.^{30}$	The "Nicolae Tipei" Prize Award Ceremony		
$9.^{30}$-$10.^{00}$	PL – Adriana NASTASE (Germany)			$9.^{30}$-$10.^{00}$	PL – Ruxandra BOTEZ (Canada)		
$10.^{00}$-$10.^{30}$	PL – Horia DUMITRESCU (Romania)			$10.^{00}$-$10.^{30}$	PL – Octavian Thor PLETER (Romania)		
$10.^{30}$-$11.^{00}$	*Coffee Break*			$10.^{30}$-$11.^{00}$	*Coffee Break*		
$11.^{00}$-$11.^{20}$	*S1.1.1*	*W5.1.1.1*	*S4.1.1*	$11.^{00}$-$11.^{20}$	*S1.1.7*	*S7.1.1*	*S4.1.7*
$11.^{20}$-$11.^{40}$	*S1.1.2*	*W5.1.1.2*	*S4.1.2*	$11.^{20}$-$11.^{40}$	*S1.1.8*	*S7.1.2*	*S4.1.8*
$11.^{40}$-$12.^{00}$	*S1.1.3*	*W5.1.1.3*	*S4.1.3*	$11.^{40}$-$12.^{00}$	*S1.1.9*	*S7.1.3*	*S4.1.9*
$12.^{00}$-$12.^{20}$	*S1.1.4*	*W5.1.1.4*	*S4.1.4*	$12.^{00}$-$12.^{20}$	*S1.1.10*	*S7.1.4*	*S4.1.10*
$12.^{20}$-$12.^{40}$	*S1.1.5*	*W5.1.1.5*	*S4.1.5*	$12.^{20}$-$12.^{40}$	*S1.1.11*	*S7.1.5*	*S4.1.11*
$12.^{40}$-$13.^{00}$	*S1.1.6*		*S4.1.6*	$12.^{40}$-$13.^{00}$	*S1.1.12*		
$13.^{00}$-$14.^{00}$	*Lunch*			$13.^{00}$-$14.^{00}$	*Lunch*		
$14.^{00}$-$14.^{30}$	PL – Kristo REINSALU (Estonia)			$14.^{00}$-$14.^{20}$	*S1.2.13*	*S3.2.5*	
$14.^{30}$-$15.^{00}$	PL – Delia DIMITRIU (United Kingdom)			$14.^{20}$-$14.^{40}$	*S1.2.14*	*S3.2.6*	
$15.^{00}$-$15.^{30}$	*Coffee Break*			$14.^{40}$-$15.^{00}$	*S1.2.15*	*S3.2.7*	
$15.^{30}$-$15.^{50}$	*S8.2.1*	*S6.2.1*	*S2.2.1*	$15.^{00}$-$15.^{20}$	*Q & A*		
$15.^{50}$-$16.^{10}$	*S8.2.2*	*S6.2.2*	*S2.2.2*	$15.^{20}$	*CLOSING SESSIONS*		
$16.^{10}$-$16.^{30}$	*S8.2.3*	*S6.2.3*	*S2.2.3*				
$16.^{30}$-$17.^{00}$	*Coffee Break*						
$17.^{00}$-$17.^{20}$	*S8.2.4*	*S5.2.1*	*S2.2.4*				
$17.^{20}$-$17.^{40}$	*S8.2.5*	*S5.2.2*	*S2.2.5*				
$17.^{40}$-$18.^{00}$	*S8.2.6*	*S5.2.3*	*S3.2.1*				
$18.^{00}$-$18.^{20}$	*S8.2.7*	*S5.2.4*	*S3.2.2*				
$18.^{20}$-$18.^{40}$	*S8.2.8*	*S5.2.5*	*S3.2.3*				
$18.^{40}$-$19.^{00}$			*S3.2.4*				
$19.^{15}$	*DINNER*						

PL - **Plenary lecture**

S1 - **Section 1. Aerodynamics**

S2 - **Section 2. Flight Mechanics and Systems Integration**

S3 - **Section 3. Astronautics and Astrophysics**

S4 - **Section 4. Materials and Structures**

S5 - **Section 5. Systems, Subsystems and Control in Aeronautics**

W5.1 Workshop – "Structural health monitoring in spacecraft structures using piezoelectric wafer active sensors"

S6 - **Section 6. Experimental Investigations in Aerospace Sciences**

S7 - **Section 7. ATS and full automation ATM**

S8 - **Section 8. Management in Aerospace Activities**

- **The "Nicolae Tipei" Prize Award Ceremony**

- (blue) **"ELIE CARAFOLI" Amphitheatre**
- (light orange) **"Nicolae TIPEI" Amphitheatre**
- (red) **"Conference room", et. 2, corp B**

CONFERENCE PROGRAM

Thursday 18.09.2014 – "ELIE CARAFOLI" Amphitheatre

$8.^{00}$ - $9.^{00}$ **REGISTRATION**

Coffee Break

$9.^{00}$ - $9.^{30}$ **OPENING SESSIONS**

***Welcome speech*:**

- **Mihnea Cosmin COSTOIU**, Minister Delegate for Higher Education, Scientific Research and Technological Development, Romania
- **Catalin NAE**, General Manager, INCAS − National Institute for Aerospace Research "Elie Carafoli", Bucharest, Romania

PLENARY SESSIONS

Chairman:

Catalin NAE

$9.^{30}$ - $10.^{00}$

PL 1 **Adriana NASTASE** (RWTH, Aachen University, Germany), ***Global Optimized and Fully-Integrated Aerospace Vehicles***

$10.^{00}$ - $10.^{30}$

PL 2 **Horia DUMITRESCU, Vladimir CARDOS, Alexandru DUMITRACHE** ("Gheorghe Mihoc – Caius Iacob" Institute of Mathematical Statistics and Applied Mathematics of the Romanian Academy, Bucharest, Romania), ***Vortical structures in the near wake of a VAWT***

$10.^{30}$ - $11.^{00}$

Coffee Break

Thursday 18.09.2014 – "ELIE CARAFOLI" Amphitheatre

Section 1: Aerodynamics

Thursday 18.09.2014. Morning session

S1.1 **Chairman:**

Paul CIZMAS
Marius STOIA-DJESKA
George SAVU

$11.^{00}$ - $11.^{20}$

S1.1.1 **Modeling of Unsteady Flows Using Reduced-Order Models Based on the Proper Orthogonal Decomposition,** Paul CIZMAS (Texas A&M University, Dept. of Aerospace Engineering, USA).

$11.^{20}$ - $11.^{40}$

S1.1.2 **Applications of the Fourier Analysis and Fourier Integral to the Calculation of Some Non-Steady Flows about Lifting Surfaces,** Valentin Adrian Jean BUTOESCU (INCAS − National Institute for Aerospace Research "Elie Carafoli", Flow Physics Department, Bucharest, Romania).

$11.^{40}$ - $12.^{00}$

S1.1.3 **Variations of the aerodynamic forces and moments due to the oscillations in the case of an unmanned aircraft,** Alexandra Emilia FORTIS, Stefan BALINT (West University of Timișoara, Romania).

12.^{00} - 12.^{20}

S1.1.4 **Small modular launchers,** Mihai Victor PRICOP, Irina Carmen ANDREI, Mihai Leonida NICULESCU, Marius Gabriel COJOCARU, Maria Cristina BREABAN (INCAS − National Institute for Aerospace Research "Elie Carafoli", Flow Physics Department, Numerical Simulation Unit, Bucharest, Romania).

12.^{20} - 12.^{40}

S1.1.5 **High speed testing for reentry vehicles,** Mihai Victor PRICOP, Corneliu STOICA (INCAS − National Institute for Aerospace Research "Elie Carafoli", Bucharest, Romania), Florin MUNTEANU (AEROSPACE Consulting, Bucharest, Romania), Mihai Leonida NICULESCU, Marius Gabriel COJOCARU, Alexandru Marius PANAIT (INCAS − National Institute for Aerospace Research "Elie Carafoli", Bucharest, Romania).

12.^{40} - 13.^{00}

S1.1.6 **Velocity distribution as a result of the interaction of the organizational processes in shear flows,** Stefan N. SAVULESCU (INCAS − National Institute for Aerospace Research "Elie Carafoli", Bucharest, Romania), Florin BALTARETU (Technical University of Civil Engineering, Faculty of Building Services, Bucharest, Romania).

13.^{00} - 14.^{00}

Lunch

Thursday 18.09.2014 – "ELIE CARAFOLI" Amphitheatre

Thursday 18.09.2014. Afternoon session

PLENARY SESSIONS

Chairman:

Cornel OPRISIU

14.^{00} - 14.^{30}

PL 3 **Kristo REINSALU** (Invent Baltics OU, Teaduspargi 6/1, Tallinn 12618, Estonia), **Claudia DOBRE** (INCAS − National Institute for Aerospace Research "Elie Carafoli", Romania), ***BEAWARE Project - creating links between eastern and western aeronautical organizations***

14.^{30} - 15.^{00}

PL 4 **Delia DIMITRIU** (Centre for Aviation, Transport, and the Environment, The Manchester Metropolitan University, United Kingdom), ***The Role of Research for End-Users: academia and industry. Case-study: Manchester Metropolitan University Cooperation with TAROM and Iasi Airport***

15.^{00} - 15.^{30}

Coffee Break

Thursday 18.09.2014 – "ELIE CARAFOLI" Amphitheatre

Section 8: Management in Aerospace Activities

Thursday 18.09.2014. Afternoon session

S8.2 **Chairman:**

Lex TEN HAVE
Stefan BOGOS

15.30 - 15.50
S8.2.1 **Crisis management in aerospace – a new interdisciplinary field of study,** Aurelian Virgil BALUTA (Spiru Haret University, Bucharest, Romania).

15.50 - 16.10
S8.2.2 **The Romanian laws for crisis in aerospace and the general rules of project management,** Aurelian Virgil BALUTA, Maria ANDRONIE (Spiru Haret University, Bucharest, Romania), Ioan MUNTEANU (MNA ProdCom IMPEX SRL, Bucharest, Romania).

16.10 - 16.30
S8.2.3 **Enhancing helicopter health and life cycle management through shared data bases and analysis tools,** Lex TEN HAVE (National Aerospace Laboratory NLR, Aerospace Vehicles Division, Emmeloord, The Netherlands).

16.30 - 17.00
` ***Coffee Break***

17.00 - 17.20
S8.2.4 **Single European Sky – benefits and costs for aviation industry,** Natalia HARTMAN (National Defence University of Warsaw, Poland).

17.20 - 17.40
S8.2.5 **The use of Aeromobile Forces in abroad mission,** Kaja WYMYSŁOWSKA (National Defence University of Warsaw, Poland).

17.40 - 18.00
S8.2.6 **Aeronautical Decision-Making – A review of decision-making models for beginners and experienced pilots,** Alexandru GHEORGHIU (Transilvania University of Brasov, Romania), Mircea BOSCOIANU (Romanian Air Force Academy, Brasov, Romania).

18.00 - 18.20
S8.2.7 **A Eject! Eject! Eject! A critical decision for fighter pilots,** Alexandru GHEORGHIU (Transilvania University of Brasov, Romania), Mircea BOSCOIANU (Romanian Air Force Academy, Brasov, Romania).

18.20 - 18.40
S8.2.8 **Aerospace Management in Nigeria,** Taofik OLAYIWOLA (Wings Aviation Nigeria Limited, Lagos, Nigeria).

19.15

DINNER

Thursday 18.09.2014 – “Nicolae TIPEI” Amphitheatre

W5.1 Workshop – "Structural health monitoring in spacecraft structures using piezoelectric wafer active sensors"

Thursday 18.09.2014. Morning session

W5.1 **Chairman:**

Victor GIURGIUTIU
Cristian POSTOLACHE
Ioan URSU

11.^{00} - 11.^{20}

W5.1.1.1 **The use of piezoelectric wafer active sensor (PWAS) in structural health monitoring (SHM) of aerospace structures,** Victor GIURGIUTIU (University of South Carolina, Department of Mechanical Engineering, SC 29208 Columbia, USA).

11.^{20} - 11.^{40}

W5.1.1.2 **New facility for evaluation of the space radiation and extreme temperatures effects on electronic devices,** Cristian POSTOLACHE, Daniel Constantin NEGUT, Mihalis CUTRUBINIS, Gheorghe MATEESCU, Viorel FUGARU (Horia Hulubei National Institute of Physics and Nuclear Engineering - IFIN HH, Magurele, Ilfov, Romania).

11.^{40} - 12.^{00}

W5.1.1.3 **Finite element analysis of the electromenchanical impedance method on aluminum plates in SHM,** Cristian RUGINA (Institute of Solid Mechanics of the Romanian Academy, Romania), Victor GIURGIUTIU (University of South Carolina, Department of Mechanical Engineering, USA), Ioan URSU, Adrian TOADER (INCAS – National Institute for Aerospace Research “Elie Carafoli”, Romania).

12.^{00} - 12.^{20}

W5.1.1.4 **Damage identification and damage metrics in SHM,** Daniela ENCIU, Mihai TUDOSE, Bogdan NECULAESCU, Adrian TOADER, Ioan URSU (INCAS – National Institute for Aerospace Research “Elie Carafoli”, Bucharest, Romania).

12.^{20} - 12.^{40}

W5.1.1.5 **Tunning of the Lamb waves in aluminium plates for Structure Health Monitoring,** Tiberiu Adrian SALAORU, Minodor ARGHIR, Marina ANDREI (INCAS – National Institute for Aerospace Research “Elie Carafoli”, Bucharest, Romania).

Hour: **13.^{00} - 14.^{00}**

Lunch

Thursday 18.09.2014 – "Nicolae TIPEI" Amphitheatre

Section 6 – Experimental Investigations in Aerospace Sciences

Thursday 18.09.2014. Afternoon session

S6.1. **Chairman:**

Florin MUNTEANU
Lica FLORE

15.^{30} - 15.^{50}
S6.2.1 **Comparative analysis of methods for identification of the natural vibration modes applied to an aeronautical mechanical structure,** Lica FLORE (STRAERO – Institute for Theoretical and Experimental Analysis of Aeronautical Structures, Bucharest, Romania), Albert Arnau CUBILLO (Universitat Politecnica de Catalunya, Spain).

15.^{50} - 16.^{10}
S6.2.2 **Post Flight Analysis of LOWGravity Experiment Onboard REXUS16**, Alexandru Camil MURESAN (INCAS − National Institute for Aerospace Research "Elie Carafoli", Bucharest, Romania).

16.^{10} - 16.^{30}
S6.2.3 **A semiempirical method of computing the principal parameters needed for operating the air conditioning plant**, Mihail Victor CERNAT, Andreea BOBONEA (INCAS − National Institute for Aerospace Research "Elie Carafoli", Bucharest, Romania), Florin MUNTEANU (AEROSPACE Consulting, Bucharest, Romania).

16.^{30} - 17.^{00}
` ***Coffee Break***

Thursday 18.09.2014 – "Nicolae TIPEI" Amphitheatre

Section 5 –Systems Subsystems and Control in Aeronautics

Thursday 18.09.2014. Afternoon session

S5.2. **Chairman:**

Mircea IGNAT
Laurentiu MORARU

17.^{00} - 17.^{20}
S5.2.1 **The New Competitive Sensors for Piezoelectric; The Electrostrictive Sensors,** Mircea IGNAT (National Institute for Research and Development in Electrical Engineering ICPE CA, Bucharest, Romania), Daniel LIPCINSKI (LUMINA The University of South-East, Bucharest, Romania), Maria CAZACU, Carmen RACLEȘ ("Petru Poni" Institute of Macromolecular Chemistry, Iasi, Romania).

17.^{20} - 17.^{40}
S5.2.2 **Notes regarding the design of squeeze film dampers working within the limits of the classical Reynolds theory,** Laurentiu MORARU ("POLITEHNICA" University of Bucharest, Faculty of Aerospace Engineering, Romania).

17.^{40} - 18.^{00}
S5.2.3 **New tuning method of the wavelet function for inertial sensors signals denoising,** Ioana-Raluca EDU (Military Technical Academy, Faculty of Mechatronics and Armament Integrated Systems, Bucharest, Romania), Felix-Constantin ADOCHIEI, Petre NEGREA (University of Craiova, Faculty of Electrical Engineering, Department of Electric, Energetic and Aerospace Engineering, Bucharest, Romania), Constantin ROTARU (Military Technical Academy, Faculty of Mechatronics and Armament Integrated Systems, Bucharest, Romania), Teodor Lucian GRIGORIE (University of Craiova, Faculty of Electrical Engineering, Department of Electric, Energetic and Aerospace Engineering, Bucharest, Romania).

18.^{00} - 18.^{20}

S5.2.4 **Towards Flexible-Winged Unmanned Aircraft Systems,** Radu Calin PAHONIE, Razvan-Viorel MIHAI, Ciprian LARCO (Millitary Technical Academy, Department of Integrated Systems of Aviation and Mechanics, Bucharest, Romania).

18.^{20} - 18.^{40}

S5.2.5 **The Aerodynamic Coefficients Estimation of a Small-Scale Paramotor,** Razvan-Viorel MIHAI, Radu Calin PAHONIE, Ciprian LARCO (Millitary Technical Academy, Department of Integrated Systems of Aviation and Mechanics, Bucharest, Romania).

19.^{15}

DINNER

Thursday 18.09.2014 – "Conference room", et. 2, corp B

Section 4: Materials and Structures

Thursday 18.09.2014. Morning session

S4.1 **Chairman:**

Ion FUIOREA
Marin SANDU
Victor MANOLIU

$11.^{00}$ - $11.^{20}$

S4.1.1 **A Multi-Material Complex Geometry Reduction Considering Equivalent Materials in Thermal-Structural Fields Coupling,** Ion FUIOREA (STRAERO – Institute for Theoretical and Experimental Analysis of Aeronautical Structures, Bucharest, Romania).

$11.^{20}$ - $11.^{40}$

S4.1.2 **The Harvesting Microstructures to the Airfield Applications,** Mircea IGNAT (National Institute for Research and Development in Electrical Engineering ICPE CA, Romania), Luca FLORESCU, Andrei CORBEANU, Raluca TURCU (Excelency Centre for Young Olympics – National Institute for Research and Development in Electrical Engineering ICPE CA, Romania).

$11.^{40}$ - $12.^{00}$

S4.1.3 **Accelerated evaluation of aerospace materials thermal behavior,** Victor MANOLIU, Gheorghe IONESCU (AEROSPACE Consulting, Bucharest, Romania), Silviu IVAN (INCAS − National Institute for Aerospace Research "Elie Carafoli", Materials Unit, Romania).

$12.^{00}$ - $12.^{20}$

S4.1.4 **Effect of nanoclay and carbon nanotubes addition in polypropylene nanocomposites,** Cristina BAN, (INCAS − National Institute for Aerospace Research "Elie Carafoli", Materials Unit, Romania, "POLITEHNICA" University of Bucharest, Faculty of Applied Chemistry and Materials Science, Romania), Adriana STEFAN (INCAS − National Institute for Aerospace Research "Elie Carafoli", Materials Unit, Romania), Ion DINCA (AEROSPACE Consulting, Romania), George PELIN (INCAS − National Institute for Aerospace Research "Elie Carafoli", Materials Unit, Romania, "POLITEHNICA" University of Bucharest, Faculty of Applied Chemistry and Materials Science, Romania), Anton FICAI, Ecaterina ANDRONESCU, Ovidiu OPREA ("POLITEHNICA" University of Bucharest, Faculty of Applied Chemistry and Materials Science, Romania).

$12.^{20}$ - $12.^{40}$

S4.1.5 **APS and HVAF deposited Amdry 997 bond layers for Thermal Barrier Coatings: A comparative study of oxidation processes by XRD, SEM, and EDS,** Aurel-Mihai VLAICU, Corneliu GHICA, Ionel MERCIONIU (National Institute of Materials Physics, Romania), Victor MANOLIU (AEROSPACE Consulting, Romania), Alexandru MIHAILESCU (INCAS – National Institute for Aerospace Research "Elie Carafoli", Romania), Gheorghe IONESCU (AEROSPACE Consulting, Romania).

$12.^{40}$ - $13.^{00}$

S4.1.6 **Evaluation of load capacity of adhesively bonded butt joints between dissimilar adherends**, Adriana SANDU, Marin SANDU, Dan Mihai CONSTANTINESCU ("POLITEHNICA" University of Bucharest, Romania).

$13.^{00}$ - $14.^{00}$

Lunch

Thursday 18.09.2014 – "Conference room", et. 2, corp B

Section 2 – Flight Mechanics and Systems Integration

Thursday 18.09.2014. Afternoon session

S2.2 **Chairman:**

Dan N. DUMITRIU
Achim IONITA
Mihai NEAMTU

15.^{30} - 15.^{50}

S2.2.1 **Inverse Dynamics Method for Minisatellite Attitude Guidance**, Ion STROE ("POLITEHNICA" University of Bucharest, Romania), Dan N. DUMITRIU (Institute of Solid Mechanics of the Romanian Academy; Romania).

15.^{50} - 16.^{10}

S2.2.2 **Implementation of isolated aero-elastic rotor for IAR 330 PUMA model in FLIGHTLAB environment,** Mihai MIHAILA-ANDRES (Military Technical Academy, Bucharest, Romania), Achim IONITA (STRAERO – Institute for Theoretical and Experimental Analysis of Aeronautical Structures, Bucharest, Romania).

16.^{10} - 16.^{30}

S2.2.3 **Analysis of IAR 330 PUMA aero-servo-elastic (ASE) model**, Andreea-Irina AFLOARE, Achim IONITA (STRAERO – Institute for Theoretical and Experimental Analysis of Aeronautical Structures, Bucharest, Romania).

16.^{30} - 17.^{00}

Coffee Break

17.^{00} - 17.^{20}

S2.2.4 **Flight mechanics model along the flight path,** Sorin Stefan RADNEF (INCAS − National Institute for Aerospace Research "Elie Carafoli", Bucharest, Romania).

17.^{20} - 17.^{40}

S2.2.5 **Point of landing predictor for high altitude balloon flights,** Florin MINGIREANU (ROSA – Romanian Space Agency, Bucharest, Romania).

Thursday 18.09.2014 – "Conference room", et. 2, corp B

Section 3 – Astronautics and Astrophysics

Thursday 18.09.2014. Afternoon session

S3.2 **Chairman:**

Ion STROE
Corneliu BERBENTE

17.^{40} - 18.^{00}

S3.2.1 **A physical – geometrical model of an early universe,** Corneliu BERBENTE ("POLITEHNICA" University of Bucharest, Faculty of Aerospace Engineering, Romania).

18.^{00} - 18.^{20}

S3.2.2 **Approach strategy in orbital rendezvous to a docking part on LVLH frame,** Achim IONITA, Ionel POPESCU (STRAERO – Institute for Theoretical and Experimental Analysis of Aeronautical Structures, Bucharest, Romania).

$18.^{20}$ - $18.^{40}$

S3.2.3 **Long Life Thrusters for Low Orbit Satellites and Special Solar Power Supply Systems for Satellites, ISS_Orbital Hotels, Earth Protection Against Asteroides and Applications on Mars,** Constantin SANDU (COMOTI – Romanian Gas Turbine Research and Development Institute, Bucharest, Romania), Dan BRASOVEANU (RAYTHEON, Arizona, USA).

$18.^{40}$ - $19.^{00}$

S3.2.4 **Advanced Interplanetary Spacecraft Fed by a Network of Concentrated Solar Wind and Light Beams,** Constantin SANDU (COMOTI – Romanian Gas Turbine Research and Development Institute, Bucharest, Romania), Dan BRASOVEANU (RAYTHEON, Arizona, USA).

$19.^{15}$

DINNER

Friday 19.09.2014 – "ELIE CARAFOLI" Amphitheatre

$8.^{30}$ - $9.^{00}$ **REGISTRATION**

Coffee Break

OPENING SESSIONS

$9.^{00}$ - $9.^{30}$

The "Nicolae Tipei" Prize Award Ceremony

PLENARY SESSIONS

Chairman:

Catalin NAE
Sorin RADNEF

$9.^{30}$ - $10.^{00}$

PL 5 **Ruxandra Mihaela BOTEZ** (ETS, University of Quebec, Canada), ***Aerodynamics improvement using morphing wing design***

$10.^{00}$ - $10.^{30}$

PL 6 **Octavian Thor PLETER, Cristian Emil CONSTANTINESCU** ("POLITEHNICA" University of Bucharest, Faculty of Aerospace Engineering, Bucharest, Romania), ***Possible Trajectories of the Flight Malaysian 370***

$10.^{30}$ - $11.^{00}$

Coffee Break

Friday 19.09.2014 – "ELIE CARAFOLI" Amphitheatre

Section 1: Aerodynamics

Friday 19.09.2014. Morning session

S1.1 **Chairman:**

Adriana NASTASE
Horia DUMITRESCU
Ioan SEBESAN

$11.^{00}$ - $11.^{20}$

S1.1.7 **Optimization of the aerodynamic wing loads on a high aspect ratio elastic wing**, Marius STOIA-DJESKA ("POLITEHNICA" University of Bucharest, Faculty of Aerospace Engineering, Bucharest, Romania).

$11.^{20}$ - $11.^{40}$

S1.1.8 **Sensitivities calculations for unsteady problems using an adjoint method**, Marius STOIA-DJESKA ("POLITEHNICA" University of Bucharest, Faculty of Aerospace Engineering, Bucharest, Romania).

$11.^{40}$ - $12.^{00}$

S1.1.9 **Calculation Methods for Aerodynamic Load Distribution and Associated Flight Dynamics Derivatives of Non-Planar Configurations of an Aircraft in the Pre-Concept Stage**, Andrei Sorin NEAMTU, Mihai NEAMTU, Stefan NEBANCEA (INCAS − National Institute for Aerospace Research "Elie Carafoli", Bucharest, Romania).

12.^{00} - 12.^{20}

S1.1.10 **Directional control of a jet with synthetic jets,** Florin FRUNZULICA, Alexandru Catalin MACOVEI, Stefan STANCIU ("POLITEHNICA" University of Bucharest, Faculty of Aerospace Engineering, "Elie Carafoli" Department of Aerospace Science, Bucharest, Romania).

12.^{20} - 12.^{40}

S1.1.11 **An analysis on the aerodynamic resistance of the pantograph used on electric railway vehicles**, Sorin ARSENE, Ioan SEBESAN ("POLITEHNICA" University of Bucharest, Faculty of Transports, Department of Railway rolling stock, Bucharest, Romania).

12.^{40} - 13.^{00}

S1.1.12 **Numerical simulations of supersonic flows in inlets with applications to reactive propulsion system,** Irina Carmen ANDREI, Mihai Leonida NICULESCU, Mihai Victor PRICOP (INCAS − National Institute for Aerospace Research "Elie Carafoli", Flow Physics Department, Numerical Simulation Unit, Bucharest, Romania).

13.^{00} - 14.^{00}

Lunch

Friday 19.09.2014 – "ELIE CARAFOLI" Amphitheatre

Section 1 – Aerodynamics

Friday 19.09.2014. Afternoon session

S1.2 **Chairman:**

Ruxandra Mihaela BOTEZ
Valentin Adrian Jean BUTOESCU

14.^{00} - 14.^{20}

S1.2.13 **Preparation of an oblique shock wind tunnel model,** Mihai Victor PRICOP, Irina Carmen ANDREI, Maria Cristina BREABAN (INCAS − National Institute for Aerospace Research "Elie Carafoli", Flow Physics Department, Numerical Simulation Unit, Bucharest, Romania), Florin MUNTEANU (AEROSPACE Consulting, Bucharest, Romania), Bogdan CARP (INCAS − National Institute for Aerospace Research "Elie Carafoli", Aero-Structures Unit, Bucharest, Romania).

14.^{20} - 14.^{40}

S1.2.14 **Computational Fluid Dynamics Optimization Process for Centrifugal Compressor - a Case Study**, Valeriu DRAGAN (COMOTI – Romanian Gas Turbine Research and Development Institute, Romania).

14.^{40} - 15.^{00}

S1.2.15 **Supersonic flights,** Giulia LAPUSNEANU ("POLITEHNICA" University of Bucharest, Faculty of Aerospace Engineering, Romania).

15.^{00} - 15.^{20}

Q & A

15.^{20}

CLOSING SESSIONS

Friday 19.09.2014 – “Nicolae TIPEI” Amphitheatre

Section 7 – ATS and full Automation ATM

Friday 19.09.2014. Morning session

S7.1 **Chairman:**

Cornel OPRISIU
Octavian Thor PLETER

11.^{00} - 11.^{20}
S7.1.1 **Base Turn Optimization**, Octavian Thor PLETER, Andrei NECUTA (“POLITEHNICA” University of Bucharest, Faculty of Aerospace Engineering, Bucharest, Romania).

11.^{20} - 11.^{40}
S7.1.2 **Advancements in Measuring Safety with the Aerospace Performance Factor**, Octavian Thor PLETER, Georgiana URSACHI, Raluca Elena TUDORICA (“POLITEHNICA” University of Bucharest, Faculty of Aerospace Engineering, Bucharest, Romania).

11.^{40} - 12.^{00}
S7.1.3 **Airport Apron Management Optimization**, Octavian Thor PLETER, Barna Istvan JAKAB (“POLITEHNICA” University of Bucharest, Faculty of Aerospace Engineering, Bucharest, Romania).

12.^{00} - 12.^{20}
S7.1.4 **De-conflicted 4D Trajectory Based Operations,** Octavian Thor PLETER, Cristian Emil CONSTANTINESCU (“POLITEHNICA” University of Bucharest, Faculty of Aerospace Engineering, Bucharest, Romania).

12.^{20} - 12.^{40}
S7.1.5 **Air Traffic Complexity using AHP - Case study for LOMOS and NERDI sectors**, Alin George DIACONU, Octavian Thor PLETER, Corneliu BERBENTE (“POLITEHNICA” University of Bucharest, Faculty of Aerospace Engineering, Bucharest, Romania).

13.^{00} - 14.^{00}

Lunch

Friday 19.09.2014 – “Nicolae TIPEI” Amphitheatre

Section 3 – Astronautics and Astrophysics

Friday 19.09.2014. Afternoon session

S3.2 **Chairman:**

Simion TATARU
George SAVU

14.00 - 14.20
S3.2.5 **Algorithm and code for analyzing hyperspectral images using the Hurst exponent,** Nicolae APOSTOLESCU (AEROSPACE Consulting, Romania), Daniela BARAN (INCAS − National Institute for Aerospace Research “Elie Carafoli”, Romania).

14.20 - 14.40
S3.2.6 **A LQG Based Method for the Design of the Control System of a Launch Vehicle,** Irina Oana MIU, Silvia NECHITA, Adrian-Mihail STOICA (“POLITEHNICA” University of Bucharest, Faculty of Aerospace Engineering, Romania).

14.40 - 15.00
S3.2.7 **Kinematics structure for the movement of a set of punctual bodies,** Sorin Stefan RADNEF (INCAS - National Institute for Aerospace Research “Elie Carafoli”, Bucharest, Romania).

15.00 - 15.20

Q & A

15.20

CLOSING SESSIONS

Friday 19.09.2014– "Conference room", et. 2, corp B

Section 4 – Materials and Structure

Friday 19.09.2014. Morning session

S4.1.<u>**Chairman:**</u>

Daniela BARAN
Victor MANOLIU

11.^{00} - 11.^{20}

S4.1.7 **Fatigue Life Calculation of the IAR-99 Aircraft,** Dorin LOZICI-BRINZEI (INCAS – National Institute for Aerospace Research "Elie Carafoli", Romania), Simion TATARU (AEROSPACE Consulting, Romania), Radu BISCA (INCAS – National Institute for Aerospace Research "Elie Carafoli", Romania).

11.^{20} - 11.^{40}

S4.1.8 **The Transport and Release of Neurotransmitters Inside to Interneuronal Synaptic Cleft**, Dumitru POPESCU ("Gheorghe Mihoc – Caius Iacob" Institute of Mathematical Statistics and Applied Mathematics of the Romanian Academy, Department of Mathematical Modelling in Life Sciences, Bucharest, Romania), Ecaterina MARIES (University of Bucharest , Faculty of Biology, Department of Anatomy, Animal Physiology and Biophysics, Bucharest, Romania).

11.^{40} - 12.^{00}

S4.1.9 **Finite element numerical experiences based on MWCNT composite mechanical tests,** Daniela BARAN (INCAS − National Institute for Aerospace Research "Elie Carafoli", Bucharest, Romania), Mihaela PETRE (AEROSPACE Consulting, Bucharest, Romania), George PELIN, Adriana STEFAN, Cristina Elisabeta BAN, (INCAS − National Institute for Aerospace Research "Elie Carafoli", Bucharest, Romania), Elena VAJAIAC (INCAS − National Institute for Aerospace Research "Elie Carafoli", Bucharest, Romania, University of Bucharest, Faculty of Physics, Bucharest – Magurele, Romania).

12.^{00} - 12.^{20}

S4.1.10 **Thermal shock performance of ablative/ceramic composite materials**, Adriana STEFAN (INCAS – National Institute for Aerospace Research "Elie Carafoli", Romania), Gheorghe IONESCU (AEROSPACE Consulting, Romania), George PELIN, Cristina BAN (INCAS – National Institute for Aerospace Research "Elie Carafoli", Romania), Beatriz PEREZ, Sonia FLOREZ, Jorge BARCENA (TECNALIA – Transport Unit, San Sebastián, Spain), Konstantina MERGIA, Kostoula TRIANTOU (Institute of Nuclear & Radiological Sciences, Energy, Technology& Safety, National Centre for Scientific Research Demokritos, Greece), Christian ZUBER, Waldemar ROTAERMEL (Deutsches Zentrum für Luft- und Raumfahrt e. V. (DLR), Köln, Germany), Jean-Marc BOUILLY, Gregory PINAUD (AIRBUS D&S, Paris, France), Wolfgang FISCHER (AIRBUS D&S, Bremen, Germany).

12.^{20} - 12.^{40}

S4.1.11 **Update and optimize geometric configuration IAR99 programs (FORTRAN-1985) for export to CATIA V5**, Dan VATUI (Been employed at INCAS − National Institute for Aerospace Research "Elie Carafoli", Bucharest, Romania).

13.^{00} - 14.^{00}

Lunch

15.^{00} - 15.^{20}

Q & A

15.^{20}

CLOSING SESSIONS

CONTENTS

Note:

- *The papers are published in volume per sections in order of their presentation at the conference "AEROSPATIAL 2014" according to the Conference Program (see the Graphic Program and Conference Program, pp. iii, v-xviii).*
- *Please, note that the responsibility for the accuracy of expression in English belongs to the authors.*

PLENARY LECTURES

Global Optimized and Fully-Integrated Aerospace Vehicles

Adriana NASTASE

Aerodynamics of Flight, RWTH, Aachen University, 52062 Aachen, Germany
nastase@lafaero.rwth-aachen.de

***Abstract**: The author has designed three global optimized (GO) models, namely Adela, a wing alone and two fully-integrated flying configurations (FCs), Fadet I and Fadet II, which are of minimum inviscid drag, at cruising Mach numbers, respectively, 2, 2.2 and 3.*
The determination of the GO shapes of FCs leads to enlarged variational problems with free boundaries. An own strategy called optimum-optimorum (OO) theory was developed in order to solve these enlarged variational problems. These GO models were designed by the author by using own developed software according to this OO theory and were checked in the trisonic wind tunnel of DLR Cologne, in the frame of some research contracts of the author, sponsored by the DFG.
A very good agreement between the theoretical predicted and the experimental-correlated values of lift and pitching moment coefficients were obtained. More recently, an iterative OO theory was developed in order to compute the total drag of the models, including also the friction dragand to allow a weak interaction with structure requests, via additional constraints. These models are useful for the design of future performant supersonic aircraft, aerospace vehicles and for UAVs.

***Key Words:** Enlarged variational problems with free boundaries, Aerodynamic global shape optimization, Supersonic flow, Aerospace vehicles.*

1. INTRODUCTION

The exploration of the space has taken a tremenduous development. The new scientifical re-search and the high technical performances make some dream of humans being a reality. The most spectacular are thelanding of Apollo 11 and the descent of Armstrong on the moon, the landing of Curiosity on Mars, the flight of Voyager 10 outside our galaxy, the scientifical exploration of the earth with the help of ISS and the recent landing of Rosetta of ESA on a comet.

At the same time more business, scientists and tourist travelers are interested to have faster intercontinental aircraft and to observe the earth during aerospace voyages. New cosmodromes are constructed by Virgin company, the Space Alliance chooses Texas for its Commercial first site of Space X launcher for cargo supply and manned mission to the ISS and the Space Florida wants to increase its commercial projects also for manned missions to ISS.

Suborbital flights are planned by Virgin, in order to respond to this increasing travel interest and to realize cheaper travelsby increasing the number of passengers and by building more economical and ecological acceptable supersonic transport aircraft (STA) and low earth orbit (LEO) space vehicles.

The main aim of the design of GO shapes of supersonic FCs is to use them to in-crease the aerodynamic performances of aircraft and space vehicles.

The shape of FC is GO, if its camber, twist and thickness distributions and **also** the similarity parameters of its planform are **simultaneously** optimized in order to reach a minimum drag, at a chosen cruising Mach number.

The determination of the GO shape of FC leads to an enlarged variational problem with free boundaries,which needs a special mathematical treatment.

The own developed optimum-optimorum (OO) and iterative optimum-optimorum (IOO) theories are special strategies for the determination of the GO shape of the FC, inside of a class of elitary FCs, which satisfy some common properties, as in [1]-[4].

A judicious choice of constraints was made in order to obtain adequate GO shapes of FCs which have:

- sharp leading edges, in order to avoid the bow shock and to fly with characteristic surfaces;
- the junction lines wing-fuselage, which begin at the apex of the wing, in order to avoid the sonic boom interference;
- the surface of the FC must be integrated, in order to avoid the negative effects of corners;
- the conturnements of their subsonic leading edges must be reduced in order to have a reduced induced drag and an increase of lift;

Overview on BEAWARE project and survey results

Claudia DOBRE[1], Kristo REINSALU[2]

[1]INCAS – National Institute for Aerospace Research "Elie Carafoli"
B-dul Iuliu Maniu 220, Bucharest 061126, Romania
dobre.claudia@incas.ro
[2]Invent Baltics OU, Teaduspargi 6/1, Tallinn 12618, Estonia
kristo.reinsalu@invent.ee

Abstract: *Statistics show that up to 95% of project Coordinators under Framework Programmes have come from the Western European countries. Majority of Eastern European actors do not have enough contacts among their counterparts from West.*
Therefore the BEAWARE project has set an objective to support potential coordinators and potential partners from Eastern European countries while identifying future R&D project opportunities in the field of Aeronautics and Air Transport within the frame of Horizon 2020.
In order to facilitate the entry into supply chains for Eastern European aerospace actors, well-focused events at major aerospace hotspots will be organized in Romania, Italy, Germany and Poland.
As of June 2014, already two events have taken place in Prague and in Marseille respectively. During all BEAWARE events participants have great opportunity to take part in matchmaking sessions and receive hands-on support by mentors and experts.

Key Words: *cooperation, east, west, aeronautics and air transport, R&D project opportunities*

1. INTRODUCTION

Bridging EAst West for Aerospace REsearch – BEAWARE project is a Coordination and Research Action funded under the FP7 workprogramme topic *AAT.2013.7-4.*

Creating cohesive links and common knowledge between potential partners in EU Framework Programme Collaborative Projects.

The BEAWARE idea was born out of the topic description that stated the importance for all concerning parties to ***"put in direct contact potential coordinators and potential partners in future projects in the field of Aeronautics and Air Transport, which are established in regions that lack of mutual knowledge"***.

The BEAWARE project has set an objective to support potential coordinators and potential partners from Eastern European countries while identifying future R&D project opportunities in the field of Aeronautics and Air Transport within the frame of Horizon 2020.

Expected impact of this kind of coordination and support action referd to the "*increase involvement from regions, which have LOW PARTICIPATION in aeronautics*".

2. FORMATION OF THE BEAWARE CONSORTIUM

The problem that was observed by the initiator of the project looking at the majority of the European projects was that there are always the same players, aproximativley 95% from western Europe, and the remaining 5% from the east part of Europe.

This trend can be observed very well in the figure below, representing the participation in AAT Calls 2010/11 (no of partners) for European countries, where the eastern European countries have a very low participation rate.

The approach of the BEAWARE consortium was to arrange well-focused events, to let people discuss, to meet "big players", but without the obsession of making a project, the consortium did not want to produce "another book".

When thinking of the formation of the BEAWARE consortium, the initiator and coordinator of this projects took into consideration that major problem of low representation of eastern countries in the European projects and decide to have a well-balanced consortium and the 12 partners of the BEAWARE consortium are 6 from the west and 6 from the east.

The Role of Research for End-Users: academia and industry

Delia DIMITRIU

The Manchester Metropolitan University, Centre for Aviation, Transport, and the Environment
Chester Street, Manchester, M1 5GD, United Kingdom
d.dimitriu@mmu.ac.uk

Abstract: *This paper illustrates the importance of shaping the research questions, methods and tools by identifying the need of end-users from the start. Manchester Metropolitan University cooperation with TAROM and Iasi Airport are illustrated as case-studies which show the need to engage an airport or airline from the beginning of research questions. Examples given are related to aviation alternative fuels. Knowing the need of industry helps researchers design a more focused research framework and methodology, which can be implemented later to a different actor. Also, the end-user, being involved from the beginning, understands better the research role and its different approach in comparison with consultancy.*

1. GENERAL BACKGROUND

1.1 Sustainability of biofuels is a key prerequisite

Recently, the alternative fuels topic seems to capture discussion of different stakeholders representatives, including the research community.

Aviation sector is more and more involved in this type of research. The main driver for aviation to use alternative fuels:

- reducing GHG emissions/CO2;
- allows aviation supply to meet demand growth while at the same time the sector diversifies fuel supply/ has an alternative.

However, there is need for identifying sustainable resources and supply. So far, only isolated trials on aviation biofuels have taken place.

The important reason being *available vs affordable*. To identify existing opportunities world – wide for aviation biofuels, means to have a global approach on existing feedstock and production. The value chain research needs to be explored further.

However, the biofuel production needs to prove a perfect balance between *economic, social and environmental* aspects.

Also, biofuels need to be certified, to show biofuels have no technical or safety problems in flights, *but* sustainability needs to be assessed along production and processing aspects.

1.2 Objectives to use biofuels

Aviation sector invests in ways to reduce or to compensate for, carbon emissions. Especially in Europe, where the airlines are engaged in EU-ETS (Emissions Trading Scheme) they are interested to get biofuels, as CO2 emissions associated to biofuels are considered zero emissions.

However, it is expected that biofuels are expensive, so high priority is given to *cost reduction through:*

- more efficient use of fuel;
- research into the development of *alternative biofuels*;
- involvement in Trials.

The ongoing measures to reduce Carbon emissions (cost reductions and emissions) include:

- modernising and renewing the fleet;
- adopting eco-friendly operations.

Examples of such operations are CDO -continuous descent operations- continuous descent approach (CDA) being most frequently implemented. Thus, Bucharest Henri Coanda Airport was involved in CDA starting from 2003.

The benefits of these operations consist in fuel consumption reduction, thus CO2 reduction, but also in nosie reduction on some flight segments.

However, apart from these 'in the air' procedures, new methods on the ground can be implemented: one-engine taxi in/out, leading also to fuel & emissions reduction.

Possible Trajectories of the Flight Malaysian 370

Octavian Thor PLETER, Cristian Emil CONSTANTINESCU

"POLITEHNICA" University of Bucharest, Faculty of Aerospace Engineering
Polizu Street 1-7, sector 1, Bucharest 011061, Romania
octavianpleter@yahoo.com, constantinescu_ce@yahoo.com

Abstract: *In the aftermath of the disappearance of the Malaysian 370 (MH370) flight in March 2014, new positioning methods were employed to establish the search area. In absence of all other positioning technologies (Transponder, ADS/B, ACARS, Radio communications, Radar), these innovative methods are based on the handshake signals between the INMARSAT-3F1 IOA satellite and the satellite transceiver on board of the aircraft. The log of these signals was made public in order for the scientific community to try to solve the mystery of the MH 370 trajectory. The log indicates the delay between the interrogation and the response signals, as well as the relative velocity indications, based on the shift of the carrier frequency due to the Doppler-Fizeau effect. This paper puts forward an original, independent and accurate positioning method and allows the calculation of the MH370 trajectory considering the wind vector field in that day, the accurate satellite orbit, and an accurate model of the Earth (the WGS-84 ellipsoid). The results were compared to other results published, and surprisingly they indicate a final position of the aircraft very far from the current search areas.*

1. INTRODUCTION

On 8 March 2014, the flight Malaysian 370 from Kuala Lumpur to Beijing disappeared without any trace. The aircraft was a Boeing 777-200ER (777-2H6ER) with the registration 9M-MRO. After 32 minutes of flight preparation, the aircraft took off and flew normally for 49 minutes.

After the crucial point of IGARI at the border between Malaysian and Vietnamese airspace, the aircraft took abnormal manoeuvres for 1 hour and 5 minutes (turns, climbs, descents) then settled for a long range automated flight of 5 hours and 54 minutes.

The total time flown abnormally was 7 hours, most probably until the fuel was exhausted. The long range en-route flight of almost 6 hours was under automated guidance, very probably following a keyboard input flight plan changed earlier during the flight.

Although all communication systems were shut down in a time window of 12 minutes (from 1709Z to 1721Z), the SATCOM satellite transponder continued to be functional and provided a number of very important clues about the flight MH370.

This paper is the result of the original work of the authors, calculating all possible trajectories of the aircraft based on these clues. Also, an optimisation cycle was used to calculate the most probable trajectory, which fits best on all the data known.

The results are surprising, because they indicate a position where the flight could have ended, which is very different from the past and the current search areas. Besides its scientific relevance, the authors hope that their work will prove useful in the future search operations.

2. MH370 FLIGHT FACTS

Malaysian Airlines 370 took off with 227 POB[1] (out of the capacity of 282) and 12 crew. The initial flight plan was from Kuala Lumpur International (KLIA) to Beijing Capital International Airport (ZBAA). The ETA[2] was 2230Z and ETE[3] 05:49. The fuel load was 49,100 kg, enough for 7.5-7.8 hours of flight.

The MH370 flight phases were described in Table 1. Table 2 provides a detailed sequence of known facts about the flight, including the six relevant pings, which allow the calculation of the flight trajectory. The key moments of the flight were defined in Table 3.

Table 2 include the ping exchanges between the INMARSAT-3 IOR satellite and the SATCOM transceiver (Figure 1). These were recorded by INMARSAT and supplied the only indication that the aircraft continued to fly for hours after its disappearance.

[1] POB: passengers on board
[2] ETA: Estimated Time of Arrival at planned destination (UTC)
[3] ETE: Estimated Time En-route (estimated duration of flight in hours and minutes)

Section 1. Aerodynamics

Modeling of Unsteady Flows Using Reduced-Order Models Based on the Proper Orthogonal Decomposition

Thomas A. BRENNER[1], Forrest L. CARPENTER, Brian A. FRENO[2], Raymond L. FONTENOT, Paul G. A. CIZMAS*

*Corresponding author
Department of Aerospace Engineering, Texas A&M University
College Station, Texas 77843-3141
cizmas@tamu.edu

Abstract: *This paper presents a summary of our current results on modeling unsteady flows using the proper orthogonal decomposition (POD) method. A brief introduction of the standard POD method is followed by a description of the dynamic POD method. We introduced the dynamic POD method to reliably model computational domains with moving or deforming meshes. The POD method is exemplified on two cases of turbomachinery flows: the NASA Transonic Rotor 67 and the Tenth Standard Configuration. The latter case was used to compare the standard and dynamic POD methods and to justify the superiority of the dynamic POD over the standard POD.*

Key Words: *Proper Orthogonal Decomposition, Model Order Reduction, Unsteady Flows.*

1. INTRODUCTION

In the past, Moore's Law of transistor scaling could be counted upon to provide exponential increases in general purpose compute performance. Looking forward in complementary metal-oxide-semiconductor process technology scaling, this is no longer true. While it is likely there will be another five generations of scaling, ending at the 8 nm process technology node in ten to twelve years, the traditional models of general purpose computing are unlikely to provide more than a 8x increase in performance despite a 32x increase in transistor density. Although there are hopes that quantum computers will become reality, it is unlikely that they will be available in the near future.

Consequently, since the computational cost of high-fidelity computational fluid dynamics simulations is still a limiting factor, there is a need to continue the development of algorithms and numerical methods for efficiently modeling engineering/scientific relevant problems. Reduced-order modeling (ROM) based on proper orthogonal decomposition (POD) is a method that proved to be successful in reducing the computational time for a wide range of applications covering transport phenomena and structural mechanics.

Accurate flow prediction is essential for simulating aeroelasticity in turbomachinery. In order to properly resolve the aerodynamic forces involved, high-fidelity models are needed. Unfortunately, these high-fidelity models have traditionally been too computationally expensive for effective use in the simulation of turbomachinery aeroelasticity.

One potential solution for reducing the cost associated with computational fluid dynamics is the use of reduced-order models (ROMs) based on proper orthogonal decomposition (POD), which seek to represent the full system dynamics using a reduced set of basis functions. Once these basis functions have been identified, the partial differential equations that govern a particular system can be projected onto the basis functions. The resulting set of ordinary differential equations is usually two or more orders of magnitude smaller than the set of ordinary differential equations obtained from more traditional discretization techniques, such as the finite volume method.

POD was used to identify the optimal basis functions for turbomachinery flow (Cizmas 2003) and the POD approach was used to construct ROMs for two-dimensional airfoil cascades in the frequency domain (Epureanu 2003). The last decade has seen a marked increase in the application of POD-based ROMs for a wide variety of flow simulations, even as the use of ROMs in turbomachinery has shifted to structural modeling (Sinha 2009) (Madden 2012). POD-based ROMs have been used to simulate fluid problems ranging from fluidized beds (T. A. Brenner 2012) to aircraft icing (Nakakita 2010). Reviews of the application of POD-based ROMs have been presented in (Dowell 2003) (Lucia 2004).

[1] Currently at GE
[2] Currently at Halliburton

Applications of the Fourier Analysis and Fourier Integral to the Calculation of Some Unsteady Flows about Lifting Surfaces

Valentin Adrian Jean BUTOESCU

INCAS – National Institute for Aerospace Research "Elie Carafoli"
B-dul Iuliu Maniu 220, Bucharest 061126, Romania
vbutoesc@incas.ro

Abstract: *The classical aerodynamic theory of the subsonic lifting surface that performs harmonic oscillations after different modes (both rigid and elastic), has been extended for two cases:*

- *the first case, when the function of time describing the oscillations is not harmonic, but remains periodic and satisfies the Dirichlet conditions;*
- *the second case when the time-function is not periodic, but it can be represented as a Fourier integral.*

All this approach is available because the integral equation of the lifting surface enjoys some properties which have been proved before in the article.
These applications of the Fourier analysis can be used to studies on the structure aeroelastic behaviour, flapping wings and gust effect on wings. Numerical examples illustrate these studies.

1. INTRODUCTION

The unsteady lifting surface theory of the harmonically oscilating wings (M<1) is an elegant method of analysis that has been developed and sucessfully applied since the middle of the forties of the XX-th century. However, the famous Theodorsen's article [**1**] had been published a few years earlier, in 1935 and it was dedicated to the two dimensional aerodynamic case of the flow about an oscillating aerofoil.
Later, other researchers among which we can cite Küssner [**2**] extended the theory to the three dimensional, compressible flow.
In this case (3D) the aerodynamic problem reduces itself to that of solving an integral equation. To solve this last problem, Multhopp [**3**] uses a method that approximates the pressure loading function with a sum of orthogonal polynomials, corrected by some weight functions to get the special behaviour at the wing borders. Other authors used trigonometric functions [**4**] instead of polynomials.
The integrals are calculated analytically using the Gauss quadratures, and the integral equation reduces itself to a system of linear equations, the unknowns being the polynomial coefficients.
The method is prefered in the mathematical approaches, because of its rigor. However, most engineers use the versatile DLM method [**5**], [**6**].
In fact, it is an extension of the well-known horseshoe vortex method, available for the steady case. The method has been shortly presented in a previous article, [**7**].
The present work summarizes the research performed by the author during the last year, [**8**], [**9**]. It continues the direction followed by Garrick [**10**] long time ago for the 2D flows.
We extended it to the case 3D motions.
The goal of the research is to give a straightforward method to be used for unsteady flows that are not necessarily harmonic. The method has the advantage that it provides analytic expressions for the pressure load distribution if the wing geometry and kinematics are known.
We used a DLM code to calculate the aerodynamic load on the harmonically oscillating wing. However the subject of the leading edge suction force remained untouched. The unsteady drag has also to be considered. These problems we will be treated in a further paper.
The results of the research can be applied in Aeroelasticity, gust effect on wings and flapping flight.

2. PRELIMINARIES: A REVIEW ON THE INTEGRAL EQUATIONS OF THE LIFTING SURFACE (M<1)

There are two cases when the lifting surface integral equation does not contain the time variable explicitly:

- the steady flow case (a kind of "trivial case");
- the harmonically oscillatory case.

Variations of the aerodynamic forces and moments due to the oscillations in the case of an unmanned aircraft

Alexandra Emilia FORTIS, Stefan BALINT

West University of Timișoara
Blvd. V. Pârvan 4, Timişoara 300223, Timiş, România
afortis@gmail.com, balint@balint.uvt.ro

Abstract: *In a longitudinal flight with constant forward velocity, for the variation of the elevator deflection there exist a safe interval. In the context of automated flight control system failure, the elevator deflection can reach values situated outside the safe interval. In this case, the longitudinal flight with constant forward velocity becomes oscillatory. In this paper, a procedure for the computation of the variations of the aerodynamic forces and moments, due to those oscillations, is implemented. Numerical illustrations are given, in the framework of the simplified models (small angle of attack) of the ADMIRE and ALFLEX unmanned aerial vehicles.*

Key Words*: aerodynamic forces, aerodynamic moments, longitudinal flight, small angle of attack*

INTRODUCTION

The general framework we are referring is to assess, to reduce and to control potential risks to which an unmanned aerial vehicle (UAV) is subjected to at any stage of its flight. The task of designing an aerodynamic model for highly manoeuvrable aerial vehicles is extremely difficult, due to configurations that can present highly coupled behaviour and unsteady flow effect. On the other hand, a competitive unmanned aerial vehicle has to satisfy requirements of low-observable, combined with the capacity to perform agile manoeuvres [1].

Our study is targeted on the investigations of the variations of the aerodynamic forces and moments in the context of the loose of a longitudinal flight with constant forward velocity and its recovery from an oscillatory flight. Numerical illustrations are performed in the simplified flight model, for particular values of the elevator deflection, characteristic to ADMIRE and ALFLEX unmanned aerial vehicles. Since we are dealing with aerial vehicles which were developed to fly at supersonic speeds and with a missing human factor to take quick decision, even the smallest disturbance on the flying vehicle can affect it dramatically. We are referring to possible oscillations that can occur due to malfunction of the automated flight control system and can affect the integrity of aircraft during the landing phase.

The Automatic-Landing-Flight-Experiment (ALFLEX), developed by NASDAQ, Japan, is a reduced-scale model of the H-11 Orbiting Plane, an unmanned reusable orbiting spacecraft. It has been built to study the flight of the spacecraft during its final approach and landing phase. This flight is made possible due to complicated automatic flight control systems, designed to perform quick responses to commands. As the mass of this vehicle is concentrated in its fuselage, the phenomenon of inertial coupling may occur, i.e. small perturbations or small changes of the control surface angles may lead to dramatic changes in roll rate.

Recent research in the context of the main topic of the paper has been developed through several tests performed on data sets obtained by ALFLEX [9]. This research was oriented to the study of the possibilities to control the rolling manoeuvres, by considering the three branches of the real equilibrium equations of motion of an aerial vehicle, offering solutions and numerical simulation results manoeuvres, as were emphasized in [6]. Studies continued in [7] by using a simplified mathematical model to demonstrate that, in a single manoeuvre, the aerial vehicle can recover from an attitude that it accidentally reached to an equilibrium state with an almost null attitude, for a safe landing.

A comparison was made in [8] between the steady states obtained by using both the simplified model and general model, and some questions about the use of equilibrium states from the simplified system as starting points in the general model analysis were raised. This problem was due to the fact that the simplified dynamical system and the general dynamical system describing the motion of a re-entry aerial vehicle are not topologically equivalent and the simplified model used up to that point was not structurally stable [5].

Research continued with the study of the issue raised by oscillations occurrence at landing phase for the model ADMIRE (Aero-Data Model in a Research Environment) along the path of longitudinal equilibrium points [10], in the context of a decoupled automated flight control system. Numerically, it was determined

High Speed Testing for Reentry Vehicles

Mihai Victor PRICOP[1,2,*], Corneliu STOICA[1], Florin MUNTEANU[3]
Mihai Leonida NICULESCU[1], Marius Gabriel COJOCARU[1], Irina Carmen ANDREI[1]
Alexandru Marius PANAIT[1]

[1]INCAS − National Institute for Aerospace Research "Elie Carafoli",
Flow Physics Department, Numerical Simulation Unit,
B-dul Iuliu Maniu 220, Bucharest 061126, Romania
pricop.victor@incas.ro*, stoica.cornel@incas.ro, niculescu.mihai@incas.ro,
cojocaru.gabriel@incas.ro, andrei.irina@incas.ro, panait.marius@incas.ro
[2]Transilvania University of Brasov,
B-dul Eroilor 29, Brasov 500036, Romania
[3]AEROSPACE Consulting,
B-dul Iuliu Maniu 220, Bucharest 061126, Romania,
munteanu.florin@incas.ro

Abstract: *A sphere as a basic aerodynamic configuration relevant for reentry vehicles was experimented in the trisonic wind tunnel of INCAS. The model is hollowed in order to have small thermal inertia. Temperature and static pressure are measured in the mid plane, from stagnation point to the rear, covering 120 degrees for top and bottom hemispheres, each. Thermocouples are inserted in the wall at half thickness. Schlieren images are obtained, covering all positions in the test matrix. Temperature time histories are to be used in future inverse aero thermal simulations. Also included are the CFD results versus experimental data. Current research that has been conducted within this paper was developed under the STAR IATASH project.*

Key Words: *wind tunnel model, reentry body, Schlieren visualization*

1. INTRODUCTION

1.1 Briefing

The objective of this paper is to provide experimental data relevant for Inverse Aero-thermal Solutions. For such purpose, there has been in-house designed, built and tested the configuration shown in Fig. 3 ÷ Fig. 6, as relevant for reentry vehicles.

The sphere shaped model is hollowed for reason of reducing the global weight and the thermal inertia. There have been conducted high speed testing, exploiting the maximum Mach number performance of the INCAS trisonic facility; heat transfer was monitored while carrying on long duration runs.

The justification of this attempt is that among the requirements of the project specified within the acknowledgements, a canonical spherical wind tunnel model was asked to be designed and built. The adopted regimes correspond to Mach numbers 2, 2.5 and 3, trying to set the stagnation pressure such as to maximize the runs duration in order to maximize heat transfer.

For a proper Schlieren visualization the whole model and relevant flow features must be visible, so that the sting has been chosen as most appropriate. Also, time history of both temperature and static pressure is acquired.

The instrumentation was customized for vertical symmetry plane pressure and mid-shell temperature. Therefore, static pressure and static temperature transducers have been provided, for a hollowed model; there is vertical symmetry instrumentation for the pressure and temperature ports; both the static temperature and static pressure transducers are located inside the model, near the surface) such that to cover in a single plane the area from the stagnation point beyond the separation point.

Forces and moments are not required to be measured. This would require a different model, to accommodate the balance.

Since the main goal is the monitoring of the heat transfer, then the thermal inertia of the model should have been minimum, then the walls of the model have to be thin.

The scale of the model should be large enough to allow the instrumentation with the available NI thermocouples and to match with the ZOC-23 pressure scanner also.

Velocity distribution as a result of the interaction between organizational processes in shear flows

Stefan N. SAVULESCU[1], Florin BALTARETU*[,2]

[1]INCAS – National Institute for Aerospace Research "Elie Carafoli"
B-dul Iuliu Maniu 220, Bucharest 061126, Romania
[2]Technical University of Civil Engineering Bucharest,
Department of Thermal Engineering,
Bd. Pache Protopopescu nr. 66, 021414, Bucharest, Romania
Corresponding author*: flbaltaretu@yahoo.com, florin.baltaretu@instal.utcb.ro

Abstract: *This paper continues the recent research of the authors concerning the interaction between the micro and macro flow structure domains (further on called IPmMD). The authors propose a probabilistic type approach of the IPmMD, in plane boundary layer, channel and pipe flows. This process, purely theoretical expressed by using transformations associated to transversal coordinate, tends to ensure the equipartition of the kinetic energy and to lead to a minimum in information transmission in the space-time ensemble. Taking into account several velocity distributions as not mutually exclusive events, new distributions are obtained by a probabilistic type union of the events. These new distributions present important aspects related to the classical transition from laminar-to-turbulent regime. In this way, as an example, the parabolic-laminar and the linear distributions lead to a velocity distribution very close to experimental data corresponding to the rough pipe flow.*

Key Words: *shear flow, probabilistic approach, velocity distribution.*

1. INTRODUCTORY REMARKS

In our previous paper [1] we introduced the existence of some physical interaction processes between micro and macro fluid structures domains (IPmMD), based on our research [2], [3]. In this paper we present a fundamental support to the IPmMD by the conditions to fulfill the entropy principle, and to minimize the energy involved. The mathematical description is based on the transformation of the coordinate across the flow main direction. For instance, the given distribution (as a velocity profile), is transformed in other distribution ranging from the very near to very far by comparison with the given initial distribution. The number of such new distribution is very great at the micro structure scale and very small at the macro structure scale. It results that the mathematical model for the IPmMD cannot be deterministic, belonging essentially to the probability field of knowledge. The deterministic real fluid flow mathematical description (Navier-Stokes equations), in spite of its generality, stands for an approximation (very useful) of IPmMD. We have to mention, accordingly, the difficulty to specify the minimum space-time scales of the validity of this deterministic description. For instance, the hot wire can measure the velocity at a scale much more smaller that the pressure device measurement. Usually, we introduce the boundary layer approximation, for the velocity profile, and the constant pressure across the layer.

Concerning the critical Reynolds number in transition, the wall roughness, as well as the chemical fluid nature, offer very different values. Similarly, the great turbulent fluctuations near wall stand for some terrifying aviation accidents during the landing or takeoff of the very modern planes.

In biomechanics, there are many examples of the IPmMD (like the instinct notion or the bird ability to flow in a turbulent atmosphere). The humanity presents also many examples of individuals abilities which can be explained by particular aspects of the IPmMD. We have to remark the fact that, in order to minimize the bulk energy, the IPmMD acts on a finite space-time domain like the turbulent spot in real fluid flows.

It is also important to mention the fundamental difference between the IPmMD approach and the classical, or quantic-relativistic approach. Accordingly, we have to mention the studies of the complexity [4].

2. THE PROBABILISTIC NATURE OF THE IPmMD

Due to the very great number of the micro elements (necessary to the fulfillment of the entropy principle), and of their organizations in a finite domain (necessary to minimize the energy involved), we explain the probabilistic nature of the IPmMD. Furthermore, the expression of the probability combination stands for an

Sensitivities Calculation for Unsteady Problems Using an Adjoint Method

Marius STOIA-DJESKA

"POLITEHNICA" University of Bucharest, Department of Aerospace Sciences "Elie Carafoli",
Polizu 1-7, RO-011061, Bucharest, Romania
marius.stoia@upb.ro

Abstract: *In this work we present an efficient approach for the calculation of the sensitivities in the case of unsteady problems like the compressible high-speed flows around a wing-section. The sensitivities are of a known response with respect to the initial conditions. These sensitivities are necessary for the solution of inverse problems or for the synthesis of an active control law. In the field of shape optimization and optimal design or control, gradient-based methods are typically used to find the optimal values of the design parameters. If the number of design parameters is large, the adjoint method is preferred since the cost of computing the sensitivities is independent of the number of design parameters.*

Key Words: *Euler Equations, Sensitivity Analysis, Adjoint Method*

1. INTRODUCTION

In the field of supersonic/ hypersonic flow analysis through numerical computations, the evaluation of uncertainty in codes represents a critical point. The problem is even more complicated if the numerical calculations cannot be always verified and/or validated using experimental results. In the framework of code uncertainty evaluation, whatever the methodology is, a basic problem arises: how sensitive is the solution from a code to the parameters whose values are defined with an uncertainty? The parameters may be included in the initial and boundary conditions, as well as in the model (i.e., in the state and constitutive equations). The answer to these questions is given by the uncertainty and, respectively, sensitivity analysis. The objective of the uncertainty analysis is to assess the effects of parameter uncertainties on the uncertainties of the calculated results.

In a deterministic approach, the uncertainty analysis is based on the sensitivities of the results with respect to model's parameters. The objective of the sensitivity analysis is to quantify the effects of parameter variations on calculated results. The scientific goal of sensitivity and uncertainty analysis is to discover and quantify the most important features of the (mathematical) model under investigation, [1]. Sensitivity and uncertainty analysis are nowadays rigorous methods for evaluating mathematical models of the physical reality because they are associated with the computation of quantitative results, which allow the analysts to perform objective comparison and judgments.

The numerical simulation of multidimensional compressible flows through the use of systems of hyperbolic conservation laws has progressed significantly towards industrial applications. The best example in this sense is perhaps the Euler system of equations. Together with the initial and boundary conditions, these systems are mathematical models of physical reality. All mathematical models include parameters whose actual values are known only approximately. Flow sensitivities, i.e. the derivatives of functional type responses that describe the flow behavior with respect to parameters that determine the flow, are useful in many situations.

There are three methods that can be used to determine the flow sensitivities. The first method is the most common. Running the code a second time with an increment of a single parameter provides the sensitivity to that parameter. The second method called the forward sensitivity method is a quasi-linear method. It requires the construction of the linear forward sensitivity equations that may be derived directly from the original system. Obviously, the sensitivity of the numerical solution to a parameter variable requires a complete solution of the forward equations.

These methods consume large CPU times because for each sensitivity, one complete new run of the code is required. The third method is called the adjoint sensitivity method. It requires the construction of the adjoint sensitivity equations, which may be obtained from the forward sensitivity equations and are also linear. The advantage is that the adjoint function method is largely cheaper, because it provides the sensitivities to all parameters by solving only one time the adjoint equations.

Calculation Methods for Aerodynamic Load Distribution and Associated Flight Dynamics Derivatives of Non-Planar Configurations of an Aircraft in the Pre-Concept Stage

Andrei Sorin NEAMŢU, Mihai NEAMŢU, Stefan NEBANCEA

INCAS – National Institute for Aerospace Research "Elie Carafoli"
B-dul Iuliu Maniu 220, Bucharest 061126, Romania
neamtu.andrei@incas.ro, neamtu.mihai@incas.ro, nebancea.stefan@incas.ro

Abstract: *The present paper deals with some fast calculation methods regarding aerodynamic loads distribution for non-planar configurations of an aircraft. The non-planar effects come from different features of the aircraft configurations, such as wing tip winglets, lateral jets, i.e. jets issuing laterally from wing tips (or from wing tip winglets), etc. Also, in the same category are multiple half lifting surfaces in the presence of a fuselage or any other combinations of the above situations. These calculation methods are especially suitable in the pre-concept phase of the aircraft development, when the configuration geometry is not entirely defined.*

1. INTRODUCERE

The purpose of this paper is to present a fast, general method of a classical, i.e. non-CFD type, for the calculation of the aerodynamic interference, in a subsonic flow of velocity U_∞, for different non-planar configurations such as multiple lifting surfaces in the presence of a body, configurations having tip winglets or jets issuing laterally from the tips, or combinations of all of these, etc. (see Figure 1).

In general, the classical methods are preferred, due to their efficiency, in some specific situations, such as the early stages of an aircraft design (alternately we may refer to these stages as the "*pre-concept phase*") or when calculating aerodynamic derivatives, especially cross-derivatives.

In general, they are useful whenever some smaller details of the aircraft configuration can be considered to have a non-significant influence on the final results. In such cases simple geometrical models can be used instead of the real configuration of the aircraft.

The classical methods are always based on simplified models, allowing an easy affordable mathematical approach.

In this respect, the lifting components of the aircraft, as wings and empennages, are usually represented by lifting surface models.

2. CALCULATION MODEL BACKGROUND

2.1 General

Consider, for the purpose of describing the basic relations, without lose of generality, the case of a combination of a rear fuselage with four semi-wings, used as empennages (two horizontal, and two vertical).

However, as generally accepted, the main aerodynamic interference effects between lifting surfaces come from *free vortices induced incidences* that can be satisfactory calculated by using the so called lifting line model.

In fact, a lifting line equation can be exactly derived from the lifting surface equation, as shown, for example, in Küchemann's theory of swept wings.

According to Prandtl, one can write for any wing section (by definition, *normal to the lifting line in the considered point*) a simple equation $C_z = a\,\alpha_e$ and combine it with the relation $\alpha_e = \alpha - i$, (corresponding to the boundary condition that the flow is tangent to any solid surface) to obtain the Prandtl lifting line equation $C_z = a\,(\alpha - i)$.

Here, C_z is the sectional lift coefficient, α_e, α and i are, respectively, the effective incidence, the "geometrical" angle of attack and the incidence induced by the free vortices, while "a" is the so called sectional slope of the lift coefficient.

As shown by Küchemann [2] in his theory of swept wings, "α_e" stands for the inducing effect of "bound" vortices and depends, in direct connection with "a", on the wing shape and aspect ratio.

Directional Control of a Jet with Synthetic Jets

Florin FRUNZULICA[1], Alexandru Cătălin MACOVEI[2], Stefan Ciprian STANCIU[3]

[1]"POLITEHNICA" University of Bucharest, Faculty of Aerospace Engineering
Polizu 1-6, RO-011061, Bucharest, Romania
ffrunzi@yahoo.com
[2]Fokker Engineering Romania, Sos. Pipera 1/VII Nord City Tower, Voluntari, Ilfov, Romania
alexandru_macovei@yahoo.ro
[3]Segula Technologies Romania, Union Business Center II
Str. Stirbei Voda, 26-28, 010113 Bucharest, Romania

Abstract: *The paper presents an application of synthetic jets in controlling a main jet's direction. The synthetic jet actuator consists of an oscillating membrane operating at high frequency and separating two cavities with exit slots of different geometries. The synthetic jets work as an alternating push-pull system and the generated vortical structure changes the flow direction of the main jet. The numerical investigations are performed using a RANS solver with an adequate turbulence model.*

Key Words: *synthetic jet, actuator, vortex ring, flow control, jet vectoring*

I. INTRODUCTION

A synthetic jet actuator is a device comprising an enclosure with a flexible membrane on one side and at least one orifice in one of the remaining rigid walls. As the membrane commences its suction phase, fluid from the device's exterior is drawn into the enclosure through the existing orifice.

On the reversal of the membrane's movement the fluid is ejected back through the opening. If certain operating and flow criteria are met, a shear layer results between the ejected column and the exterior fluid and a vortex ring forms at the slot's exit. Repeating the process periodically leads to a series of successive vortex rings and the resulting jet's velocity profile resembles that of a continuous jet. The schematic diagram in figure 1 shows the design principle behind this type of devices.

Synthetic jet actuators do not introduce additional fluid mass into the system therefore they are called zero net mass flux devices. The jets they produce have the ability to change the external flow field in the vicinity of the device, therefore they are of interest in applications such as separation control, electronics cooling, jet vectoring.

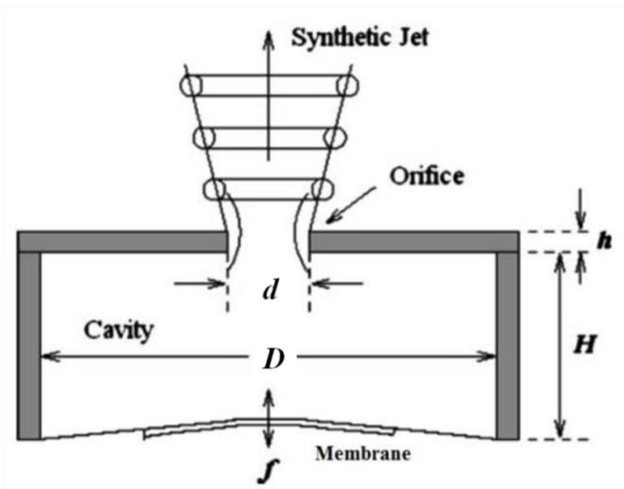


Figure 1. The conceptual scheme of synthetic jet actuator, [2]

II. GENERATING SYNTHETIC JETS

In the first step of our effort an the two-dimensional actuator presented in figure 2 was chosen with the membrane at the bottom of the cavity, operating at a fixed amplitude of $\Delta = 0.5mm$ and at set of frequencies between 5 and 1000 Hz.

An analysis about the aerodynamic drag of the pantograph used on railway electric vehicles

Sorin ARSENE, Ioan SEBESAN

"POLITEHNICA" University of Bucharest, Faculty of Transport, Depart Rolling Stock Railway
Splaiul Independentei no. 313, Sector 6, Bucharest 060042, Romania
sorinarsene@gmail.com, ioan_sebesan@yahoo.com

Abstract: *Climate change with rapid evolving, causes high speed wind gusts that can adversely affect the operation of electric vehicles railway. These vehicles achieve high performance as long as the power supply is ensured without discontinuity or disruption in this process. This article is intended an analysis on the influence of wind on energy collector (pantograph) located on the vehicle body. In this way, in a first step we modelled EP3 geometric pantograph, which was raised to maximum working height. In the second stage, on the air flow simulation, we took into account the case where this equipment has angle determined by the joint of the arms facing in the direction of flow. The simulation is performed for different angles point within the range [0°, 180°] of the wind speed.*

Key Words*: aerodynamic drag of the pantograph, the influence of wind, air flow simulation.*

1. INTRODUCTION

Electric railway vehicles it can moves between two points located on a section of a railroad when the energy required for this purpose is taken from an external source, in this case line of contact (catenary). The equipment, through which a vehicle is supplied with energy from catenary is called the pantograph and is located on its body. The layout and use of the collector (pantograph) determine an increasing on the resistance to moving and hence the energy required to moving the electric vehicle compared to a vehicle powered from an internal source of energy (diesel vehicle), as can be seen and in papers [1-4].

Generalized formula for determining the running resistance for railway vehicles also is known as Davis's relationship [1-11] is:

$$R_t = a + b \cdot v + c \cdot v^2 \tag{1}$$

where

R_t – Total resistance to motion of the vehicle;

a – Mechanical rolling resistances caused by the axle loads;

$b \cdot v$ – Non-aerodynamic drag;

$c \cdot v^2$ – Aerodynamic drag;

v – Speed of the vehicle;

Explicit formula for the parameter "c" regarding aerodynamic resistances according to the literature [12-17] is:

$$c = \frac{C_x \cdot S \cdot \rho}{2} \tag{2}$$

where:

$C_x = \dfrac{2 \cdot F_x}{S \cdot \rho \cdot \bar{v}^2}$ – aerodynamic coefficient of air sliding (also known as the coefficient of air penetration) (dimensionless

S – front surface of the vehicle in cross section (m^2);

ρ – density of the moving vehicle air (kg/m^3);

F_x – the frontal sliding force (N);

$\bar{v}$ – velocity of the fluid (air) (m/s).

Computational Fluid Dynamics Optimization Process for Centrifugal Compressor - a Case Study

Valeriu DRĂGAN

COMOTI – Romanian Gas Turbine Research and Development Institute
220 D Iuliu Maniu Avenue, 061126 Bucharest 6, Romania, P.O. 76, P.O.B. 174,
drvaleriu@gmail.com

Abstract: *Computational Fluid Dynamics has been an ubicuous tool for compressor design for decades, helping the designers test the aerodynamic parameters of their machines with great accuracy. Due to advances of multigrid methods and the improved robustness of structured solvers, CFD can nowadays be part of an optimization loop with artificial neural networks or evolutive algorithms. This paper presents a case study of an air centrifugal compressor rotor optimized using Numeca's Design 3D CFD suite. The turbulence model used for the database generation and the optimization stage is Spalart Allmaras Results indicate a fairly quick convergence time per individual as well as a good convergence of the artificial neural network optimizer.*

Key Words: *RANS, CFD, Centrifugal compressor, optimization*

1. INTRODUCTION

This paper presents a case of centrifugal compressor off design point optimization. For practical applications it is often necessary to adapt existing turbomachinery for different working conditions.

In this case, the mass flow of the original compressor design point will be lowered to accommodate the new specifications. Typically this would be accomplished by scaling methods Refs. [1-3]. However, the current design theme requires that the diameters and height of the rotor be kept constant (i.e. the new design rotor must fit without adaptations in the same machine as the old rotor).

Also, because the compressor is powered by a synchronous electric motor, the rotational speed is also constant. From classic turbomachinery calculations, the hub and tip incidence angles vary with mass flow when maintaining the angular speed constant Ref [4]. Empirically there are optimal incidence angles which depend on the local Mach number Refs [5, 6] and therefore for optimal performance, a compressor rotor must correlate these parameters.

The method used relies on the optimization module of Numeca Design 3D which uses simulated annealing in order to estimate, after analyzing a sufficiently large database, an optimal geometrical configuration.

Because the method is iterative, it allows the artificial neural network to adapt itself by adding each optimization iteration to the database - which leads to convergence i.e. the CFD results confirm to a satisfactory degree the estimation of the artificial neural network Ref. [7].

2. THE CFD OPTIMIZATION

The original rotor was obtained using linear design calculations and semi-empirical corrective correlations to account for the boundary layer blockage and flow retarding. The table below provides a comparison between the CFD results obtained with Numeca Fine Turbo and the linear design method.

Figure 1 depicts the solid mesh on the walls of the blades and the overall mesh quality parameters for the case above. The turbulence model used is Spalart-Allmaras with rotation and curvature corrections as presented in Ref [8].

Table 1 - Design data versus numerical simulation data (Original rotor at design point)

Parameter	Linear design with correlations	Numerical simulation
Total-to-total isentropic efficiency [%]	92.2	92.2
Outlet static pressure [Pa]	147830	156532
Outlet total pressure [Pa]	190680	185727
Outlet velocity magnitude [m/s]	288.03	248.473
Power consumption [kW]	248.68	242.495

Section 2. Flight Mechanics and Systems Integration

INVERSE DYNAMICS METHOD FOR MINISATELLITE ATTITUDE GUIDANCE

Ion STROE[1], Dan N. DUMITRIU[2]

[1]"POLITEHNICA" University of Bucharest
313 Splaiul Independenţei, Bucharest 060042, Romania
ion.stroe@gmail.com
[2]Institute of Solid Mechanics of the Romanian Academy
Str. Constantin Mille 15, Bucharest 010141, Romania
dumitri04@yahoo.com, dumitriu@imsar.bu.edu.ro

***Abstract**: For the parameterization using the x-y-z sequence of rotations, the attitude dynamics equations of a minisatellite are written as Euler's equations of motion for a rigid body with one fixed point. Based on these direct dynamics equations, an inverse dynamics method is used for attitude guidance of the minisatellite motion from one fixed attitude posture to another fixed attitude posture. The particular case A=B≠C of an axisymmetric minisatellite is also considered and compared with the general case A≠B≠C where all three principal moments of inertia are different. There is no numerical difficulty in applying the simple inverse dynamics method for satellite attitude guidance, only numerical derivations are needed.*

***Key Words**: inverse dynamics, satellite attitude guidance, x-y-z sequence of rotations, angular velocity vector.*

1. INTRODUCTION

In order to realize a functional minisatellite (satellite with a mass of 100-500 kg), besides the specific complex technological issues (e.g., what actuators to use [1], more precisely if using three momentum reaction wheels is reasonable in the case of a minisatellite or if more complex sets of propulsion thrusters must be used or if some combined solution comprising one or two momentum reaction wheels and two or one sets of propulsion thrusters is more appropriate), there is also the attitude guidance problem. The attitude guidance of a minisatellite can be based on an inverse dynamics method, derived from the direct dynamics equations of rotation motion. This paper presents a simple inverse dynamics method for minisatellite attitude guidance from one fixed attitude posture to another fixed attitude posture.

Satellite attitude guidance is aimed to provide, in open loop, the external torques to be applied for obtaining the desired/required attitude maneuver. Of course, in practice the guidance is always completed by a closed loop control system [2], bringing real-time corrections to the external torques initially estimated by the guidance part, based on real-time sensor attitude data. Thus, from this overall guidance, navigation and control system, only the satellite attitude guidance part is studied in this paper, using and inverse dynamics approach. The satellite/rigid body attitude dynamics equations are written here using the x-y-z sequence of rotations (called also Tait-Bryan angles or Cardan angles) [3,4,5]. Besides the x-y-z sequence of rotations chosen here for being widely used in flight dynamics, there are other possibilities to parameterize the position of the rigid body frame with respect to the inertial reference frame, such as: the well-known Euler angles (roll, pitch and yaw), quaternions, rotation vectors, Rodrigues parameters [1,2], full 3×3 rotation matrices.

2. INVERSE DYNAMICS FORMULATION FOR SATELLITE ATTITUDE GUIDANCE

The dynamics of a satellite, considered as a rigid body rotating about its center of mass and with the symmetric moment of inertia tensor having a diagonal form, can be expressed in the body-attached reference frame ($O \equiv G, \vec{x}_1, \vec{y}_1, \vec{z}_1$) using the following Euler's equations of motion [3]-[7]:

$$\begin{cases} A\dot{\omega}_x - (B-C)\,\omega_y\,\omega_z = M_x \\ B\dot{\omega}_y - (C-A)\,\omega_z\,\omega_x = M_y \\ C\dot{\omega}_z - (A-B)\,\omega_x\,\omega_y = M_z \end{cases} \tag{1}$$

Implementation of an isolated aero-elastic rotor for IAR 330 PUMA model in FLIGHTLAB environment

Mihai MIHAILA-ANDRES[1], Achim IONITA[2]

[1]Military Technical Academy
39-49 George Coşbuc Avenue, Sector 5, Bucharest 050141 Romania
mihailmi@rdslink.ro
[2]STRAERO – Institute for Theoretical and Experimental Analysis of Aeronautical Structures
B-dul Iuliu Maniu 220, Bucharest 061126, Romania
achim.ionita@straero.ro

Abstract: *One of the most important objectives in the design of a full multi-body dynamic IAR330 PUMA model is the modelling of its aero-elastic effects. An isolated aero-elastic main rotor has been developed using two methods: one based on finite element modal reduction of the rotating blade structure with large-amplitude motion using nonlinear normal modes and another one using CSM/CFD coupling algorithms. The elastic blade model created in the FLIGHTLAB environment has been compared to that provided by ARISTOTEL partners as a means of an initial validation model. This comparison has taken mode frequency and shape comparison at 100% RPM. The numerical results obtained with FLIGHTLAB were consistent with the experimental results, especially for first lag, flap and second flap modes. The second aero-elastic blade model was created in ANSYS and the fluid-structure analysis of the strongly coupled aeroelastic interaction also showed a good concordance with the high-speed camera shootings of the IAR330 Puma in hover.*

INTRODUCTION

This work is focused on the modelling of rotorcraft for aeroelastic RPC. First, the technology used at STRAERO to analyse the fluid-structure interaction of a main rotor using coupled mechanical and fluid simulations is presented.

Based on this technology, both a separate analysis of the main rotor's structure and of the fluid flow must be performed in order to calibrate the fluid-structure interaction model.

Then, the final model of the aero-elastic main rotor is presented with the results obtained for the hover flight condition.

In addition, an isolated aero-elastic main rotor model has be developed based on a modal reduction of the blade structure.

The Aerospatiale Puma 330 is a twin-engine medium transport helicopter with a fully articulated four-bladed rotorcraft.

The paper focuses on the numerical simulation of the aeroelastic phenomena the blades are subjected to during flight in hover.

Our test helicopter had a take-off weight of 7345kg and was flown in hover at a main rotor rotational speed of 27.75rad/sec with a collective pitch angle of 16°.

EXPERIMENTAL AND ANSYS FEM MODEL CALIBRATION

Due to symmetry of the problem, the structural model of the rotorcraft consists of a simplified hub with one blade attached using elements that replicate the hinges.

The blade has a radius of 7.54m, with a NACA0012 profile twisted linearly with 8° from 25% of the root to tip.

Extensive tests were performed on both samples of materials and the whole blade in order to determine the mechanical characteristics of the blade [1, 2, 3, 4].

The FEM of the blade was validated based on the modal and gravimetric tests [5]. The volume of the blade was modeled with SOLID185 elements with different material properties to match the composite structure and the surface of the blade was modeled with SHELL181 multilayer elements (Fig. 1).

Analysis of IAR 330 PUMA aero-servo-elastic (ASE) model

Andreea-Irina AFLOARE, Achim IONITA

STRAERO – Institute for Theoretical and Experimental Analysis of Aeronautical Structures
B-dul Iuliu Maniu 220, Bucharest 061126, Romania
andreea_ai18@yahoo.com, achim.ionita@straero.ro

Abstract: *This work presents an analysis of full rotorcraft model developed for Rotorcraft Pilot Coupling (RPC). The dynamics include contribution of rigid body modes, structural modes of fuselage, aero-elastic modes for main rotor with additional axial dynamic inflow state. The rotorcraft dynamics is completed by contribution of main controls actuators and controllers' dynamics to improve stability and maneuverability performances. The analysis investigates the extended linearized configuration of rotorcraft to obtain a reduced order model, especially designed to include the servo-elastic contribution of rotor and fuselage dynamics through simulation model of realistic complexity. The need for low order models is motivated by computational reasons for high complex vehicle where the model is described by a large number of first order differential equations. The effect of helicopter dynamic of constraining degree of freedom is modeled by the quasi-static reduction of the constrained degree of freedom. We have taken this technique because it is a clear frequency separation between the dynamics to be left free and the dynamics to be constrained. The objective of the reduced-order realization is that the states of reduced model approximate the behavior of the states of ASE model and the outputs of the reduced order model match the output response of the initial system. The proposed strategy is validated in a case study.*

LIST OF ABBREVIATION

ARISTOTEL –Aircraft and Rotorcraft Pilot Couplings –Tools and Techniques for Alleviation and Detection
ASE – Aero-Servo-Elastic model
RB – Rigid Body model
FCS – Flight Control System
SCAS – Stability and Control Augmentation System
HQR – Handling Qualities Requirements
PAO – Pilot Assisted Oscillations
PF – Pilot Flying
PIO – Pilot Induced Oscillations
RPC – Rotorcraft Pilot Coupling
HOST – Helicopter Overall Simulation Tool
MASST – Modern Aero-servo-elastic State Space Tools
APM – Active Pilot Model
PPM– Passive Pilot Model
RCAH – Rate Command Attitude Hold
TOW – Take-off Weight
LTI – Linear Time Invariant model

1. INTRODUCTION

The prediction of aero-servo-elastic instabilities related to adverse interactions between pilot and vehicle is a subject that should considerably take part in the design process of modern/innovative rotor-craft configurations, but that cannot yet rely on a mature, well established technology. In the last decades the scientific community has started a deeper analysis of this kind of phenomena, starting with fixed-wing aircraft, focusing the attention on the identification of the events that may be classified as resulting from pilot-vehicle interactions, as well as on the developments of appropriate computational tools suitable for predicting the proneness of modern rotorcraft to RPC, and identifying suitable guidelines to designers of next generation aircraft such to avoid adverse RPC inception [1].

Prediction techniques of the flight qualities, based on piloting models have been proposed over the past six decades. There are two forms of analytical criteria for the specification of handling qualities: the open-loop criteria, such as limits on measured responses or on modes, and the closed-loop criteria, assuming a pilot feedback structure. These criteria are dependent on the accuracy and adequacy of the pilot model forms

Section 3. Astronautics and Astrophysics

A Physical – Geometrical Model of an Early Universe

Corneliu BERBENTE

"POLITEHNICA" University of Bucharest, Department of Aerospace Sciences "Elie Carafoli"
Polizu Street 1-7, sector 1, Bucharest 011061, Romania
berbente@yahoo.com

Abstract. *A physical-geometrical model for a possible early universe is proposed. One considers an initial singularity containing the energy of the whole universe. The singularity expands as a spherical wave at the speed of light generating space and time. The relations of the special theory of relativity, quantum mechanics and gas kinetics are considered applicable. A structuring of the primary wave is adopted on reasons of geometrical simplicity as well as on satisfying the conservation laws. The evolution is able to lead to particles very close to neutrons as mass and radius. The actually admitted values for the radius and mass of the universe as well as the temperature of the ground radiation (3-5 K) can be obtained by using the proposed model.*

Key Words: *singularity, spherical wave, ordered structure, primary wave, associated photon*

1. INTRODUCTION

"And God said: let there be light. And there was light.
And God saw that light it was good". (Genesis)

The standard model for the early universe considers an initial explosion: so called BIG BANG [1; 2], although no sound could have been heard through vacuum if an outer observer could exist; BIG FLASH is a better name, as the light can propagate through vacuum. The whole energy of our universe was implied but this fact has to be more taken into account.

In the following we present the ***basic assumptions*** of a somewhat different model:

a) a singularity occurred under the form of a spherical wave expanding at a limit speed c considered constant (the speed of the wave front) while its center is at rest. There was no time and space until this singularity appeared. With it the time has started to flow and the space is created during the wave occurrence and expansion. Thus one can speak of a moment $t = 0$ and of a point O (the sphere center). In addition one considers the sphere having a spin; thus an axis of universe could be introduced;

b) the special theory of relativity, quantum mechanics and gas kinetics [3; 4; 5; 6] are applicable;

c) the spherical wave is made of pure energy and contains the whole energy, E_U, of a future universe. This energy is big, but finite, and at $t = 0$, the density of energy is infinite (of the type of a Dirac function [7]);

d) one associates to any amount of energy, E, a photon-type particle, a sphere of radius r_E, and a temperature T_E under the form:

$$E = hc/\lambda_E;\, r_E = \lambda_E = hc/E;\, T_E = E/k_B \tag{1}$$

where h is the Planck constant, k_B - the Boltzmann constant and λ_E the wave length of the *associated photon*. ***One starts the calculations from the time t_0 when the explosion front has arrived at the radius r_0 given by:***

$$r_0 = hc/E_U;\,(t_0 = r_0/c;\; r_0 E_U = const.)\,. \tag{2}$$

The spherical wave of radius r_0 given by relation (2) will be called ***the primary wave (PW).*** It is not quite a light spherical wave except its front which propagates at the limit speed (which can be assimilated to the speed of light in vacuum). In the rest ***PW*** is more similar to a ***photon gas*** at very high pressure and temperature.

The inner photon-like particles are colliding elastically at different directions leading to resultant radial velocities smaller than the limit speed;

e) by using the special theory of relativity, one assigns to our model of universe a mass M_{AU} given by:

$$M_{AU} = E_U/c^2;\,(M_{AU} r_0 = h/c = const.); \tag{3}$$

f) one ascribes to the primary wave a kinetic momentum (spin) equal to the spin of the associated photon, $h = h/2\pi$; this spin can be seen as a resultant spin of the inner photon-like particles in collision;

Approach strategy in orbital rendezvous to a docking part on LVLH frame

Achim IONITA, Ionel POPESCU

STRAERO – Institute for Theoretical and Experimental Analysis of Aeronautical Structures
B-dul Iuliu Maniu 220, Bucharest 061126, Romania
achim.ionita@straero.ro, ionel.popescu@straero.ro

Abstract: *The orbital rendezvous problem is a main one in aerospace engineering. The paper aims to realize an analysis of rendezvous maneuvers between a chaser vehicle and a target vehicle in permanent LEO (low earth orbit). The work starts with a study of the modeling of the dynamic equation of relative motion proposed by Hill-Clohessy-Wiltshire for determining translational maneuvers that facilitates approach of the chaser to a docking part of the target. Then the implementation of the control architecture based on SDRE (State Dependent Riccati equation) technique applied to the nonlinear relative motion dynamics including the Earth oblateness perturbation. The computational tool MATLAB/Simulink is carried out. In simulation of the approach strategy V-R bar operations are analyzed and the accelerations needs to the control the response of such control system. The simulation analysis of rendezvous maneuvers regarded as a chaser vehicle and a target vehicle in LEO orbit is validated in a case study.*

Key Words: *LEO, orbital rendezvous and docking, J_2 perturbation, LQR, SDRE*

ABBREVIATION

LEO – Low Earth Orbit
SDRE – State Dependent Riccati Equation
J_2 – Earth Oblateness perturbation
LVLH – Local vertical Local Horizontal frame
CW – Clohessy Wiltshire equations
SDC – State Dependent Coefficient factorization
GNC – Guidance, Navigation and Control
LQR – Linear Quadratic Regulator
ARE – Algebraic Riccati Equation
IOS – Instructor Operation System

SYMBOLS AND VARIABLES

μ – Earth's gravitational constant (m^3/sec^2)
ω – mean motion (1/sec)
r_t, r_c – radius of target, respectively chaser (m)
u_x, u_y, u_z – forces exerted by chaser (N)
a_{J_2} – relative effect of the Earth oblateness (m/sec^2)
m_c – mass of the chaser (kg)

INTRODUCTION

Over the years on-orbit manoeuvres of the spacecraft became priority problems of space vehicle community. Due to the cost and time disadvantage of manual control an autonomous mission on orbit appear to be favourable. An autonomous chaser vehicle had to be capable of rendezvous and docking manoeuvres requires a significant development in the various technologies. Rendezvous and docking operations of unmanned vehicles e.g. presently the European ATV, the Japanese HTV and Progress within the International Space Station are automatic but not fully autonomous. The proximity operations and the docking are extremely delicate and precise translational and of course, rotational manoeuvres. In addition, precise relative position and velocity state estimates are required. A simplified CW linear model and a non-linear dynamic model which includes effects due to the non-spherical nature of the Earth (J_2 effects) will be

Long Life Thrusters for Low Orbit Satellites and Special Solar Power Supply Systems for Satellites, ISS/Orbital Hotels, Earth Protection Against Asteroides and Applications on Mars

Constantin SANDU[1], Dan BRASOVEANU[2]

[1]COMOTI – Romanian Gas Turbine Research and Development Institute
220 D Iuliu Maniu Avenue, 061126 Bucharest 6, Romania, P.O. 76, P.O.B. 174
Corresponding author: constantin.sandu@comoti.ro
[2]RAYTHEON, Arizona, USA,
brasovdx@yahoo.com

Abstract: *Low orbit satellites are powered by thrusters to control attitude and to prevent orbit decay. The system described here places the propellant tank of satellite within the focal point of a light parabolic mirror mounted on the satellite body. When the thruster is not actuated, the parabolic mirror is folded over the propellant tank protecting it from Sun light. Before any actuation of satellite thruster(s), the parabolic mirror is unfolded and the Sun light is focused on the propellant tank increasing propellant pressure and temperature. The additional energy provided in this way allows more orbit corrections and implicitly increases the satellite operational life.*
The Special-Solar-Power-Supply-System (SSPSS) includes one large and one small parabolic mirror having the same focal point. The Sun light is focalized by the large parabolic mirror into the focal point. The light is then reflected by the small parabolic mirror as parallel rays passing through one hole drilled into the center of the large mirror. An articulated mirror tube fixed on the convex side of the large mirror directs the concentrated beam toward the consumer which requires additional power. The consumer can be a satellite, ISS, a space hotel, etc. High power SSPSS can be used to protect Earth protection from asteroids or for Mars applications.

I. 1 LONG LIFE THRUSTERS FOR LOW ORBIT SATELLITES

I.1.1 Current low orbit satellites

Low orbit satellites, which orbit at altitudes of 100-300 km, are subject to aerodynamic drag of rarefied atmosphere. For this reason satellites are powered by micro-thrusters to prevent orbit decay. These thrusters are also used for attitude control. The Global Positioning System (GPS) and other communication satellites exemplifies the need for frequent attitude and orbit corrections due to the high pointing accuracy required for their operation.
Cold-gas systems are the simplest and oldest thruster type used for attitude control. Cold gas was the most common type used in the 1960s era. Today, these systems are still used when the total required impulse is less than about 1000 lb-s. A typical cold gas system can be seen in fig.1 [1]. It contains a gas storage container, a gas loading valve, filtration, pressure regulation, pressure relief, and a series of thrusters with valves. Gases like Helium, Nitrogen compressed at pressures of 34500 kPa are currently used.

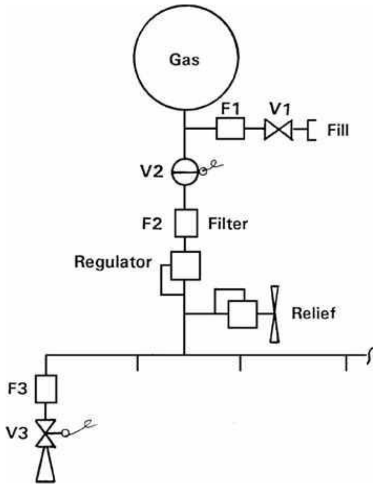


Fig.1-Typical cold gas thruster system

Advanced Interplanetary Spacecraft Fed by a Network of Concentrated Solar Wind and Light Beams

Constantin SANDU[1], Dan BRASOVEANU[2]

[1]COMOTI – Romanian Gas Turbine Research and Development Institute
220 D Iuliu Maniu Avenue, 061126 Bucharest 6, Romania, P.O. 76, P.O.B. 174
Corresponding author: constantin.sandu@comoti.ro
[2]RAYTHEON, Arizona, USA,
brasovdx@yahoo.com

Abstract: *'Advanced Interplanetary Spacecraft'(AIS) using concentrated solar wind and light can be built by our civilization. AIS will permit rapid colonization of the Solar System because Sun resources are unlimited. The basis of 'Network of Concentrated Solar Wind and Light Beams'(NCSWLB) is the 'Solar Power Focusing and Concentration System'(SPFCS). The SPFCS consist of a large and a small parabolic mirror made of thin reflective foils and having a common focal point. The Sun light rays and solar wind are focalized by the large parabolic mirror into the focal point. The light and solar wind reflected then by the small parabolic mirror as a group of parallel rays and ions pass through a central hole placed in the center of large parabolic mirror. This concentrated beam of ions and light rays is radially directed toward any location within the Solar system. The NCSWLB consists of many SPFCS placed in a fixed position at a certain distance from the. AIS are powered by magneto-plasma-dynamic thrusters. AIS has a special parabolic mirror and inlet device shaped to direct ions collected from the beam produced by SPFCS to thruster where ions are accelerated by the electromagnetic field. The AIS can navigate toward and away from the Sun accelerating or decelerating as needed.*

I. ADVANCED INTERPLANETARY SPACECRAFT

I.1 General

Currently, human travel through the solar System is a difficult task. The most powerful form of electromagnetic propulsion is the Magnetoplasmodynamic thruster (MPDT) [1]. This thruster is also known as 'Lorentz Force Accelerator', a subclass plasma thrusters with a strong electromagnetic acceleration mechanism involving the interaction of a current between an anode and a cathode and a magnetic field which could be applied or induced by the current itself. This interaction gives rise to a Lorentz force density (f = J x B) that accelerates propellant downstream and out of the thruster. A great advantage of MPDT over other types of electric propulsion (such as the Hall thruster or the ion thruster) is high thrust. Theoretically, MPDT can provide a wide range of thrust levels (100 mN - 100 N) depending on the power level, high specific impulse (1000-5000 s) and high thrust efficiency, (10…25% with argon and up to 60% with lithium propellant), and the ability to handle hundreds of kW in a single compact device.
It has been well established that performance can be significantly increased when adding an applied magnetic field to the thruster. This is often necessary at low power levels (below 100 kW) when the current is too low to provide a sufficient self-induced magnetic field. Thrust, efficiency and specific impulse tend to increase with the applied magnetic field intensity. It has been observed that the thrust increases linearly with the product J·B, where J is the total current applied to the thruster and B is the value of the applied magnetic field measured at the solenoid's center (the detailed physics behind the acceleration mechanism in the applied magnetic field is not yet fully understood and more experimental research is needed to clarify how MPDT could power AIS in the future. MPDT technology has been explored academically, but commercial interest has been low due to several remaining problems. The biggest problem is that power requirements on the order of hundreds of kilowatts are required for optimum performance. Current interplanetary spacecraft power systems (such as radioisotope thermoelectric generators [2] and solar arrays are incapable of producing that much power. NASA's Project Prometheus [3] reactor was expected to generate power in the hundreds of kilowatts range but was discontinued in 2005. A project to produce a space-going nuclear reactor designed to generate 600 kilowatts of electrical power began in 1963 and ran for most of the 1960s in the USSR. It was to power a communication satellite which was in the end not approved [4]. Given the state of the art, nuclear reactors are too heavy for space applications. It is clear that new solutions are required for solving the power generation problem.

Algorithm and code for analyzing hyperspectral images using the Hurst exponent

Nicolae APOSTOLESCU*[,1], Daniela BARAN[2]

*Corresponding author
*[,1]AEROSPACE Consulting
B-dul Iuliu Maniu 220, Bucharest 061126, Romania
apostolescu.nicolae@incas.ro, apostol@incas.ro
[2]INCAS – National Institute for Aerospace Research "Elie Carafoli"
B-dul Iuliu Maniu 220, Bucharest 061126, Romania
baran.daniela@incas.ro, dbaran@incas.ro

Abstract: *The main goal of this paper is to present the implementation of an algorithm developed to calculate Hurst exponent (H), applied here to characterize the pixel spectrum from hyperspectral image. Because a hyperspectral reflectance curve from each pixel may be regarded as a chaotic series and that fact inspires us to treat a spectrum as a time series. Hyperspectral data are typical heteroscedastic variables, which makes it inappropriate to apply the normal/ classic time series analysis, such as the autoregressive-integrated-moving-average model.*
Generally, Hurst exponent is a measure used in nonlinear time series analysis to reveal local trend of series among adjacent successive terms. H can describe the local change in the ratio between the ranges of accumulated mean-removed values to the original standard deviation and thus represent the diversity of spectral values. Although H may be used to characterize regions of the image regarding persistence or antipersistence spectrum (highlighting noisy data), it does not directly address the separation between the classes of interest. The algorithm uses the rescaled range analysis method. This method introduces a measure of the variability of a time series using a ratio range/standard deviation (R/S).
The algorithm was tested on hyperspectral data with spectra of various lengths and with persistence or antipersistence spectrum.

Key Words: *hyperspectral data, spectral profiles, time series, Hurst exponent, persistent spectrum.*

1. INTRODUCTION

Hyperspectral images are important source of information which is used in many environmental assessments and monitoring of agriculture, meteorology, mineralogy, … etc. These data obviously provide much more detailed information about the scene than a normal color camera, which only acquires three different spectral channels corresponding to the visual primary colors red, green and blue.

Hyperspectral data sets are generally composed of about 100 to 200 spectral bands of relatively narrow bandwidths (5-10 nm), whereas, multispectral data sets are usually composed of about 5 to 10 bands of relatively large bandwidths (70-400 nm).

Hence, hyperspectral imaging leads to a vastly improved ability to classify the objects in the scene based on their spectral properties.

Due to the rich information content in hyperspectral images, they are uniquely well suited for automated image processing, whether it is for online industrial monitoring or for remote sensing. Efficient exploitation of hyperspectral images is of great importance in remote sensing.

Hyperspectral images contain abundant spatial, spectral, and radiometric information of earth surfaces, which makes earth observation and information acquisition much more effective and efficient for material applications.

Images acquired from hyperspectral sensors contain many more bands and potentially more information than multispectral images, but hyperspectral images also tend to contain more noise, especially when acquired using small aircraft.

Hyperspectral data are spectrally overestimated and the useful signals usually occupy lower dimensional subspace which needs to be inferred.

Therefore is need for exploration of dimensionality reduction methods which can effectively reduce noise in data sets with minimum loss of information.

The signal information is usually concentrated in lower dimensional subspaces. Dimensionality reduction, equivalent with band selection benefits of advantage of high band correlation to remove data

A LQG Based Method for the Design of the Control System of a Launch Vehicle

Irina-Oana MIU[1,2], Silvia NECHITA[1], Adrian-Mihail STOICA[1]

[1]"POLITEHNICA" University of Bucharest, Faculty of Aerospace Engineering,
Polizu 1-7, 011061, Bucharest Romania
miu.irina@incas.ro, nechita_silvia_91@yahoo.com, stoica.am@gmail.com
[2]INCAS − National Institute for Aerospace Research "Elie Carafoli"
B-dul Iuliu Maniu 220, Bucharest 061126, Romania

Abstract: *In the last decades, the design of launchers control systems remains a challenge for the control engineer. The main interest is oriented both, to specific features of the controlled plant, namely of the launcher, and to accomplish some specific required performances. The first aspect of this problem is that a launcher is a complex unstable dynamic system with fast time-varying parameters, subject to parametric and dynamic uncertainty. The second aspect aims to develop appropriate design methodologies such that the launcher control system is able to stabilize it over the whole trajectory, to track some imposed attitude commands and to reduce the drift due to atmospheric turbulence. The proposed method described in the paper is based on the Linear Quadratic Gaussian (LQG) approach and it is illustrated by a case study for the VEGA launcher. The paper is organized as follows. After an introductory section, in the second section of the paper the design model of the launcher is presented together with the design performances imposed on the control system. In the third section, the Linear Quadratic Gaussian (LQG) based methodology is presented. Numerical results and simulations are given in the fourth section. The paper ends with some concluding remarks and future developments.*

Key Words: *launch vehicle, dynamic model, Kalman filter, LQG, numerical simulations.*

1. INTRODUCTION

The space engineering has a history of more than a half of century, but the recent years marked a continuously growing interest for much applications. This interest is mainly due to diversification of space missions and applications requiring launch vehicles for the satellites placements on prescribed Earth orbits. The aim is to increase the accuracy of desired trajectory tracking together with the reducing of operational costs. The first objective mentioned above is strongly depend on the performances of the launcher flight control system. From the perspective of the control engineer, the design of the launcher vehicle control system is a challenging task. Indeed, the launcher is an unstable plant which dynamics is changing quickly due to its fast pass through the atmosphere.

Moreover, the launcher is subject to atmospheric disturbances generating both drifts from the desired trajectory or even, more dangerous, high loads determined by large angles of attack. Additionally, a realistic model of the launch vehicle must include, besides its rigid body dynamic, bending modes modelling the flexibility of the structure. Another important aspect which must be taken into account is the fact that these design models inherently include parametric modelling uncertainties.

Over the last years, a wide variety of design methods for launchers control systems have been analyzed. Among them one mentions besides the will-known proportional-integral-derivative (PID) control laws, optimal control approaches as H_∞ and L_1 norm minimization ([1], [2], [3]), nonlinear techniques including backstepping ([4], [6]), sliding-mode ([5], [7]) and neuro-fuzzy methods ([8], [9]).

The aim of this paper is to analyze the performances provided by linear quadratic Gaussian (LQG) control laws from the perspective of the main objectives imposed for the launcher control systems.

1.1 The VEGA launcher

As a case study the VEGA-like launcher is considered. The VEGA program has its origins back in the early 1990's, when studies were performed to investigate the possibility of complementing the Ariane family with a small launch vehicle using Ariane solid booster technology.

VEGA is a conventional launch vehicle, with all the components lost after orbiting the payload, whose development aims to orbit small to medium payloads in LEO (Low Earth Orbits). The qualification flight from Europe's Spaceport in French Guiana was performed in February 2012. The Vega Launcher was developed by European Program in the auspices of the European Space Agency, as a cooperative project

Kinematics Structure for the Movement of a Set of Punctual Bodies

Sorin Stefan RADNEF

INCAS – National Institute for Aerospace Research "Elie Carafoli"
B-dul Iuliu Maniu 220, Bucharest 061126, Romania
radnef.sorin@incas.ro

Abstract: *The paper has as central subject the kinematic structuring of the mechanical movement of a set of punctual bodies, so that to emphasise an instantaneous movement as a rigid body and a movement relative to this instantaneous rigid. The consequence was the identical formulation of the fundamental two theorems of mechanics as for a rigid body, regarding the external actions applied to the punctual bodies, and a conservative formulation of these theorems for the internal motion relative to this instantaneous rigid. Some properties of this kinematic structure are investigated to bring into attention the intrinsic aspects of the movement.*

Key Words**:** *punctual bodies, motion structure, relative inertia*

1. INTRODUCTION

The paper deals with the movement of a set of punctual bodies that interact between them and with bodies not in their set, showing that the motion may be structured emphasizing a motion as an instantaneous rigid and the relative motion with respect to this instantaneous rigid.

It will be pointed out the intuitive properties of each of these motions and their significance for the general mechanics of motion.

In an earlier paper, presented at the conference AEROSPATIAL 2012, the problem of the three bodies was approached identifying a similar structure of the movement of these bodies and based on the results of this study, now it will be possible to consider even the problem for the two bodies from this view point.

Another objective of this paper is to prepare tools for the study of the intrinsic relationships between continuous mediums and the large set of punctual bodies.

2. MOTION KINEMATICS

Relative to an any reference system, having a reference axes system (OXYZ), the set of punctual bodies are described by the position vectors, $\vec{R}_k$, inertial properties expressed by their masses, m_k, velocities, $\vec{V}_k$ and forces, $\vec{F}_k$, applied to each body as expression of actions exerted on them.; where k=1,2, … n is the index of the kth body.

Considering the mass centre velocity defined by the formula, [2]:

$$(\sum_{k=1}^{n} m_k) \cdot \vec{V}_C = \sum_{k=1}^{n} m_k \cdot \vec{V}_k = \vec{H} \qquad (1)$$

which defines the impulse of the entire system of punctual bodies, the relative velocity to the mass centre is then, in fact:

$$\vec{v}_k = \vec{V}_k - \vec{V}_C$$

and:

$$\vec{v}_k = \frac{D}{Dt}\vec{r}_k = (\frac{D}{Dt}r_k) \cdot \frac{\vec{r}_k}{r_k} + \vec{\Omega}_k \times \vec{r}_k$$

having $\vec{r}_k = \vec{R}_k - \vec{R}_C$ the position vector relative to the mass centre.

In the same manner, we will define the entire kinematic moment relative to the mass centre, $\vec{K}_C$, using a unique angular velocity $\vec{\Omega}_C$, a follows:

Section 4. Materials and Structures

A Multi-Material Complex Geometry Reduction Considering Equivalent Materials in Thermal-Structural Fields Coupling

Ion FUIOREA

STRAERO – Institute for Theoretical and Experimental Analysis of Aeronautical Structures
B-dul Iuliu Maniu 220, Bucharest 061126, Romania
ifuiorea@straero.ro

Abstract: *The paper presents a technology designated to reduction of a complex thin walled structure composed by different materials (steel, cooling water). The technology is considered in order to simplify the FEM model of the structure for a transient problem consisting in thermal-structural-fluid fields coupling. The economy of the model in number of solving equation terms is realized especially by using multilayered SHELL elements. Each layer is composed by some equivalent materials whose mechanical and thermal properties were determined considering a set of numerical tests on different complex samples cut from real structure.*

1. INTRODUCTION

STRAERO was involved in a project whose main task consisted in design, validate and life cycle estimation of a mechanical test bench designated for testing different rocket engines. As the inner temperature of the ejected gases inside the exhaust system was too high to be supported by the steel walls of the bench, a cooling jacket system was considered to mitigate the temperature effect upon the composing materials as presented in figures 1.1 and 1.2. The pressure of the water inside the cooling channels and its flow rate were calculated in order to assure the necessary heat transfer between the hot inner gases and the cooling jacket walls.

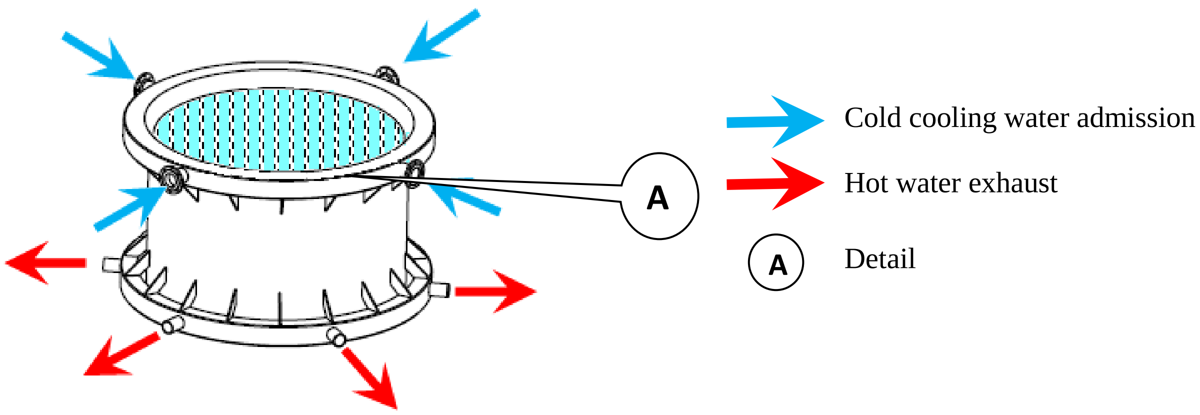


Fig. 1.1 Cooling jacket functioning scheme

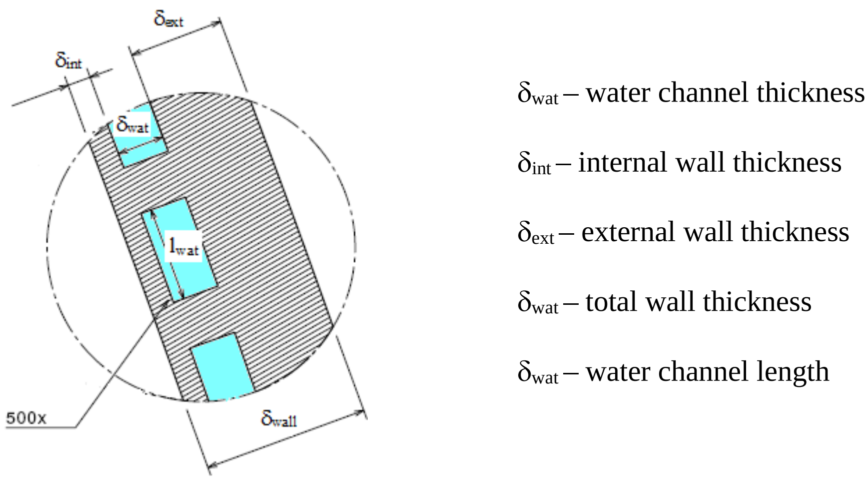


Fig. 1.2 Cooling jacket functioning scheme - detail **A**

The Harvesting Micro-structures to the Airfield Applications

Mircea IGNAT[1,2], Luca FLORESCU[3], Andrei CORBEANU[3], Raluca TURCU[3]

[1]National Institute for Research and Development in Electrical Engineering ICPE CA
Splaiul Unirii, Nr. 313, Sector 3, 030138, Bucharest, Romania
[2]LUMINA the University of South-East Europe
Șos. Colentina nr. 64b, Sector 2, 021187, Bucharest, Romania
mircea.ignat@icpe-ca.ro
[3]Excelency Centre for Young Olympics – National Institute for Research and Development in Electrical Engineering ICPE CA
Splaiul Unirii, Nr. 313, Sector 3, 030138, Bucharest, Romania
luca.florescu@gmail.com, andicorbeanu@yahoo.com, raluca_turcu200@yahoo.co.uk

***Abstract**. To the air track appear the different mechanical stress as vibration and shock which can be converted in electric energy. The our paper proposes a few structure solutions based on harvesting microelectromechanical structures with piezoelectric, electrostrictive and inductive electromagnetic conversions. The parameter of an piezoelectric harvesting microgenerator; voltage;20- 500mV, electric current; 0,023mA - 1 mA, vibration amplitude; 0,0008 mm. The parameter of an electrical induction (or electromagnetic) harvesting microgenerator; voltage; 0,05-1,46V, micropower; 0,05-3W, stroke; 0,5mm. In paper are presented; the parameter and characteristics, the matrix microgenerator connection, the mounting of this harvesting microgenerators on the track of airport or the airfield. Also, are presented the theoretical aspects; functional models, the specific relations of the conversion effects, and the potential applications; the monitoring wireless systems, the microlighting signals, etc.*

1. INTRODUCTION

Energy harvesting represents the conversion of energy from the environment and then the generation of electricity, which can be used to power electronic and electric devices. Different technologies can be employed depending on the energy source. For movement, mechanical source harvesters can be used (which can work from electrostatic, piezoelectric and electromagnetic conversions). Other energy sources include light, heat, electromagnetic radiation (on radio frequency), biological energy sources and more. Some versions are now even printed. Coupled with new forms of energy storage and lower power electronics, these energy harvesters can negate the need for small batteries in many applications enabling new markets, such as wireless sensors that last for decades or charging of consumer electronics devices.

An image of the harvesting electric micropower applications is showed in Fig.1 [1, 2, 3, 7]. A situation on the energy sources from the environment, versus harvested power densities is presented in Table 1 [1, 2, 3]. An evolution of the micropower supply to the different periods is presented în Fig. 2 [1, 2, 3].

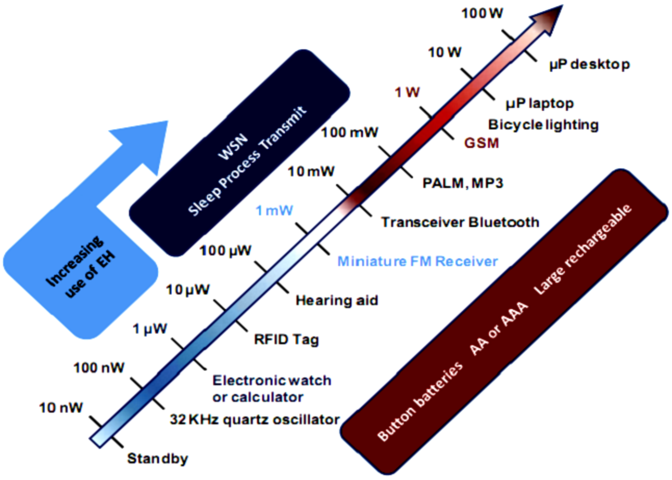


Fig. 1 A situation on the field of harvesting applications versus the nano and micropower generated

An accelerated evaluation concerning the thermal behavior of aerospace materials

Victor MANOLIU[1], Gheorghe IONESCU[1], Silviu IVAN[2]

[1]AEROSPACE Consulting, B-dul Iuliu Maniu 220, Bucharest 061126, Romania
manoliu.victor@incas.ro, ionescu.gheorghe@incas.ro
[2]INCAS − National Institute for Aerospace Research “Elie Carafoli”, Materials Unit
B-dul Iuliu Maniu 220, Bucharest 061126, Romania
ivan.silviu@incas.ro

Abstract: *The “hot parts” of turbo engines (combustion chamber, blades, ducts, vanes, adjustable nozzles, diffuser, etc.) for both rockets and aerospace vehicles, are subjected to high thermal loads that act with variable intensity and duration. Of the wear factors associated to multilayer ceramic protections that are known to influence the above mentioned sub assemblies (corrosion, erosion, sliding friction), high temperature-thermal shocks are the most disruptive. This paper serves to briefly present a new procedure for aerospace material testing that evaluates their behavior under high heating/cooling gradients. The proposed evaluation procedure, tested on the INCAS thermal shock installation, enables a seven fold increase in cooling speed by using water as a cooling agent instead of compressed air. The developed testing installation is versatile, operates in a semi-automatic mode and monitors fundamental parameters such as temperature, heating/cooling speeds, the duration of each heat register, etc.*

Key Words: *hot parts, thermal shock, air cooling, water cooling*

1. INTRODUCTION

Gas turbine generators operate at high ranges, both mechanically and thermally. Temperatures within commercial aircraft turbines can reach 1500°C [1].

Extreme operational conditions that may occur during flight, such as engine failure in flight, missing landings, etc. require knowledge on the behavior of materials subjected to high speed heating and cooling.

Out of all the wear the factors that work simultaneously on “turbo engine” hot parts – temperatures above 1500ºC: quick thermal shock, pyrolysis, particle erosion at speeds above Mach 3, corrosion, adhesion, etc. the thermal factor is the most disruptive.[2] Increased thermal strain over short intervals, can reach considerable values and may lead to plastic deformation of the material.

The use of protective systems, thermal barrier coatings (TBC) in turbo engine “hot parts” is absolutely necessary considering the high operating temperatures.

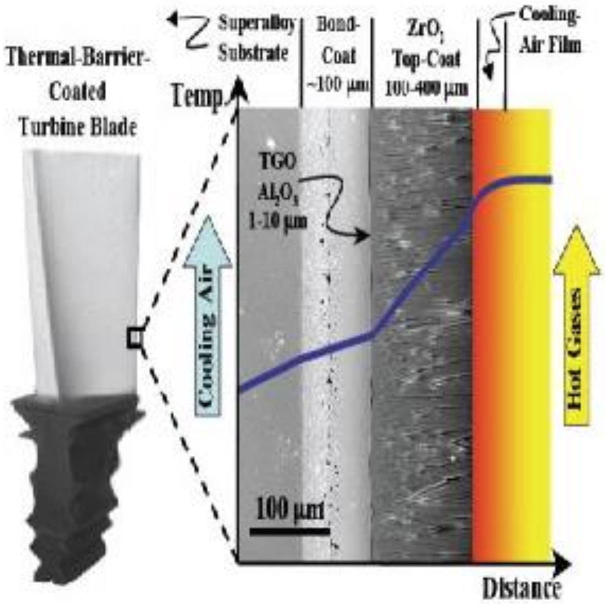


Fig. 1 Basic configuration of a TBC multilayer system from a turbine blade

Effect of Nanoclay and Carbon Nanotubes Addition in Polypropylene Nanocomposites

Cristina-Elisabeta BAN[1,2], Adriana STEFAN[1], Ion DINCA[3], George PELIN[1,2], Anton FICAI[2], Ecaterina ANDRONESCU[2], Ovidiu OPREA[2]

[1]INCAS − National Institute for Aerospace Research "Elie Carafoli", Materials Unit,
B-dul Iuliu Maniu 220, Bucharest 061126, Romania
ban.cristina@incas.ro, stefan.adriana@incas.ro, pelin.george@incas.ro
[2]"POLITEHNICA" University of Bucharest, Faculty of Applied Chemistry and Materials Science
1-7 Polizu St, 011061, Bucharest, Romania
anton.ficai@upb.ro, ecaterina.andronescu@upb.ro, ovidiu73@yahoo.com
[3]AEROSPACE Consulting, B-dul Iuliu Maniu 220, Bucharest 061126, Romania
dinca.ion@incas.ro

Abstract: *The paper presents a study concerning thermoplastic nanocomposites based on isotactic polypropylene matrix, nanofilled with montmorillonite modified with quaternary ammonium salt and carboxyl functionalized carbon nanotubes, respectively, added in the same concentration relative to the matrix. The nanofilled and single polymer materials are obtained by simple melt compounding through extrusion process followed by injection molding into specific shape specimens for mechanical testing of the samples. The nanofilled polypropylene materials are compared to the single polymer materials and an evaluation of the effect of processing temperature on polypropylene based materials is made. The materials are characterized by FT-IR spectroscopy, SEM microscopy and thermal degradation analysis. Mechanical properties were evaluated in terms of tensile and flexural strength and modulus, while thermo-mechanical properties in terms of thermal stability under load (heat deflection temperature). The results show positive effects concerning the effect of nanofiller addition to the thermoplastic polymer concerning mechanical strength and modulus of the materials at flexural and tensile tests, but thermal stability under load modification is insignificant.*

Key Words: *nanoclay, carbon nanotubes, polypropylene nanocomposites, mechanical strength*

I. INTRODUCTION

Polymer nanocomposites have gained interest in the last decades due to the attractive properties of nanostructured fillers, and their ability to enhance the matrix performance when added in low contents (1-5%), improvements comparable to those achieved by conventional loadings (15- 40%) of traditional fillers [1]. This new class of multifunctional materials found applications in a wide variety of fields, from microelectronics to aeronautic and aerospace industry [2]. Owned to their good balance between properties, low density , corrosion resistance, facile processabiliy and low cost [3, 4], polyolefins represent one of the most versatile class of polymeric matrices. Nanofilled isotactic polypropylene (PP) nanocomposites can be obtained through several processing methods, melt mixing, solution casting and in situ polymerization, among them, melt mixing having some major advantages as it combines high speed and simplicity with the absence of solvents and contaminants [5]. Carbon nanotubes and layered silicates represent two of the most promising reinforcement agents due to their properties that can provide the final composite special characteristics from mechanical, thermal or electrical point of view. Studies show that lower nanofiller contents lead to enhanced mechanical properties [6], [7] [8, 9].

The study presents the characterization of isotactic polypropylene filled with carboxyl functionalized MWCNT and quaternary ammonium salts modified montmorillonite (Cloisite30B) obtained through the simple melt extrusion technique. The results show an improvement of the tensile and flexural strength and modulus when adding nanofiller. In the case of higher MWCNT, the nanocomposites presented higher stiffness, decomposition temperature, and thermal stability under load. Cloisite 30B improvements are lower than the ones obtained using MWCNT, probably due to the nature of the modifying agents of the montmorillonite that does not favor an optimum dispersion.

II. EXPERIMENTAL SECTION

Materials. The matrix used for the nanocomposite obtaining was isotactic polypropylene (TIPPLEN H 949 purchased form Bastplast SRL) homopolymer type with 45 flow index. The nanofillers were multiwalled

Evaluation of load capacity of adhesively bonded butt joints between dissimilar adherends

Adriana SANDU*, Marin SANDU, Dan Mihai CONSTANTINESCU

"POLITEHNICA" University of Bucharest
Splaiul Independenţei 313, 060042, Bucharest, Romania
*Corresponding author: adriana.sandu@upb.ro
marin_sandu@yahoo.com, dan.constantinescu@upb.ro

Abstract: *The paper presents a numerical study concerning the loading limit of several adhesively butt joints between rectangular adherends made of dissimilar materials. In this case, the use of structural adhesives is unavoidable.*
The influence of partially filling with adhesive of the gap between adherends and simple or combined loadings in tension, shear and bending are analyzed.
Finite element nonlinear analyses (by stepped loading) were performed taking into account an ideal elastic-plastic behaviour of the involved materials: aluminium alloy, epoxy adhesive, plastics.
By comparing the obtained results it was possible to formulate useful recommendations for the design of structures of butt joint type with dissimilar adherends.

Key Words: *butt joints, dissimilar adherends, load capacity evaluation*

1. INTRODUCTION

Assessing the influence of defects on adhesive bonded joints is an important issue regarding the integrity and the in service safety of a multitude of advanced structures.

Analytical and/or numerical simulations of the effect of gaps in the adhesive layer have been the subject of several papers, but only single-lap joints [1]-[6] or double-lap joints [7] were considered.

The configuration from figure 1,a, where the gap in the adhesive may be central or close to one end of the connection, is investigated in paper [3]. The shear stress peak occurs (the same as for joint without flaw) close to the ends of the overlapping area of length *L*. Theoretically, the value of shear stress at the ends of this area must be zero. As a reference configuration the joint without defect and with identical adherends is considered. In the above cited paper it was emphasized that the shear stress has a significant increment (comparative to the reference case) only if void length is extended to more than 2/3 of *L*. The situation is worst if the void is placed near one end of the overlapping area.

In the case of the joint with adherends made of the same material, a central void having the extension L/3 raise the maximum shear stress with about 20%, while the same defect placed near one end (as an example, beginning at $x_1=L/10$), the stress peak raises with approximately 40%.

When the adherends are made of dissimilar materials, a more significant increase in maximum tangential stress was observed. For the configuration in figure 1,*a*, the difference between the rigidities of the adherends is characterized by the dimensionless parameter

$$R=\frac{1-\nu_2^2}{1-\nu_1^2}\cdot\frac{E_1}{E_2}\cdot\frac{h_1}{h_2}\,, \tag{1}$$

where E_i , ν_i are the Young's modulus and the Poisson's ratio of the adherends materials and h_i are the thicknesses of the adherends in joining zone (i = 1, 2).

A more general case (Fig. 1,b) is analyzed in [6]. Shear, peeling and tensile stresses (τ_{xy}, σ_y and σ_x) are induced in the adhesive layer due to the eccentricity of the loading. Depending on the adherends width (*w*), plane strain, plane stress or spatial stress state can be considered in the analysis of the structure.

In papers [1]-[6], analytical calculations and finite element analyses are performed taking into account large values of the width *w*, i.e. by considering plane strain states. In these cases, the expression (1) of parameter *R* is modified by replacing the ratio h_1/h_2 with $(h_1/h_2)^3$.

In the case of structure from figure 1,*b*, local stress peaks appear at the defect ends, but the stress concentration is higher near the ends of the overlapping area. The maximum stress depends on the void length (L_2) and on its placement into the adhesive layer (L_1).

Fatigue Life Experiments of the IAR-99 Aircraft

Dorin LOZICI-BRINZEI[1], Simion TATARU[2], Radu BISCA[1]

[1]INCAS − National Institute for Aerospace Research "Elie Carafoli"
B-dul Iuliu Maniu 220, Bucharest 061126, Romania
lozici.dorin@incas.ro, bisca.radu@incas.ro
[2]AEROSPACE Consulting, B-dul Iuliu Maniu 220, Bucharest 061126, Romania
tataru.simion@incas.ro

Abstract: *Predictions of fatigue properties and experimental verifications are most important tools. Accidents occurring in the past can now be prevented using the tools presented. The definition of fatigue, in reality, is: "failure under a repeated or otherwise varying load, which never reaches a level sufficient to cause failure in a single application". Physical testing is clearly unrealistic for every design component. In the majority of applications, fatigue-safe life design requires prediction of component fatigue life that accounts for predicted service loads and materials. The primary tool for both understanding and being able to predict and avoid fatigue has proven to be finite element analysis (FEA). Computer-aided engineering (CAE) programs use three major methods to determine the total fatigue life: Stress life (SN), Strain life (EN) and Fracture Mechanics (FM). FEA can predict stress concentration areas, and can help design engineers predict how long their designs are likely to last before experiencing the onset of fatigue. If S-N data are available the Miner rule may be adopted to calculate the fatigue life under spectrum loading (not exemplified in this paper). It is generally recognized that fatigue failure accidents had a significant influence on the development of practical knowledge about preventing similar accidents afterwards. The paper ends with summary and conclusions.*

Key Words*: aircraft, fatigue life, aluminum alloys, flight loads, boundary conditions, assessment of the flight vehicle's environment, finite element method.*

1. IAR 99-Overview

Figure1.1: Instructional and trainer aircraft

IAR-99 "Hawk" can perform complex combat missions, of following types:

- ground attack on enemy troops and ground targets within the tactical and operational field and support of own troops;
- interception and destruction of air targets at low and medium altitudes;
- research and aerial reconnaissance within the tactical and operational field.

To execute these missions depending on the variant of arming the aircraft allows the attachment of the following types of weapons:

- artillery weapons with high rate of fire;
- guided or unguided bombs of different types and loads;
- guided and self-directed missiles of various types and loads.

Finite element numerical experiences based on MWCNT composite mechanical tests

Daniela BARAN*,[1], Mihaela PETRE[2], George PELIN[1], Adriana STEFAN[1]
Cristina Elisabeta BAN[1], Elena VAJAIAC[1,3]

[1]INCAS – National Institute for Aerospace Research "Elie Carafoli"
B-dul Iuliu Maniu 220, Bucharest 061126, Romania
Corresponding author: baran.daniela@incas.ro*,
pelin.george@incas.ro, stefan.adriana@incas.ro, ban.cristina@incas.ro
[2]Aerospace Consulting, B-dul Iuliu Maniu 220, Bucharest 061126, Romania
petre.mihaela@incas.ro
[3]University of Bucharest, Faculty of Physics, Electricity and Magnetism, Solid–State Physics, Biophysics Department, Bucharest – Magurele 077125, Romania
vajaiac.elena@incas.ro

Abstract: *The main purpose of this paper is to develop some numerical experiences based on mechanical tests performed on MWCNT (Multi wall carbon nanotubes) composites created in our Material compartment using finite element commercial codes (here NASTRAN). The results of numerical simulations are consistent with the laboratory tests and encourage us to continue to improve the models using NASTRAN capabilities in order to obtain a realistic simulation of aeronautical structures made of such composites, considering taking into account their special properties.*

Key Words: *MCWNT composites, traction tests, bending tests, finite element simulations*

1. INTRODUCTION

In this paper we consider numerical finite element simulations on some multiwall carbon nanotubes (MWCNT) and epoxy resin P401 composite. The samples were obtained by ultrasonic homogenization of the epoxy resin with different MWCNT content: 0; 0.5; 2 and 4% CNT, followed by curing at room temperature using triethylenetetramine as curing agent Ultrasonic homogenization was used as mixing method, as it ensures the optimum dispersion of the carbon nanotubes into the epoxy matrix [1].

On three samples of each case were performed different mechanical tests: determination of the Young Modulus in traction tests, and determination of flexural modulus in flexural tests.

Considering these mechanical tests we developed a set of numerical simulations in order to obtain more information on the following aspect: how can be used these materials in designing aeronautical structures comparing them with traditional metal structures.

Several papers as [2], [3], [4], [5] purpose methods to deal with the material constants of single or multi wall carbon nanotubes materials considering their molecular structure. In this paper we consider only the experimental values of this constants as linear elastic materials and use them in finite element analysis with PATRAN/NASTRAN first to simulate the laboratory tests, then to evaluate a composed structure that may appear in aircraft design [6], [7].

For this purpose we performed the numerical simulations in two stages:

a) we tried to reproduce in a finite element commercial code (NASTRAN/PATRAN) the numerical tests performed in our laboratory, and
b) we consider a plate similar with those used in aeronautical structures which includes in a realistic way some MWCNT composite elements and compare this structure with a classical aluminum structure.

2. MECHANICAL TESTS

The mechanical test was performed with INSTRON 5982 facility at room temperature. The samples obtained through ultrasonic homogenization are based on epoxy resin with 0; 0.5; 2 and 4% wt MWCNT.

The samples were subjected to tensile and 3 point bending tests. Tensile tests were performed according to ISO 527, using 50 mm/min tensile rate and dumbbell shape specimens [12] and bending tests were performed according to ISO 178, using 2 mm/min speed of test and rectangular specimens [13].

Thermal shock performance of ablative/ceramic composite materials

Adriana STEFAN[1], Gheorghe IONESCU[2], George PELIN[1], Cristina BAN[1], Ion DINCA[2], Beatriz PEREZ[3], Sonia FLOREZ[3], Jorge BARCENA[3], Konstantina MERGIA[4], Kostoula TRIANTOU[4], Christian ZUBER[5], Waldemar ROTAERMEL[5], Jean-Marc BOUILLY[6], Gregory PINAUD[6], Wolfgang FISCHER[7]

[1]INCAS – National Institute for Aerospace Research "Elie Carafoli",
B-dul Iuliu Maniu 220, Bucharest 061126, Romania
stefan.adriana@incas.ro, pelin.george@incas.ro, ban.cristina@incas.ro

[2]AEROSPACE Consulting, B-dul Iuliu Maniu 220, Bucharest 061126, Romania,
ionescu.gheorghe@incas.ro, dinca.ion@incas.ro

[3]TECNALIA – Transport Unit, San Sebastián, Spain, Mikeletegi Pasealekua 2, E-20009
Donostia – San Sebastián, Gipuzkoa (Spain)
beatriz.perez@tecnalia.com, sonia.florez@tecnalia.com, jorge.barcena@tecnalia.com

[4]Institute of Nuclear & Radiological Sciences, Energy, Technology& Safety, National Centre for Scientific Research Demokritos, Agia Paraskevi Attikis, P.O.Box 60037, 153 10, Athens, Greece,
kmergia@ipta.demokritos.gr, ktriantou@ipta.demokritos.gr

[5]Deutsches Zentrum für Luft- und Raumfahrt e. V. (DLR), Linder Höhe, 51147 Köln, Germany,
Christian.Zuber@dlr.de; Waldemar.Rotaermel@dlr.de

[6]AIRBUS D&S, 6, rue Laurent Pichat, 70516 Paris Cedex 16, France,
Jean-Marc.Bouilly@astrium.eads.net, Gregory.Pinaud@astrium.eads.net

[7]AIRBUS D&S, Airbus-Allee 1, 28 199 Bremen, Germany,
Wolfgang.Fischer@astrium.eads.net

Abstract: *A hybrid thermal protection system for atmospheric earth re-entry based on ablative materials on top of ceramic matrix composites is investigated for the protection of the metallic structure in oxidative and high temperature environment of the vehicles. Joints of ablative material (carbon fibers and phenolic resin, ASTERMTM or cork based NORCOATTM) and Ceramic Matrix Composite (CMC) material (carbon fibers embedded in silicon carbide matrix, Cf/SiC, SICARBONTM or C/C-SiC) using commercial high temperature inorganic adhesives. To study the thermal performance of the bonded materials the joints were tested under thermal shock at the QTS facility. For carrying out the test, the sample is mounted into a holder and transferred from outside the oven at room temperature, inside the oven at the set testing temperature (1100°C), at a heating rate that was determined during the calibration stage. The dwell time at the test temperature is up to 2 min at 1100ºC at an increasing rate of temperature up to ~ 9,5°C/s. Evaluating the atmospheric re-entry real conditions, the most suited cooling method is natural cooling in air environment as materials that re-enter the Earth atmosphere are not subjected to other conditions. The average weight loss was calculated for all the samples from one set, without differentiating the adhesive used as the weight loss is due to the ablative material consumption that is the same in all the samples and is up to 2%. The thermal shock test proves that, thermally, all joints behaved similarly, the two parts withstanding the test successfully and the assembly maintaining its integrity.*

Key Words: *thermal shock, ablative materials, silicon carbide matrix composites, inorganic adhesives*

1. INTRODUCTION

The aim of the FP7 project HYDRA is the development of a hybrid thermal protection system to be used in extreme oxidative environments space applications that require high temperature resistance, such as hot parts of space vehicles for orbital entry (CTS/ARV), planetary probes and NEO exploration.

The project focuses on designing, integration and verification of a hybrid heat shield based on ablative and ceramic components.

The novelty of the solution consists in the integration of a low density ablative outer-shield on top of an advanced thermo-structural ceramic composite layer (Fig.1).

Section 5. Systems, Subsystems and Control in Aeronautics

Notes regarding the design of squeeze film dampers working within the limits of the classical Reynolds theory

Laurenţiu MORARU

Department of Aerospace Sciences, The "POLITEHNICA" University of Bucharest
Splaiul Independenţei 313, 060042, Bucharest, Romania
laurentiu.moraru@gmail.com

Abstract: *Squeeze film dampers (SFD) are used to control the shaft dynamics in rotating machinery; SFD are essentially thin oil films installed around the ball bearing housing (or even ball bearings outer races) to lower the stiffness and to provide damping for a better control of the lateral vibrations of the shaft. Significant efforts have been dedicated to SFSs, however, these dampers are still subject to open research. This paper will discuss some design aspects as well as modeling aspects of the SFD that operate within the limits of the classical Reynolds theory.*

Key Words: *Squeeze film dampers (SFD), hydrodynamic bearings, rotor dynamics*

1. INTRODUCTION

The dynamics of turbomachinery depends upon the behavior of the rotor, which in turns, is strongly influenced by the rotor's supports. The design the shaft supports for high speed turbines is a difficult task; the design of the shafts supports for aviation jet engines must also address additional requirements stemming from safety regulations that actually make ball bearings mandatory, so designers must use additional devices to tune the stiffness and damping of the shaft supports in order to obtain appropriate shaft dynamics.

Squeeze Film Dampers (SFD) are probably the main class of devices that can be used to tune the properties of shaft's supports when space and mass constraints are stringent. SFDs are essentially thin oil films installed around the ball bearing housing (or even ball bearings outer races) to lower the stiffness and to provide damping for a better control of the lateral vibrations of the shaft. SFDs are mainly used in aerospace turbines, although as ground –installed turbines can utilize much cheaper linear "piston" damper (and the shafts' weight is not a major concern). In theory, any fluid film installed around a device can provide damping, however, classical hydrodynamic journal bearings are prone to instability, so the spin motion in spin motion in squeeze film dampers is prevented by mechanical and/or hydrodynamic forces. Figure 1 shows a schematic of a SFD in which the spin is prevented by the seals and by a pin.

Squeeze Film Dampers have been studied for several decades, and, in spite of the fact that many researchers have been dedicated their efforts to understanding squeeze film lubrication, e.g. Refs 0, 0 designing SFDs is, still, partly an art, as many aspects related to modeling these devices are still subject to open research. As any oil film, SFDs can be affected by cavitation, which is strongly influenced by the oil supply/drain system and by the seals; some aspects regarding the design of the SFDs are briefly mentioned herein.

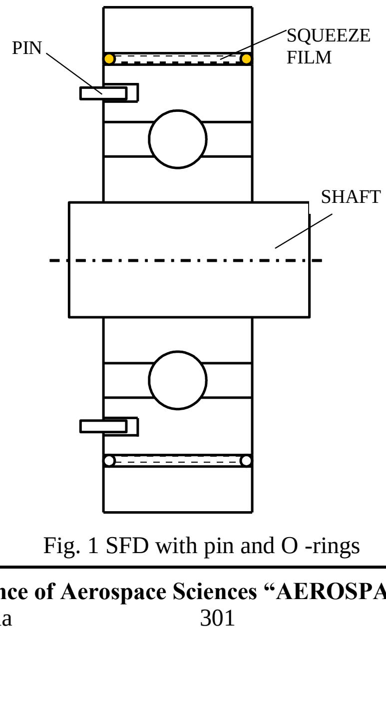


Fig. 1 SFD with pin and O -rings

Tuning Method of the Wavelet Function for Gyro Sensor Signals Denoising with Wavelet Transform

Ioana-Raluca EDU[1,*], Felix-Constantin ADOCHIEI[2], Radu OBREJA[2], Constantin ROTARU[1], Teodor Lucian GRIGORIE[2]

[1]Military Technical Academy, Faculty of Mechatronics and Armament Integrated Systems
B-dul George Coşbuc 39-49, Sector 5, Bucharest 050141, Romania
Corresponding author: edu_ioana_raluca@yahoo.com*
[2]University of Craiova, Faculty of Electrical Engineering, Department of Electric, Energetic and Aerospace Engineering, B-dul Decebal 107, Craiova 200440, Dolj, Romania
fadochiei@etti.tuiasi.ro, negreapetre@yahoo.com, ltgrigorie@yahoo.com

Abstract: *The current research aimed at developing new software procedures for processing data from gyro sensors in order to provide accurate navigation information. In the first phase of our project, our concern was to implement a real-time evaluation criterion with the intention of achieving real-time data from a gyro. In the second phase, we were interested to achieve a better estimation and compensation of the gyro sensors angular velocity measurements. These sensor errors occur due their miniaturization. The main goal of this study was to propose a signal-processing algorithm, based on the Wavelet filter, used along with a criterion for evaluating and updating the Wavelet's optimal level of decomposition, for reducing the noise. We performed numerical simulations using signals received from a gyro and analyzed the numerical results to see whether the proposed method could be used to achieve more precise information on a vehicle displacement.*

Key Words — *signal processing, decomposition level, wavelet transform.*

I. INTRODUCTION

Navigation applications were recently extended to aerial or terrestrial control traffic applications due their overall increasing performance levels in positioning accuracy. For example, advanced systems are implemented all over the world to avoid collisions at national and international level, allowing the onboard monitoring of neighboring vehicles' positions and speeds in real time [1]-[3].

Inertial navigation systems (*INS*) have played an increasingly larger role throughout the navigation's development period. Aerospace navigation specialists are continuously designing and implementing new architectures required by the current technological limitations of these type of systems and sensors.

The errors in inertial navigation systems are generally caused by the sensors' errors [4]-[6]. Gyro sensors' disturbances are reflected in the angular speed's measured values. The degree of miniaturization has a strong impact on the gyros sensors noise.

Our scientific research goal was to develop advanced algorithms, for processing data from inertial sensors, and to implement these algorithms in miniaturized inertial measurement units, in order to obtain accurate navigation data of monitored vehicles.

The practical challenge of the study was to develop and validate an advanced algorithm that would process the signals received from gyros, and later from *INS*, correct noise, and offer precise information regarding the vehicle displacement.

In order to obtain a better accuracy of the existing measurements an improved wavelet filter was proposed. The wavelet filter optimal order (the optimal decomposition level) was calculated using a correlation analysis function applied to the signals achieved from the gyros and to the gyro's real angular speed signals.

II. PROPOSED METHOD

In signal's analysis, the continuous Wavelet transform (*CWT*) can be considered as a tree decomposition of the signal, as illustrated in Fig. 1, a combination of a set of basic functions obtained by means of dilation and translation of a single prototype Wavelet function $\psi(t)$ [6].

The continuous Wavelet transform $(W_\psi f)(s,\tau)$, of the signal $f(t) \in L^2(R)$ can be determined as:

Towards Flexible-Winged Unmanned Aircraft Systems

Radu-Călin PAHONIE, Răzvan-Viorel MIHAI, Ciprian LARCO

Millitary Technical Academy, Department of Integrated Systems of Aviation and Mechanics
B-dul George Coşbuc 39-49, Sector 5, Bucharest 050141, Romania
razvan.viorel_mihai@yahoo.com, pahonier@yahoo.com, ciprian_larco@yahoo.com

Abstract: *To better understand the aerodynamic characteristics of flexible wings and grasp their potential applications in the field of small unmanned aircraft systems, one needs to solve the coupled fluid-solid dynamics problem in order to track the pressure distribution and the corresponding shape change of the lifting surfaces. In this paper, we use CFD simulations to underline the aerodynamic characteristics of a custom designed small aircraft wing. Moving towards the goal of computing and analyzing the dynamics of the coupled fluid and structure systems, the results are used to improve the overall design of the wing. Based on the CFD solution, a number of important conclusions regarding lift surface shape optimization have been drawn.*

BACKGROUND

Small unmanned aircraft systems (UASs) have become a focal spot in current times for military operations, offering to the active combat troops, as well as to interested decision makers, their vital ISR capabilities (intelligence, surveillance and reconnaissance). A UAS, also known as un unmanned aerial vehicle (UAV) or drone, is a reusable aircraft that typically uses onboard sensors to automatically control its flight. UASs come in many different shapes and sizes and have been used in a variety of military and civilian applications including but not limited to ISR, search and rescue and also atmospheric research.

The concept is for a small, inexpensive air platform that can be used and even disposed of, in missions were large aircrafts are not practical. The ever decreasing weight of the payload components used in such missions coupled with the attention these aircrafts are getting from the research community make the research and development of small unmanned aircrafts very dynamic [1]. If the sensors that equip these UAVs are evolving by leaps and bounds, the airframe structure and aerodynamic characteristics are progressing at a much slower pace. Therefore, this paper investigates a number of aspects and proposes some solutions to further the research and expand the field of coupled fluid-solid dynamics of airflow on a UAVs custom designed flexible wings.

It is well known that flying in the Reynolds number range between 100,000 and 500,000, flow separation around an airfoil can lead to sudden increases in drag and loss of efficiency.

By searching to develop practical flying wing UAVs, two approaches have been encountered so far. The first and most popular is the configuration of the airframe as a lifting body or flying wing using conventional wooden or composite structure, propeller driven thrust and winglets/wingtips. The second approach is using a rigid body, a push propeller and vertical stabilizers moved inboard to the wing roots. This last solution has shown an increase in yaw stability as well as has made the fins less prone to "rash" damage in the different take off and landing environment.

Because conventional approaches have used optimized rigid wings and accepted the need for stabilization systems or pilot skill compensation to deal with the unsteady behavior, this paper proposes the implementation of a flexible wing design to tackle this issue.

Many airfoils have been developed, with varied camber angles, thickness or other characteristics that give different aerodynamic properties. These characteristics allow an airplane to fulfill different tasks and have different flight regimes. For example, a sailplane needs high lift, low drag and pitching moment at low Reynolds number, but for an aerobatic model needs a symmetrical section with low c_m and the capacity to operate both upright and inverted is desirable together with a very high c_l.

Currently a different concept is in research: the possibility of creating a wing that could change itself and its properties in order to adapt itself to the demands needed. The concept of morphing (*Figure 1 Morphing Process of flexible wing control surface*) was inspired from birds.

Believe it or not but nature is far ahead of us in this field. A morphing wing is able to adapt itself the same way a bird's wing adapts when diving for prey or when in a cruising flight. Imagine an aircraft capable of twisting its wings when in need of roll or capable of modifying its wing area to modify the amount of lift needed in different situations (i.e. take off and landing).

Section 5.1
Workshop – "Structural health monitoring in spacecraft structures using piezoelectric wafer active sensors"

The use of Piezoelectric Wafer Active Sensor (PWAS) in Structural Health Monitoring (SHM) of Aerospace Structures

Victor GIURGIUTIU

University of South Carolina, Department of Mechanical Engineering
300 Main St. S., Columbia, SC 29208, USA, victorg@sc.edu

Abstract: *Piezoelectric wafer active sensors (PWAS) are lightweight and inexpensive enablers for a large class of structural health monitoring (SHM) applications. PWAS transducers couple with the guided Lamb waves into the monitored structure. This gives PWAS transducer extended range of detection because guided waves travel at large distance in thin wall structures such as the aircraft skins. PWAS transducers have several modes of operation: (a) embedded guided-wave ultrasonics, i.e., pitch-catch, pulse-echo, phased arrays, thickness mode; (b) high-frequency modal sensing, i.e., the electro-mechanical (E/M) impedance method; (c) passive detection, i.e., acoustic emission and impact detection. The PWAS modes of operation can be broadly classified into (i) propagating waves methods; (b) standing waves methods is given*

This paper starts with a brief review of PWAS physical principles and basic modeling method using the coupled-field equations of linear piezoelectricity. The principle of tuning between PWAS transducers and the guided waves in the structure is presented and discussed showing that certain combinations of PWAS size, excitation wavelength, and structural properties (material and thickness) can preferentially excite certain Lamb wave types while rejecting other wave types. The paper discusses several applications of the PWAS technology to aircraft structures. The PWAS phased array and the embedded ultrasonic structural radar (EUSR) is used to perform in-situ detection a growing crack during fatigue testing of an aluminum 2024-T3 panel. The detection of disbond in a helicopter rotor blade using PWAS disbond gages with the electromechanical (E/M) impedance method is presented. The paper ends with conclusions, and suggestions for further work

Key Words: *structural health monitoring, SHM, nondestructive evaluation, NDE, piezoelectric wafer active sensors, PWAS, phased arrays; pulse-echo, crack imaging, electromechanical (E/M) impedance method; disbond detection; rotor blades*

1. INTRODUCTION

Structural health monitoring (SHM) uses a set of permanently attached sensors to obtain on demand information about the structural performance and state of health 0. The benefits of monitoring the structural state include design feedback, performance enhancement, on-demand condition-based maintenance, and predictive fleet-level prognosis.

On-board structural sensing systems have been envisioned for determining the health of a structure by monitoring a set of sensors over time, assessing the remaining useful life from the recorded data and design information, and advising of the need for structural maintenance actions. Piezoelectric wafer active sensors (PWAS) have emerged as one of the major SHM technologies; the same sensor installation can be used with a variety of damage detection methods: propagating ultrasonic guided waves, standing waves (E/M impedance) and phased arrays.

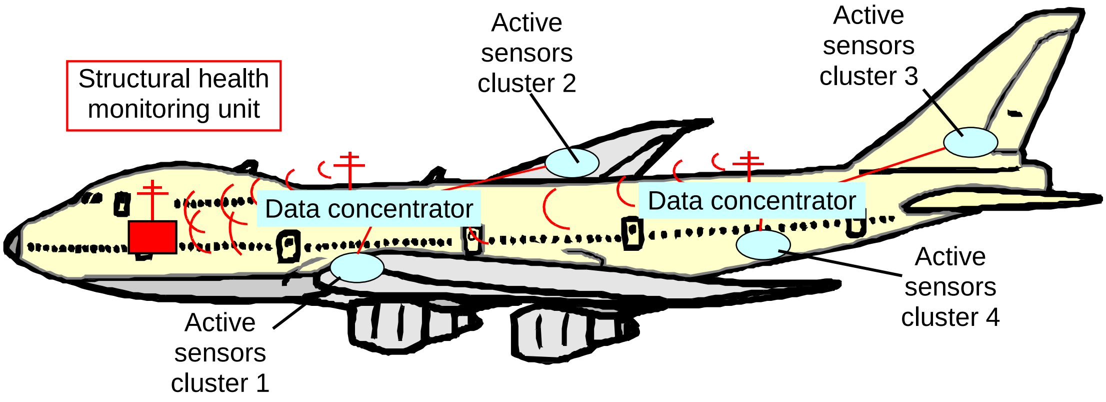


Figure 1. Schematic representation of a generic airliner SHM system consisting of active sensors, data concentrators, wireless communication, and SHM central unit

New Facility for Evaluation of the Space Radiation and Extreme Temperatures Effects on Electronic Devices

Cristian POSTOLACHE, Daniel NEGUT, Mihalis CUTRUBINIS, Gheorghe. MATEESCU, Viorel FUGARU

Horia Hulubei National Institute for Physics and Nuclear Engineering
30, Reactorului St., Magurele, Ilfov, Romania,
cristip@nipne.ro, dnegut@nipne.ro, mcutrubinis@nipne.ro, mateescu@yahoo.com, vfugaru@nipne.ro

Abstract: *The spacecraft, satellites and equipment's must perform current activities in a hostile environment. For short or long-term missions, the effect of cosmic environment must be evaluated. In this paper are analysed the main cosmic stressors and presented a new facility that simulates the effects of cosmic rays, extreme temperature and high vacuum pressure environment conditions on electronic devices. Cosmic ray was simulated using gamma ray 60-Co sources.*

Key Words: *Testing facilities, space environment, cosmic ray, electronic devices, piezoelectric wafer active sensor, gamma sources*

1. INTRODUCTION

NASA and ESA have developed ambitious programs in the last decade involving the long-term space missions to the moon, Mars, and beyond.

The new programs implied fundamental and applied researches in negative effect of space environment in materials and electronic devices.

The main stress agents are: cosmic rays, exposing at cryogenic or high temperature conditions, high vacuum pressure environment, high velocity cosmic dust, micrometeorites.

The challenge in simulation of space environment is to accomplish the high energetic and multi-component radiation fields with similar cosmic radiations characteristics.

Cosmic rays are not easy to reproduce using standard accelerators, because they produce particle flux with nearly monoenergetic distributions.

Cosmic ray can be simulated using new ELI-NP facility that has the capacity to generate radiation fields with similar characteristics with cosmic rays (high energy electron, proton, nucleus beams and gamma rays).

The aim of this research is to identify new experimental facilities and protocols on the effect of ionising radiation on materials with applications in space.

2. SPACE ENVIRONMENT

The space vehicles, satellites, equipments and astronauts must perform current activities in a hostile environment. The main stress agents are:

- Natural space radiation,
- Exposing at cryogenic or high temperature conditions,
- High vacuum pressure environment,
- High velocity cosmic dust and micrometeorites.

2.1 Space radiation environments

Cosmic ray (CR) discovered in 1912 by Victor Hess, are high energy particles generated by astrophysical phenomena [1]. The CR can be classified in two main classes:

(a) transient radiation and
(b) trapped radiation.

2.1.1 The transient radiation

The transient CR consists of Galactic Cosmic Ray (GCR) and Solar Cosmic Radiation (SCR).
GCR generated in Milky Way space and outside of the galaxy, contain manly hadrons components (about 85% protons, 12% helium nuclei, and less than 1% heavy ions with composition show in figure 1), almost

Finite element analysis of the electromechanical impedance method on aluminum plates in SHM

Cristian RUGINA[1], Victor GIURGIUTIU[2], Ioan URSU[3], Adrian TOADER[3]

[1]Institute of Solid Mechanics of the Romanian Academy
C-tin Mille str. Nr. 15, sector 1, Bucharest, 10141, Romania
rugina.cristian@gmail.com
[2]University of South Carolina, Department of Mechanical Engineering
300 Main St. S., Columbia, SC 29208, USA
vgiurgiutiu@gmail.com
[3]INCAS – National Institute for Aerospace Research "Elie Carafoli"
B-dul Iuliu Maniu 220, Bucharest 061126, Romania
ursu.ioan@incas.ro, toader.adrian@incas.ro

Abstract: *The paper describes the electro-mechanical (E/M) impedance method with piezoelectric wafer active sensors (PWAS) bonded to duraluminum plates. The method is mainly experimental, but for simple geometries like circular PWAS bonded to circular plates, an simplified 2D axisymmetric analytic model exist, without taking into account the adhesive layer, geometrical imperfections and structural flaws. It is briefly presented bellow. An detailed study, based on the 2D axisymmetric and 3D finite element method, that take into account the adhesive layer, structural flaws, in the form of arc-shapes fabricated laser cracks, is presented. The effect due to the presence of damages that modifies the E/M impedance spectrum, causing frequency shifts, peak splitting, and appearance of new harmonics, is highlighted both experimentally and confirmed numerically with the finite element method.*

Key Words: *electromechanical impedance method, structural health monitoring, piezoelectric wafer active sensor.*

1. INTRODUCTION

The active SHM sensing techniques are based on two different approaches: transient guided waves and standing waves.

In such SHM processes, a PWAS is required to generate elastic waves. These waves travel along the mechanical structure, are reflected by different structural abnormalities, i.e., cracks, corrosions, delaminations, and others, or from the boundary edges, and then are recaptured by the same sensor in a pulse-echo configuration or by other sensors of same or different type, even passive sensors, in pitch-catch, or pulse-echo configuration [1]; this is the so-called method of Lamb waves.

If the structural damage or boundary edges are in the close vicinity of the active sensor, their reflections overlap the incident transient wave, making impossible the interpretation.

This drawback can be overpassed by using the ultrasonic standing waves, in the so-called electromechanical impedance (E/M) method; by sweeping the frequency of the input signals to PWAS, some changes appear in the impedance measured by an impedance analyzer connected to the PWAS terminals. By monitoring the changes in the real part of the impedance function, which is most sensitive to structural changes, one can evaluate the integrity of the host structure [2].

In aerospace applications it become more and more used and studied [4], [5], due to the thin aluminum plate structure of the aerospace vehicles, where it can be combined with active control of the structures.

The method is not only sensitive to structural changes, but also to geometrical imperfections, quality and thickness of the adhesive layer, properties of the piezoceramic material.

The method is mainly experimental, but for simple geometries like circular PWAS bonded to circular plates, a simplified 2D axisymmetric analytic model exist.

So this geometry is taken as a study base in this paper.

A numerical study based on a 2D axisymmetric finite element method is done to compare the numerical results with experimental and analytic ones.

A 3D FEM analysis is also done in the case of plates with arc shape, with constant length, laser fabricated cracks.

Good results were obtained compared to the experimental measurements in those case.

Damage identification and damage metrics in SHM

Daniela ENCIU, Mihai TUDOSE, Bogdan NECULAESCU, Adrian TOADER, Ioan URSU

INCAS – National Institute for Aerospace Research "Elie Carafoli"
B-dul Iuliu Maniu 220, Bucharest 061126, Romania
enciu.daniela@incas.ro, tudose.mihai@incas.ro, bogdan.neculaescu@gmail.com,
toader.adrian@incas.ro, Corresponding author: ursu.ioan@incas.ro

Abstract: *The development of real-time structural health monitoring (SHM) techniques involves among others the design of an in-situ damage detection methodology and also the off-line study of the damage severity based on the evaluation of damage metrics such as root mean square deviation (RMSD) and cross-correlation coefficient (CC). The paper is based on a consistent family of experimental data obtained in the STAR project "Structural health monitoring in spacecraft structures using piezoelectric wafer active sensors (PWAS) and multimodal guided waves". In the experimental setup, the HP 4194A impedance analyzer was used. Specimens representing spacecraft structures were A2024 aluminum disks with PWAS standard PZT-5A material bonded on them. The simulated cracks were laser fabricated, in the shape of circular arcs centered on the symmetry center of the disks. The classical PZT based electro-mechanical impedance (EMI) method for SHM, with the PZT electro-mechanical admittance (inverse of the impedance) used as damage indicator, has been considered. The extreme temperature variations and radiations specific to space applications were applied to specimens. Their effect on PWAS transducers, and consequently on EMI, was so investigated. The paper also outlines a method for the in-situ identification of the damages based on neural network (NN) techniques.*

Key Words: *spacecraft structures, structural health monitoring, piezoelectric wafer active sensors, electromechanical impedance, pattern recognition/damage identification, off-line identification, damage metrics, statistical methods, root mean square deviation, online identification, neural networks.*

1. INTRODUCTION

One of the active *structural health monitoring* (SHM) [1], sensing techniques is based on standing waves, in the so-called electromechanical impedance (EMI) method [1]-[4]. By sweeping the frequency of the input signals to *piezoelectric wafer active sensors* (PWAS), some changes appear in the impedance measured by an impedance analyzer connected to the PWAS terminals. By monitoring the changes in the real part of the impedance function, which is most sensitive to structural changes [2], one can evaluate the integrity of the host structure.

Signal processing and pattern recognition are essential steps in SHM. Higher frequency modal analysis (tens of kHz and above) is achieved in PWAS SHM with EMI method that is thus sensitive to local changes in the structure and can detect incipient changes in the local region.

Physical support of the method consists in the fact that structural damage, such as crack in metal or delamination of layer composite structures, causes local changes of stiffness, damping and mass. The dimensions of such changes in structure are compatible with the wavelengths associated with these high frequencies.

The deviation between the pristine dynamic properties and the damaged dynamic properties is used to detect the damage and diagnose its location and extent.

The effect of damage on EMI spectra is observed by shifts taking place in existing resonances, new resonances and peaks split [1]; see Figs 1, 2, 5-13.

In the last decade of the 20th century and the first decade of 21st century the using of SHM systems in association with predictive maintenance and fault detection (FD) systems has shown a rapid development due to safety demands in all areas of activity, especially in aerospace applications, chemical industry, nuclear power plants, etc. To emphasize the dimension of this engineering challenge, it is worth noting the prevention of industrial accidents and the increasing cost of scheduled and unscheduled maintenance action for an aging infrastructure has risen to astronomical levels, e.g., up to 27 billion pounds every year in the British economy [5].

The development of real-time SHM techniques involves among others the design of an in-situ damage detection methodology and also the off-line study of the damage severity based on the evaluation of damage metrics such as root mean square deviation (RMSD).

Tunning of the Lamb waves in aluminum plates for Structure Health Monitoring

Tiberiu Adrian SALAORU, Minodor ARGHIR, Marina ANDREI

INCAS – National Institute for Aerospace Research "Elie Carafoli"
B-dul Iuliu Maniu 220, Bucharest 061126, Romania
salaoru.tiberiu@incas.ro, arghir.minodor@incas.ro, andrei.marina@incas.ro

Abstract: *The detection of the defects inside aerospace mechanical structures using the method of Lamb waves is important because of its major benefits: it may reveal the location and size of the defects with high accuracy, it is nondestructive and it is not requiring expensive equipment for application. An important way to apply this method consists in mechanically exciting using a piezoelectric actuator of a point of the aluminum plate and collecting the signal using a piezoelectric transducer from another point of the same plate surface. The presence of the defect, its size and position can be revealed by interpreting the shape, the phase and amplitude of the collected signal.*
The specimen used as mechanical structure is a rectangular aluminum plate. The frequency of the excitation signal has been determined in advance by tuning procedure. This consists in acquiring and processing the signals amplitude in 10-800 kHz frequency range for a pristine plate.

1. INTRODUCTION

An important method for monitoring the health of the structures (SHM) is using the guided waves. These waves have the advantage of low energy losses in the structures which conducts to an excellent transfer of the energy through the entire structure. The analysis of these waves in plates has been performed by Horace Lamb who published the results first time in 1917 [1]

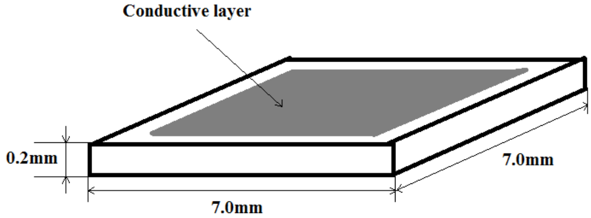
These waves presents two wave modes: symmetric (S0, S1, … Sn) which are propagating by changing the thickness of the plate and anti-symmetric (A0, A1, … An) by bending the plate[2]. The most usual modes used for SHM are the fundamental modes S0 which are dominating at 130-400 kHz and A0 at 20-130 kHz frequencies. These modes have the advantage of an easier identification of the oscillation groups than the other superior modes. The first step for testing a structure using Lamb waves is to find the optimum frequency for each fundamental propagation mode [3]. This is essential for defects revealing in the plates because is required the highest wave propagation energy due to the fact, the additional signal generated by defects are in general weak and difficult to sense. This procedure has been performed on pristine aluminum plate identical as the damaged one (same size, physical and mechanical properties), using two PWAS transducers (Piezoelectric Wafer Active Sensors), first acting as transmitter and the second as receiver.

The goal of this procedure is to establish two optimal frequencies for interrogation, one for the dominant symmetric basic mode and the other for the dominant anti-symmetric basic mode [4]. This is needed for distinguishing the two received basic propagation modes in the case of a defective plate.

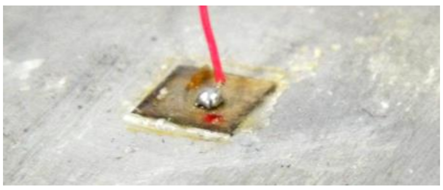
2. EXPERIMENT LAYOUT

2.1 Experimental system

The experiment has been performed using a rectangular, free of defects aluminum plate, A1 having 530 x 400 mm. On this plate have been attached four PWAS devices using high temperature resistant adhesive.
The PWAS devices used in this experiment are produced by STEMiNC company, having the part number SMPL7W7T02412. They have a square shape, having the size of 7x7x0.2mm (Figure 2.1 a and b).



(a) PWAS dimensions



(b) detailed view of the attached PWAS to the plate

Fig. 2.1 PWAS details

Section 6. Experimental Investigations in Aerospace Sciences

Comparative Analysis of Methods for Identification of the Natural Vibration Modes Applied to an Aeronautical Mechanical Structure

Lica FLORE[1], Albert ARNAU CUBILLO[2]

[1]STRAERO – Institute for Theoretical and Experimental Analysis of Aeronautical Structures
B-dul Iuliu Maniu 220, Bucharest 061126, Romania
licaflore@yahoo.com
[2]Universitat Politecnica de Catalunya – UPC BarcelonaTech

Abstract: *This paper comprises the experimental data obtained during the study of an aeronautical structure. The main objectives of this research have been to evaluate the efficiency and precision of different experimental techniques, to find an optimal way of excitation of the structure, to approach different signal processing methods and to evaluate and analyze the differences between the numerical and experimental results. The study of the mechanical structure has been performed through different experimental and computational techniques in order to validate the subsequent results. The study is separated in two different parts. In a first part the experimental conditions are detailed while the second part focuses in the analysis of the obtained results.*

1. INTRODUCTION

In order to determine the natural vibration modes of an aeronautical structure different experimental methods and mathematical tools are available. The results derived from these methods may present differences depending on the configuration of the experiments or the nature of the structure. Hence, it is interesting to analyze the source of such differences so the results obtained can be proved consistent.

This paper presents a study on the results obtained through different experimental techniques applied to an aeronautical structure, specifically the horizontal stabilizer of a medium helicopter (IAR-330H). This structure presents most of the common elements in any aeronautical structure. Because of this, the conclusions drawn from this analysis might be useful in other studies of the same nature.

The study consisted in the analysis of the results obtained through three different techniques in order to compare the influence of different experimental conditions and validate the results. These techniques are impulse and harmonic analyses and finite element modeling (FEM).

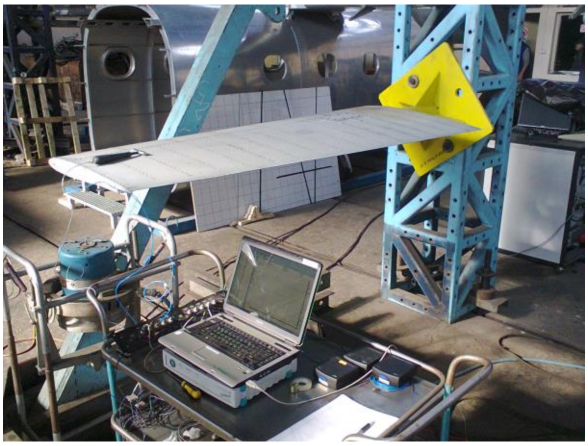


Figure 1. Mounting of the stabilizer in the test bench during impact hammer testing

Figure 2. Configuration during testing with electrodynamic shaker

2. DESCRIPTION OF THE EXPERIMENTS PERFORMED

Before presenting the results obtained it is important to highlight the conditions in which the experiments have been performed. The analyzed prototype has been studied while mounted in a test bench simulating the linkage when assembled in the helicopter. The support structure is shown in Fig. 1.

All the testing activities have been performed in the laboratory SC STRAERO SA from April 15th to June 10th, 2014.

A semiempirical method of computing the principal parameters needed for operating the air conditioning plant

Mihail Victor CERNAT*,[1], Andreea BOBONEA[1]

*Corresponding author
*,[1]INCAS - National Institute for Aerospace Research "Elie Carafoli"
B-dul Iuliu Maniu 220, Bucharest 061126, Romania
cernat.mihail@incas.ro*, bobonea.andreea@incas.ro

Abstract: *An important component of INCAS trisonic wind tunnel is the air conditioning plant, together with the water recycling station, the water-cooling tower and the air storage tanks. The compressor plant houses two Ingersoll Rand Centac C70 centrifugal compressors, their drive motors and the air drying beds. The compressor plant delivers 400 m^3/min of filtered, dry air at a maximum pressure of 20 bar and at about 20°C to the air storage tanks. The compressors are provided with constant mass flow and back pressure regulation. One of the principal parameters needed for operating the compressors plant is the time necessary to pump a tank from an initial pressure p_i to a final pressure p_f which corresponds to the wind tunnel run start pressure. In the compression process, a great deal of heat is added to the air thus recycled cooling water is used in order to maintain an optimal temperature level. The remaining moisture after cooling is removed from the air by passing it through one of two silica gel filled vessels. Finally, the air is filtered downstream of the dryers and delivered into the storage tanks with an absolute humidity of less than 0.2 grams of water per Kg of air.*

Key Words: *experimental investigations, semi empirical method, pump time, thermal regeneration*

1. INTRODUCTION

The present paper continues the theme of famous researches in the field of wind tunnel testing of the authors [1, 2], by detailing and adapting the semi empirical method of computing the principal parameters needed for operating the air preparation plant. Due to the fact that the air conditioning plant is a big energetic consumer, one of the principal parameters needed for operating the compressors plant is the time necessary to pump a tank from an initial pressure p_i to a final pressure p_f which corresponds to the wind tunnel run start pressure.

2. DESCRIPTION OF THE AIR CONDITIONING FACILITY

The Trisonic Wind Tunnel together with the air preparation plant is one of the most valuable assests of the National Institute for Aerospace Research - I.N.C.A.S. " Elie Carafoli", Bucharest, Romania. The high flow quality parameters and the wide range of testing capabilities ensure the competitivity of the tunnel at an international level. The 1.2 m x 1.2 m wind tunnel is an open circuit, blowdown type with a speed range from low subsonic (M=0.1) to a maximum Mach number of 3.5. This range includes transonic Mach Numbers which are obtained through use of a perforated wall transonic test section [3].

The air preparation facility is composed of the air conditioning plant, the water recycling station, the water-cooling tower and the air storage tanks, as can be seen in Fig. 1.

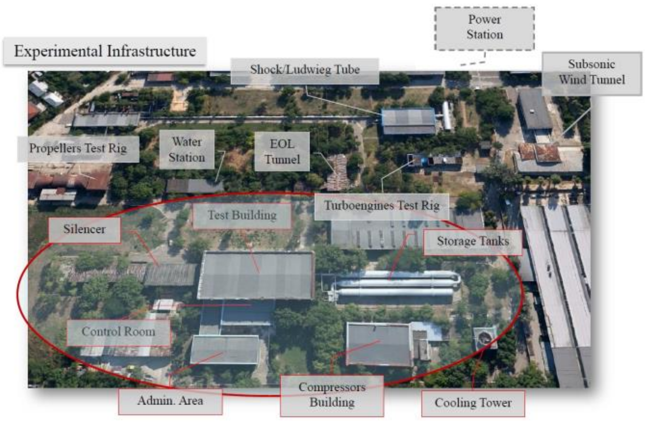


Fig. 1 - Air conditioning Plant [4]

Section 7. ATS and full Automation ATM

Airport Apron Management Optimization

Octavian Thor PLETER, Barna Istvan JAKAB

"POLITEHNICA" University of Bucharest, Faculty of Aerospace Engineering
Polizu Street 1-7, sector 1, Bucharest 011061, Romania,
octavianpleter@yahoo.com, uvexscott@yahoo.com

1. SUMMARY

The airport apron is the platform where the aircraft are parked, unloaded, loaded, and/or boarded. ICAO does not include the apron in the maneuvering area of the airport. Most research effort has been devoted to studying the flight and the ground movement of aircraft on the maneuvering area, leaving the apron management as a secondary subject, out of the core research effort. However, increasing demand of apron capacity from the General Aviation operators led to increased workload for apron managers, the demand for apron usage optimization and the necessity to address the apron safety issue, due to a growing number of incidents and accidents occurring on this platform.

This paper is a result of two years of work to develop an original automated tool for apron management optimizer for a high profile aviation company providing Fixed Based Operations on airports worldwide (Signature Flight Support / BBA). The idea of the tool (APO or Airport Parking Optimizer) is to test and plan new apron configurations in order to maximize their efficiency, capacity and safety. Furthermore, it can act as a real time decision tool by allocating a parking position for an incoming aircraft and also showing its ground movement route with respect to other aircraft based on the traffic predictions and reservations. This way it takes the stress and the high responsibility from humans, letting them focus more on their job, and providing a steady flow of aircraft combined with a lower workload. Finally, it will be also a safety net by monitoring the movements of the aircraft on the apron and generating a short term conflict alert whenever necessary to prevent a collision.

The optimization criteria (TCR or Total Costs and Risks) are the cost of aircraft towing (maneuver cost) to and from its assigned parking position, and the risk of collision with other aircraft or obstacles on ground. Sometimes, the access of an aircraft to/from its assigned parking position requires temporarily towing other aircraft to make room for the movement. This is more frequent as the apron approaches its full parking capacity. The maneuver cost is proportional to the length of the tow movement. The risk is an integral of a hazard function, which depends on the instantaneous minimum distance between the extremities of the moving aircraft and the closest environmental objects (ground obstacles, extremities of other parked aircraft). The optimizer uses a kinematic model of aircraft motion on ground, and a database for various types of aircraft. The TCR is expressed in monetary units and represents real costs and artificial penalty costs. The risk is represented as the cost of a collision between two aircraft multiplied by its probability to happen, the larger the distance the lower the probability is. The maneuver cost is mainly based on employee salary and tug fuel consumption.

The APO improves the safety, efficiency and capacity of an apron on three levels: strategic, pre-tactic and tactic. On the strategic level it has the planning function, helping the user to analyze different layouts. It runs random scenarios on these user defined layouts and calculates average TCRs for them. Based on the TCR users can define which configuration is better. Later the best three layouts could be saved as blue, green and red ones. These three configurations may be marked on the surface of the apron using paint in the corresponding colors. On pre-tactic level, which could happen one day before or in the morning, the exact layout is chosen (green, red or blue) according to the reservations and traffic predictions. On tactic level a parking position is allocated for each incoming aircraft after an optimization which runs hundreds of simulations with random parking position allocations.

2. INTRODUCTION

The apron is known as the most dangerous place of an airport. This is due to the mix of vehicles, people and aircraft which are simultaneously on the same place. This mix, even in this modern word can cause death, serious injuries or hundreds of thousands of dollars damage cost when aircraft collide. The situation is even worse when bad weather condition (rain, snow, hail) meets strict time constraints and different priorities.

Air Traffic Complexity Using AHP – Case Study for LOMOS and NERDI sectors

Alin George DIACONU[1], Octavian Thor PLETER[2], Corneliu BERBENTE[3]

"POLITEHNICA" University of Bucharest, Faculty of Aerospace Engineering
Spl. Independentei 313, 060042, Bucharest, Romania,
alin07_a@yahoo.com

Abstract: *Knowing the air traffic complexity specific for a certain airspace and a certain timeframe can bring benefits for all stakeholders involved in the ATM field (especially for ATS providers and aircraft operators) through an optimized roster for ATCO's, a higher level of safety for the air traffic services and an indirect reduction of fuel consumption. Within this paper the authors present a case study for the busiest two sectors from ACC Bucuresti, LOMOS sector and NERDI sector, which is used to validate using the ATCO SIM simulator a linear air traffic complexity function. The function is composed of a family of factors established through a decision making process undertaken by ATCO's and experts in ATM domain. Each factor and family of factors is weighted using an original approach of the authors presented as well in other papers and based on AHP.*

ACRONYMS

ACC	= Area Control Centre
ACS	= Area Control Surveillance
AHP	= Analytic Hierarchy Process
AIP	= Aeronautical Information Publication
ANSP	= Air Navigation Service Provider
AoR	= Area of Responsibility
APP	= Approach ATC Service
APS	= Approach Control Surveillance
ATC	= Air Traffic Control
ATCO	= Air Traffic Controller
ATM	= Air Traffic Management
ATS	= Air Traffic Services
CAA	= Civil Aviation Authority
COP	= Coordination Point
FIR	= Flight Information Region
ICAO	= International Civil Aviation Organisation
IFR	= Instrument Flight Rules
LoA	= Letter of Agreement
NDB	= Non-Directional Beacon
NM	= Nautical Mile
RAF	= Romanian Air Force
RNAV	= Area Navigation
TMA	= Terminal Manoeuvring Area
VOR/DME	= Very High Frequency Omnidirectional Range / Distance Measuring Equipment

1. INTRODUCTION

It is already a common practice for a complexity study specific for air traffic control to be directly linked with the concept of workload. It was determined that one of the main factors contributing to the variations of workload in ATC is the air traffic complexity. Knowing well in advance the figures of complexity for certain airspace and a certain timeframe can bring benefits for all stakeholders involved in the ATM field (especially

[1]PhD Student in Aerospace Engineering at UPB-FIA
[2] PhD in Aerospace Engineering and Economic Sciences, Professor at UPB-FIA
[3] PhD in Aerospace Engineering, Professor at UPB-FIA

Section 8. Management in Aerospace Activities

Crisis management in aerospace- a new interdisciplinary field of study

Virgil Aurelian BALUTA

Spiru Haret University
Bucharest, 13 Ion Ghica Str., District 3, Bucharest 030045, Romania
aurelian.baluta@yahoo.com

Abstract: *Airline crisis of last years in Romania showed an outline of a new field of study. The crisis management in aerospace is a new interdisciplinary field of study that will develop rapidly in the coming years. The paper presents some elements of crisis management in aerospace. I included section or paragraph for the position of the following branches in crisis management: management of organizations, flight management, management of each aerospace activity, project management, military management, public and administrative management. The paper refers how is connected crisis management in aerospace to older field of management. I want to demonstrate that the specific elements taken from different managerial branches generate a new branch, special connected to crisis in aerospace. As a managerial activity is presented in the horizontal plane the correlation with accounting, planning, statistics and collect of resources for crisis in aerospace. Like every managerial activity are presented the rules for informational system for crisis in aerospace.*

Key Words: *crisis, management, aerospace, project management.*

1. INTRODUCTION

Crisis in management and management of crises are two different things. The new events in aerospace show that is necessary to develop the approach of crisis management in aerospace as a new branch of science. The development of management may help the aerospace field. In this paper I want to present the impact of some fields of management in solve problems for aerospace crisis and develop crisis management in aerospace as a new branch.

In literature the problems of aerospace accidents are included in the general field of "emergency situations". The paper are focus in direction of solve the problems that appear after disaster, including an aerospace accident and to prevent them. I want to suggest to use the ultimate resources of management and to organize better and better the aerospace activity in accordance with new level of science in management. Even the aerospace management is in the top of the science, it can receive from other branch of management and to keep the best quality of the protection of human live. New successful methods from management may be adapted for aerospace needs. The balanced scorecard (BCS), as an example, is already implemented in air forces of many countries. This method is seen as one tool for strategic management for every kind of activity, including for airspace. BCS method is in the same time part of the global consumer-oriented strategy of every kind of company, including for airspace (Ivancik R, Necas P, 2012).

2. GENERAL MANAGEMENT AND ECONOMIC THINKING

The real objective of economic science and of the management as part of economic science is human in action (Brailleanu T, 2005), not the material value. The progress oh human civilization depending on quantity and quality of work.

These work is done in organization and in full contact with clients. More that in other branch, the life of clients is in the hands of the airplane company.

The crisis management must in the line with the new managerial model, at least with a couple of them: managers must be free to coordinate, to act and to ensure problem solving; explicit implementation of performance criteria and measurement; enhanced discipline and control in resource utilization, first of all in planning activities; (Cioclea, 2011).

As a rule, a part of air accidents may be prevent by measures and tools. For such as events the companies and public authorities have to draw up programs and strategies. New papers in general management show that is possible a strategy in turbulent times and design some principle.

Changing mental processing of information and continue to improve the last best strategy are only two such of principle.

The Romanian laws for crisis in aerospace and the general rules of project management

Virgil Aurelian BALUTA[1], Maria ANDRONIE[1], Ioan MUNTEANU[2]

[1]Spiru Haret University
Bucharest, 13 Ion Ghica Str., District 3, Bucharest 030045, Romania
aurelian.baluta@yahoo.com, andronie_maria@spiruharet.ro
[2]MNA ProdCom IMPEX SRL
Str. Constantin Rădulescu Motru nr. 16, Bucharest 40365, Romania
munteanu0403@yahoo.com

Abstract: *For aerospace crisis there are special laws in Romania. In the same time to prevent, to collect resources, to forecast the actions and to protect human beings, in case of aerospace crisis are in force general and special laws. The crisis in aerospace has a power impact for public. The paper presents how the laws in force now in Romania connected to crisis in aerospace are in accordance with different rules of project management and why is compulsory such correlation. Some elements of crisis in aerospace are attentively followed by mass-media institutions. Starting these, we explain how the result of actions in case of crisis in aerospace are depending in the same time on respect of laws and the respect of the project management rules. We have some proposals to change the laws in force now in Romania, to put them in accordance with general rules of project management. Crisis management on civil aviation safety is also based on international conventions to which Romania joined.*

Key Words: *Project management, Aerospace crisis, Requirements for the law.*

1. INTRODUCTION

Every new crisis or emergency situation, including in aerospace, put in attention of public several problems. One of them is the law that regulate the emergency situation. For the public is important if the law help to focus resources (human, materials, utilities, equipment) to repair the emergency, to prevent for the future such events, to prepare for new challenges. In modern economic speech we can say that is important to have laws in accordance with the project management. The air transport as branch, and every flight for an airline company, is a project. To eliminate crisis in aerospace means in economic terms to do these projects very well.

Project management developed very much in the last years. We have experience in a couple kind of project management. In this paper we intend to compare some rules of project management with the laws in force for crisis in aerospace.

We refer in these paper on the Romanian law. This means the EU laws and regulations, international agreements approved by Romanian authorities, Romanian laws, Government Ordinances, Government Emergency Ordinances, Government Decisions, Orders.

2. AEROSPACE CRISIS AND PROJECT MANAGEMENT

2.1 Science of management and project management in aerospace crisis

Fayol said that management means "evaluating of the future and starting measures that it need". (Pugh D. S, Hickson D. J, 1989).

In accordance with this, the measures in case of aerospace crisis are inseparable part of management the aerospace companies and the public authorities.

The general problem of the cost and project management has a special dimension in prevention of aerospace crisis. In companies dedicated on cost strategies is accepted by management science that the reduce of cost is project by mixt team "cost-quality" (Diaconu L, 2009). So, the objective to reduce the cost is linked to change in post-selling services or other special benefits of the clients, not from the quality and security of the air transport.

To be competitive, every kind of company need ideas. In managerial science on speak about "bank of ideas" that increase the "managerial entropy" (Ionescu S, 2011).

Single European Sky – benefits and costs for aviation industry

Natalia HARTMAN

National Defence University of Warsaw
00-910 Warszawa, al. Gen. A. Chruściela 103, Poland
natalka.hartman@gmail.com

Abstract: *Each year the demand of aviation services is increasing but European airspace is still fragmented according to national borders. Delays of implementation Single European Sky is increasingly high. Consequently aviation industry each year loses a lot of money, owing to inter alia delays, elongation route of flight or higher fuel consumption. Comparison of Air Traffic Management-Related Operational Performance U.S./Europe shows how inefficient is ATM in Europe and how costly it is for airspace users. This study describes also with what kind of costs and benefits are related to the full implementation of the SES.*

Key Words: *Single European Sky, implementation, benefits, costs, comparison EU/USA, aviation industry, air traffic management system*

1. INTRODUCTION

Air transport is considered to be the most modern and most dynamically developing branch of transport, therefore plays a significant role in the economy and society of the European Union. We can observe permanent growth in interest in this type of transport, faster and safer aircraft wins the competition with other modes of transport.

Aviation market analysts estimate that the average global growth will amount to 3.2%, which is working to generate growth carriage of passengers at around 5% (4.7% Airbus, Boeing, 5%). Increase in air transport about few percent per annum, on a decade scale, will result in close to three times the increase in air traffic. In Europe, air traffic management system is fragmented and dominated by national entities having a monopoly on the provision of services in the aviation industry.

Improper operation of the air traffic management system and the lack of system solutions contributing to the increase financial outlays for the air transport sector. Quest for reduce unnecessary costs was one of the direct causes of adoption of the single European sky. The implementation of a new, coherent legislation had tasked to facilitate for create a common aviation policy and also for create the conditions for the smooth and sustainable development of the air transport sector.

Nevertheless, Single European Sky program turned out to be one of the most ambitious plans for the European Union in the field of transport, maybe even too ambitious. There is discussion among the representatives of the aviation industry if the implementation of the SES is still possible, needed and profitable. Athar Husai Khan, acting Secretary General of Association of European Airlines (AEA), believes that, for the moment at least, there is more hope than expectation that the Single European Sky will deliver on its performance targets.

The European Commission has long acknowledged problems with the pace of its Single Sky initiative, especially in consolidating traffic management. There are many opinions of representatives of the aviation industry that, despite the problems, the Single European Sky have to be implemented. Lufthansa CEO Christoph Franz said: We welcome the Commission's efforts to push through the Single European Sky, but we are furious that the largest EU Member States are simply not delivering. Simultaneously point out that This fragmentation is ridiculous and unacceptable.

The Commission must stand firm, rejecting every national performance plan that falls short of the EU-wide target. We will give them our full support in this initiative.

2. HISTORY - GENERAL INFORMATION

The Single European Sky (SES) is an European Commission initiative designed to remove boundaries in the air. The SES main goal is to reform the architecture of European air traffic control to meet future capacity and safety needs.

This will be achieved by improving the overall performance of Air Traffic Management (ATM) and Air Navigation Service (ANS) in Europe, with the aim to:

Aeromobile forces in abroad missions

Kaja WYMYSŁOWSKA

National Defence University of Warsaw
00-910 Warszawa, al. Gen. A. Chruściela 103, Poland
kajawymyslowska@gmail.com

Abstract: *In this article it will be shown the role of Aeromobile forces during the abroad mission. Firstly it will be explained how to understand concept "Aeromobile forces". After that it will be shown short classification of abroad mission. In main part I will introduce the utilization polish air forces especially using of helicopters Mi-17 and Mi-24 through the example from three different missions in Ethiopia, Chad and Afghanistan by showing their main tasks. Analysis included in this article should help with estimating capability of old types of helicopters. This chapter will raise an issue concern methods for dealing with resistance. Last part will involve some costs explanation connected to helicopter operating costs. The conclusions contain all lessons learned from all of missions mentioned in the article and some prospective, possible solutions.*

Key Words: *Aeromobile forces, helicopters, cooperation, abroad mission, costs, experience.*

1. INTRODUCTION

Over the years, the Polish army took part in many foreign missions. They were both humanitarian or peacekeeping - but not only. Each foreign mission poses new tasks for Polish army. Circumstances, the current situation, the type of mission and the nature of the tasks posed in front of PMC (Polish Military Contingent) had a result as a constant changes in the army. These are the changes in the training, upgrading/new equipment implementation or other changes in the way of command. Missions abroad which was realized by Polish military allow soldiers to get new experience which in the future may be used for training others.

Examples of using Aeromobile forces in missions in Ethiopia, Chad and Afghanistan shows the potential of this type of forces. A wide variety of tasks performed by Aeromobile forces during these three missions, reflects the high level of soldiers training, the ability to cooperate with other types of troops, flexibility and the possibility of versatility use in abroad missions. This subject also raises very important issues regarding the modernization of the Polish army and accurately polish helicopters. Is the equipment, despite numerous advantages, potentials but also after many years serve in the army, should be replaced by other, more modern helicopters?

The advent of helicopters in their mature form technically awakened great expectations about the possibility of the use of this vehicle for air transport tasks and in situations when the plane appeared to be helpless. Helicopters brought to the aviation new, extremely important technique of usage. Properties of maneuverability of this universal air machine procure that today we can meet helicopters everywhere.

2 AEROMOBILE FORCES - GENERAL CHARACTERISTICS

Aeromobile forces it is type of forces included in Land forces. The basic tasks include support to onshore and offshore operations, subjugation of important enemy objects. These forces have the greatest tactical and operational maneuverability. That kind of forces can operate in conjunction with other ground forces or independently. The use of such forces allows commanders to quick response across the entire width and depth of their area of responsibility.
Aeromobile forces includes tactical units, divisions, subdivisions:

- Air cavalry
- Landing and assault
- Paratrooper
- Land forces aviation

Aeromobile units in Polish army:

- 25 Air Cavalry Brigade
- 6 Brigade Airborne Assault

This kind of army is prepared to conduct diversionary activities, offensive and defensive.

Aeronautical Decision-Making – A review of decision-making models for beginners and experienced pilots

Alexandru GHEORGHIU[1], Mircea BOSCOIANU[2]

[1]Transilvania University of Brasov
B-ul Eroilor 29, Brasov 500036, Romania
alexandru.gheorghiu@unitbv.ro
[2]Romanian Air Force Academy
Str. Mihai Viteazul 160, Brasov 500187, Romania
boscoianu.mircea@yahoo.com

Abstract: *Even in the most "insignificant" part of a flight, poor decision making and judgment may endanger the flight safety and cause a catastrophe. The main purpose of this article is to describe and to reveal the importance of decision making under uncertainty or in critical situations in the aeronautical environment. Some decision-making models are presented with their pros and cons. These models can be used by both beginners and experienced pilots in their training programs on the ground or in the air. OODA loop model of Col. John Boyd, PPP model proposed by Federal Aviation Administration, and Naturalistic-Decision Making strategy of Gary Klein are one of the models presented below.*

Key Words: *Aeronautical Decision-Making, OODA, PPP, NDM*

Quote: "A superior pilot uses his superior judgment to avoid situations that would require the use of his superior skills"

1. INTRODUCTION

Making decision refers to a mental process that we all use to determine a particular course of action to solve a problem. When it is used by pilots in their flying activities, this process is known as Aeronautical Decision Making (ADM). In Advisory Circular 60-22, the Federal Aviation Administration defines ADM as "a systematic approach to the mental process used by aircraft pilots to consistently determine the best course of action in response to a given set of circumstances"[2].

The literature associated with the ADM is quite wide, mostly categorized in two concepts. One as classical decision-making (CDM), presented by numerous researchers (Hammond, McClelland & Mumpower, 1980; Cannon-Bowers, Salas & Pruitt1996) as a linear series of steps such as: detection of an event, developing courses of action, comparing the advantages and disadvantages of each course of action, choosing a particular course and evaluating the degree to which the selected course resolved the problem [6].

The other concept is based on the intuitive competencies rather than analytical ones. This process is known as naturalistic decision-making (NDM), and studies how people take decision and react in a natural environment. According to Gary Klein, this domain include: wrong defined goals and wrong structured tasks, uncertainty, ambiguity, and missing data, shifting and competing goals, dynamic and continually changing conditions, time stress, high stakes, multiple players, organizational goals and norms, and the most important element - experienced users [9].

2. ADM MODELS

Commonly used models both in general and military aviation are: SHOR (Wohl 1981) – Stimuli, Hypotheses, Options, Response; PASS (Maher 1989) – Problem identification, Acquire information, Survey strategy, Select strategy; FORDEC (Hormann 1995) – Facts, Options, Risks and benefits, Decision, Execution, Check; SOAR (Oldaker 1996) – Situation, Options Act, Repeat; DESIDE (Murray 1997) Detect, Estimate, Set safety objectives, Identify, Do, Evaluate; OODA loop (Boyd 1961) – Observe, Orient, Decide, Act; PPP (Federal Aviation Authority) – Perceive, Process, Perform.

Some of them are briefly described below:

OODA loop

The O.O.D.A. Loop, which stands for Observe, Orient, Decide and Act, is a decision-making process proposed by Col. John Boyd, a former USAF fighter pilot and military strategist that fought in Korea, which

Eject! Eject! Eject! A critical decision for fighter pilots

Alexandru GHEORGHIU[1], Mircea BOSCOIANU[2]

[1]Transilvania University of Brasov
B-ul Eroilor 29, Brasov 500036, Romania
alexandru.gheorghiu@unitbv.ro
[2]Romanian Air Force Academy
Str. Mihai Viteazul 160, Brasov 500187, Romania
boscoianu.mircea@yahoo.com

Abstract: *Since the beginning of fighter planes, the need for saving the pilot in case of emergency had a primary role in development of aircraft survivability. Even if he deals with a parachute in his back or he has the most sophisticated and automatically operated ejection seat in his aircraft, the main authority for ejection and leaving the aircraft remains to the pilot. The implications of ejection on mental and physical health of fighter pilots are discussed and an analysis of decision to eject from single or two seat aircraft was made.*

Key Words: *decision, ejection seat, fighter pilot*

1. INTRODUCTION

Since the beginning of fighter planes, the need for saving the pilot in case of emergency had a primary role in development of aircraft survivability.

Even if he deals with a parachute in his back or he has the most sophisticated and automatically operated ejection seat in his aircraft, the main authority for ejection and leaving the aircraft remains to the pilot.

The greatest disaster that could occur during an air mission is not the destruction of an aircraft, the real catastrophe is the loss of a pilot. For this reason, along with the development of aeronautical technology, progress has been made in the field of escape systems. (FOWLIE, RAF, 1985)

2. CONSEQUENCES ON PILOT'S PHYSICAL AND MENTAL HEALTH

The biggest impact that ejection has on the pilot are the physical and physiological consequences. The most common of these consequences are those that affect the spine (compression fractures), or injuries to limbs due to incorrect position in ejection or landing.

A study made by Moreno Vázquez for Spanish Air Force including 48 ejections from 1979-1995, revealed that of 48 pilots who ejected, 7 died, 25 had severe injuries, 11 had minor injuries and 5 had no injuries. This study conclude that the pilot position in the ejection seat, plane control, ejection inside the

List of Authors

A

Felix-Constantin ADOCHIEI	–	University of Craiova, Faculty of Electrical Engineering, Department of Electric, Energetic and Aerospace Engineering, B-dul Decebal 107, Craiova 200440, Dolj, Romania, fadochiei@etti.tuiasi.ro
Andreea-Irina AFLOARE	–	STRAERO – Institute for Theoretical and Experimental Analysis of Aeronautical Structures. B-dul Iuliu Maniu 220, Bucharest 061126, Romania, andreea_ai18@yahoo.com
Irina Carmen ANDREI	–	INCAS − National Institute for Aerospace Research "Elie Carafoli", Flow Physics Department, Numerical Simulation Unit, B-dul Iuliu Maniu 220, Bucharest 061126, Romania andrei.irina@incas.ro
Marina ANDREI	–	INCAS − National Institute for Aerospace Research "Elie Carafoli", B-dul Iuliu Maniu 220, Bucharest 061126, Romania, andrei.marina@incas.ro
Ecaterina ANDRONESCU	–	"POLITEHNICA" University of Bucharest, Faculty of Applied Chemistry and Materials Science, 1-7 Polizu St, 011061, Bucharest, Romania, ecaterina.andronescu@upb.ro
Maria ANDRONIE	–	Spiru Haret University, Bucharest, 13 Ion Ghica Str., District 3, Bucharest, Zip code: 030045, Romania, andronie_maria@spiruharet.ro
Nicolae APOSTOLESCU	–	AEROSPACE Consulting, B-dul Iuliu Maniu 220, Bucharest 061126, Romania, apostolescu.nicolae@incas.ro
Minodor ARGHIR	–	INCAS − National Institute for Aerospace Research "Elie Carafoli", B-dul Iuliu Maniu 220, Bucharest 061126, Romania, arghir.minodor@incas.ro
Sorin ARSENE	–	"POLITEHNICA" University of Bucharest, Faculty of Transports, Department of Railway rolling stock, Splaiul Independenţei 313, 060042, Bucharest, Romania, sorinarsene@gmail.com

B

Stefan BALINT	–	West University of Timișoara, Bd. V. Pîrvan, nr. 4, 300223, Timisoara, Romania, balint@balint.uvt.ro
Virgil Aurelian BĂLUŢĂ	–	Spiru Haret University, Bucharest, 13 Ion Ghica Str., District 3, Bucharest, Zip code: 030045, Romania, aurelian.baluta@yahoo.com
Florin BALTARETU	–	Technical University of Civil 2Engineering, Faculty of Building Services, B-dul Pache Protopopescu 66, Sector 2, Bucharest 021414, Romania, flbaltaretu@yahoo.com
Cristina Elisabeta BAN	–	INCAS − National Institute for Aerospace Research "Elie Carafoli", Materials Unit, B-dul Iuliu Maniu 220, Bucharest 061126, Romania; "POLITEHNICA" University of Bucharest, Faculty of Applied Chemistry and Materials Science, 1-7 Polizu St, 011061, Bucharest, Romania, ban.cristina@incas.ro
Daniela BARAN	–	INCAS − National Institute for Aerospace Research "Elie Carafoli" B-dul Iuliu Maniu 220, Bucharest 061126, Romania, baran.daniela@incas.ro
Jorge BARCENA	–	TECNALIA – Transport Unit, San Sebastián, Spain, Mikeletegi Pasealekua 2, E-20009 Donostia – San Sebastián, Gipuzkoa (Spain), jorge.barcena@tecnalia.com
Corneliu BERBENTE	–	"POLITEHNICA" University of Bucharest, Faculty of Aerospace Engineering, 1-7 Polizu St, 011061, Bucharest, Romania, berbente@yahoo.com
Radu BISCA	–	INCAS − National Institute for Aerospace Research "Elie Carafoli", B-dul Iuliu Maniu 220, Bucharest 061126, Romania, bisca.radu@incas.ro

Andreea BOBONEA – INCAS − National Institute for Aerospace Research "Elie Carafoli", B-dul Iuliu Maniu 220, Bucharest 061126, Romania, bobonea.andreea@incas.ro

Mircea BOSCOIANU – Romanian Air Force Academy, Str. Mihai Viteazul 160, Brasov 500187, Romania, boscoianu.mircea@yahoo.com

Jean-Marc BOUILLY – AIRBUS D&S, 6, rue Laurent Pichat, 70516 Paris Cedex 16, France, Jean-Marc.Bouilly@astrium.eads.net

Dan BRASOVEANU – RAYTHEON, Arizona, USA, brasovdx@yahoo.com

Thomas A. BRENNER – Department of Aerospace Engineering, Texas A&M University, College Station, Texas 77843-3141

Valentin Adrian Jean BUTOESCU – INCAS − National Institute for Aerospace Research "Elie Carafoli", Flow Physics Department, B-dul Iuliu Maniu 220, Bucharest 061126, Romania, butoescu.valentin@incas.ro

C

Forrest L. CARPENTER – Department of Aerospace Engineering, Texas A&M University, College Station, Texas 77843-3141

Mihail Victor CERNAT – INCAS − National Institute for Aerospace Research "Elie Carafoli", B-dul Iuliu Maniu 220, Bucharest 061126, Romania, cernat.mihail@incas.ro

Paul CIZMAS – Texas A&M University, Dept. of Aerospace Engineering, College Station 77843-3141, USA, cizmas@tamu.edu

Cristian Emil CONSTANTINESCU – "POLITEHNICA" University of Bucharest, Faculty of Aerospace Engineering, Polizu Street 1-7, postal code 011061, sector 1, Bucharest, Romania, constantinescu_ce@yahoo.com

Dan Mihai CONSTANTINESCU – "POLITEHNICA" University of Bucharest, Splaiul Independenţei 313, 060042, Bucharest, Romania, dan.constantinescu@upb.ro

Marius Gabriel COJOCARU – INCAS − National Institute for Aerospace Research "Elie Carafoli", Flow Physics Department, Numerical Simulation Unit, B-dul Iuliu Maniu 220, Bucharest 061126, Romania, cojocaru.gabriel@incas.ro

Andrei CORBEANU – Excelency Centre for Young Olympics – National Institute for Research and Development in Electrical Engineering ICPE CA, Splaiul Unirii, Nr. 313, Sector 3, 030138, Bucharest, Romania, andicorbeanu@yahoo.com

Albert Arnau CUBILLO – Universitat Politecnica de Catalunya, Spain

Mihalis CUTRUBINIS – "Horia Hulubei" National Institute of Physics and Nuclear Engineering - IFIN HH, 30, Reactorului St., Magurele, Ilfov, Romania, mcutrubinis@nipne.ro

D

Alin George DIACONU – "POLITEHNICA" University of Bucharest, Faculty of Aerospace Engineering, Polizu Street 1-7, postal code 011061, sector 1, Bucharest, Romania, alin07_a@yahoo.com

Delia DIMITRIU – Centre for Aviation, Transport, and the Environment, The Manchester Metropolitan University, United Kingdom, d.dimitriu@mmu.ac.uk

Ion DINCA – AEROSPACE Consulting, B-dul Iuliu Maniu 220, Bucharest 061126, Romania, dinca.ion@incas.ro

Valeriu DRAGAN – COMOTI – Romanian Gas Turbine Research and Development Institute, 220 D Iuliu Maniu Avenue, 061126 Bucharest 6, P.O. 76, P.O.B. 174, Romania, drvaleriu@gmail.com

Claudia DOBRE – INCAS − National Institute for Aerospace Research "Elie Carafoli", B-dul Iuliu Maniu 220, Bucharest 061126, Romania, dobre.claudia@incas.ro

Dan N. DUMITRIU – Institute of Solid Mechanics of the Romanian Academy; C-tin Mille str. Nr. 15, sector 1, Bucharest, 10141, Romania, dumitri04@yahoo.com, dumitriu@imsar.bu.edu.ro

E

Ioana-Raluca EDU – Military Technical Academy, Faculty of Mechatronics and Armament Integrated Systems, B-dul George Coşbuc 39-49, Sector 5, Bucharest 050141, Romania, edu_ioana_raluca@yahoo.com

Daniela ENCIU – INCAS – National Institute for Aerospace Research "Elie Carafoli", B-dul Iuliu Maniu 220, Bucharest 061126, Romania, enciu.daniela@incas.ro

F

Anton FICAI – "POLITEHNICA" University of Bucharest, Faculty of Applied Chemistry and Materials Science, 1-7 Polizu St, 011061, Bucharest, Romania, anton.ficai@upb.ro

Wolfgang FISCHER – AIRBUS D&S, Airbus-Allee 1, 28 199 Bremen, Germany, Wolfgang.Fischer@astrium.eads.net

Lică FLORE – STRAERO – Institute for Theoretical and Experimental Analysis of Aeronautical Structures, B-dul Iuliu Maniu 220, Bucharest 061126, Romania, licaflore@yahoo.com

Luca FLORESCU – Excelency Centre for Young Olympics – National Institute for Research and Development in Electrical Engineering ICPE CA, Splaiul Unirii, Nr. 313, Sector 3, 030138, Bucharest, Romania, luca.florescu@gmail.com

Sonia FLOREZ – TECNALIA – Transport Unit, San Sebastián, Spain, Mikeletegi Pasealekua 2, E-20009 Donostia – San Sebastián, Gipuzkoa (Spain), sonia.florez@tecnalia.com

Raymond L. FONTENOT – Department of Aerospace Engineering, Texas A&M University, College Station, Texas 77843-3141

Alexandra Emilia FORTIS – West University of Timișoara, Bd. V. Pîrvan, nr. 4, 300223, Timisoara, Romania, afortis@gmail.com

Brian A. FRENO – Department of Aerospace Engineering, Texas A&M University, College Station, Texas 77843-3141

Florin FRUNZULICA – "POLITEHNICA" University of Bucharest, Faculty of Aerospace Engineering, "Elie Carafoli" Department of Aerospace Science, Polizu 1-6, RO-011061, Bucharest, Romania, ffrunzi@yahoo.com

Viorel FUGARU – "Horia Hulubei" National Institute of Physics and Nuclear Engineering - IFIN HH, 30, Reactorului St., Magurele, Ilfov, Romania, leroiv@hotmail.com

Ion FUIOREA – STRAERO – Institute for Theoretical and Experimental Analysis of Aeronautical Structures, B-dul Iuliu Maniu 220, Bucharest 061126, Romania, ifuiorea@straero.ro

G

Alexandru GHEORGHIU – Transilvania University of Brasov, B-ul Eroilor 29, Brasov 500036, Romania, alexandru.gheorghiu@unitbv.ro

Victor GIURGIUTIU – University of South Carolina, Department of Mechanical Engineering, SC 29208 Columbia, USA, vgiurgiutiu@gmail.com

Teodor Lucian GRIGORIE – University of Craiova, Faculty of Electrical Engineering, Department of Electric, Energetic and Aerospace Engineering, B-dul Decebal 107, Craiova 200440, Dolj, Romania, ltgrigorie@yahoo.com

H

Natalia HARTMAN – National Defence University of Warsaw, 00-910 Warszawa, al. Gen. A. Chruściela 103, Poland, natalka.hartman@gmail.com

I

Gheorghe IONESCU	–	AEROSPACE Consulting, B-dul Iuliu Maniu 220, Bucharest 061126, Romania, ionescu.gheorghe@incas.ro
Mircea IGNAT	–	National Institute for Research and Development in Electrical Engineering ICPE CA, Splaiul Unirii, Nr. 313, Sector 3, 030138, Bucharest, Romania, mircea.ignat@icpe-ca.ro
Achim IONITA	–	STRAERO – Institute for Theoretical and Experimental Analysis of Aeronautical Structures, B-dul Iuliu Maniu 220, Bucharest 061126, Romania, achim.ionita@straero.ro
Silviu IVAN	–	INCAS − National Institute for Aerospace Research "Elie Carafoli", Materials Unit, B-dul Iuliu Maniu 220, Bucharest 061126, Romania, ivan.silviu@incas.ro

J

Barna Istvan JAKAB	–	"POLITEHNICA" University of Bucharest, Faculty of Aerospace Engineering, Polizu Street 1-7, postal code 011061, sector 1, Bucharest, Romania, uvexscott@yahoo.com

L

Ciprian LARCO	–	Millitary Technical Academy, Department of Integrated Systems of Aviation and Mechanics, B-dul George Coşbuc 39-49, Sector 5, Bucharest 050141, Romania, ciprian_larco@yahoo.com
Dorin LOZICI-BRINZEI	–	INCAS − National Institute for Aerospace Research "Elie Carafoli", B-dul Iuliu Maniu 220, Bucharest 061126, Romania, lozici.dorin@incas.ro

M

Alexandru Catalin MACOVEI	–	"POLITEHNICA" University of Bucharest, Faculty of Aerospace Engineering, "Elie Carafoli" Department of Aerospace Science, Polizu 1-6, RO-011061, Bucharest, Romania, alexandru_macovei@yahoo.com
Victor MANOLIU	–	AEROSPACE Consulting, B-dul Iuliu Maniu 220, Bucharest 061126, Romania, manoliu.victor@incas.ro
Gheorghe MATEESCU	–	"Horia Hulubei" National Institute of Physics and Nuclear Engineering - IFIN HH, 30, Reactorului St., Magurele, Ilfov, Romania, mateescu@nipne.ro
Konstantina MERGIA	–	Institute of Nuclear & Radiological Sciences, Energy, Technology& Safety, National Centre for Scientific Research Demokritos, Agia Paraskevi Attikis, P.O.Box 60037, 153 10, Athens, Greece, kmergia@ipta.demokritos.gr
Razvan-Viorel MIHAI	–	Millitary Technical Academy, Department of Integrated Systems of Aviation and Mechanics, B-dul George Coşbuc 39-49, Sector 5, Bucharest 050141, Romania, razvan.viorel_mihai@yahoo.com
Mihai MIHAILA-ANDRES	–	Military Technical Academy, B-dul George Coşbuc 39-49, Sector 5, Bucharest 050141, Romania, mihailmi@rdslink.ro
Irina Oana MIU	–	INCAS − National Institute for Aerospace Research "Elie Carafoli" B-dul Iuliu Maniu 220, Bucharest 061126, Romania, miu.irina@incas.ro
Laurentiu MORARU	–	"POLITEHNICA" University of Bucharest, Faculty of Aerospace Engineering, Polizu Street 1-7, postal code 011061, sector 1, Bucharest, Romania, laurentiu.moraru@gmail.com
Ioan MUNTEANU	–	MNA ProdCom IMPEX SRL, Str. Constantin Rădulescu Motru nr. 16, Bucharest 40365, Romania, munteanu0403@yahoo.com
Florin MUNTEANU	–	AEROSPACE Consulting, B-dul Iuliu Maniu 220, Bucharest 061126, Romania, munteanu.florin@incas.ro

N

Adriana NASTASE	–	RWTH, Aachen University, Templergraben 55, 52062 Aachen, Germany, nastase@lafaero.rwth-aachen.de

Andrei Sorin NEAMTU – INCAS − National Institute for Aerospace Research "Elie Carafoli", B-dul Iuliu Maniu 220, Bucharest 061126, Romania, neamtu.mihai@incas.ro, neamtu@incas.ro

Mihai NEAMTU – INCAS − National Institute for Aerospace Research "Elie Carafoli", B-dul Iuliu Maniu 220, Bucharest 061126, Romania, neamtu.andrei@incas.ro

Stefan NEBANCEA – INCAS − National Institute for Aerospace Research "Elie Carafoli", B-dul Iuliu Maniu 220, Bucharest 061126, Romania, nebancea.stefan@incas.ro

Silvia NECHITA – "POLITEHNICA" University of Bucharest, Faculty of Aerospace Engineering, Polizu Street 1-7, postal code 011061, sector 1, Bucharest, Romania, nechita_silvia_91@yahoo.com

Bogdan NECULAESCU – INCAS – National Institute for Aerospace Research "Elie Carafoli", B-dul Iuliu Maniu 220, Bucharest 061126, Romania, bogdan.neculaescu@gmail.com

Daniel Constantin NEGUT – "Horia Hulubei" National Institute of Physics and Nuclear Engineering - IFIN HH, 30, Reactorului St., Magurele, Ilfov, Romania, negutzd@yahoo.com

Mihai Leonida NICULESCU – INCAS − National Institute for Aerospace Research "Elie Carafoli", Flow Physics Department, Numerical Simulation Unit, B-dul Iuliu Maniu 220, Bucharest 061126, Romania, niculescu.mihai@incas.ro

O

Radu OBREJA – University of Craiova, Faculty of Electrical Engineering, Department of Electric, Energetic and Aerospace Engineering, B-dul Decebal 107, Craiova 200440, Dolj, Romania, radu@sistemeuroteh.ro

Ovidiu OPREA – "POLITEHNICA" University of Bucharest, Faculty of Applied Chemistry and Materials Science, 1-7 Polizu St, 011061, Bucharest, Romania, ovidiu73@yahoo.com

P

Radu Calin PAHONIE – Millitary Technical Academy, Department of Integrated Systems of Aviation and Mechanics, B-dul George Coşbuc 39-49, Sector 5, Bucharest 050141, Romania, pahonier@yahoo.com

Alexandru Marius PANAIT – INCAS − National Institute for Aerospace Research "Elie Carafoli", B-dul Iuliu Maniu 220, Bucharest 061126, Romania, panait.marius@incas.ro

George PELIN – INCAS − National Institute for Aerospace Research "Elie Carafoli", Materials Unit, B-dul Iuliu Maniu 220, Bucharest 061126, Romania; "POLITEHNICA" University of Bucharest, Faculty of Applied Chemistry and Materials Science, 1-7 Polizu St, 011061, Bucharest, Romania, pelin.george@incas.ro

Beatriz PEREZ – TECNALIA – Transport Unit, San Sebastián, Spain, Mikeletegi Pasealekua 2, E-20009 Donostia – San Sebastián, Gipuzkoa (Spain), beatriz.perez@tecnalia.com

Mihaela PETRE – AEROSPACE Consulting, B-dul Iuliu Maniu 220, Bucharest 061126, Romania, petre.mihaela@incas.ro

Gregory PINAUD – AIRBUS D&S, 6, rue Laurent Pichat, 70516 Paris Cedex 16, France, Gregory.Pinaud@astrium.eads.net

Octavian Thor PLETER – "POLITEHNICA" University of Bucharest, Faculty of Aerospace Engineering, Polizu Street 1-7, postal code 011061, sector 1, Bucharest, Romania, octavianpleter@yahoo.com

Cristian POSTOLACHE – "Horia Hulubei" National Institute of Physics and Nuclear Engineering - IFIN HH, 30, Reactorului St., Magurele, Ilfov, Romania, cristip@nipne.ro

Ionel POPESCU – STRAERO – Institute for Theoretical and Experimental Analysis of Aeronautical Structures, B-dul Iuliu Maniu 220, Bucharest 061126, Romania, ionel.popescu@straero.ro

Mihai-Victor PRICOP – INCAS − National Institute for Aerospace Research "Elie Carafoli", Flow Physics Department, Numerical Simulation Unit, B-dul Iuliu Maniu 220, Bucharest 061126, Romania, pricop.victor@incas.ro

R

Sorin Stefan RADNEF – INCAS − National Institute for Aerospace Research "Elie Carafoli", B-dul Iuliu Maniu 220, Bucharest 061126, Romania, radnef.sorin@incas.ro

Kristo REINSALU Invent Baltics OU, Teaduspargi 6/1, Tallinn 12618, Estonia, kristo.reinsalu@invent.ee

Waldemar ROTAERMEL – Deutsches Zentrum für Luft- und Raumfahrt e. V. (DLR), Linder Höhe, 51147 Köln, Germany, Waldemar.Rotaermel@dlr.de

Constantin ROTARU – Military Technical Academy, Faculty of Mechatronics and Armament Integrated Systems, B-dul George Coşbuc 39-49, Sector 5, Bucharest 050141, Romania, rotaruconstantin@yahoo.com

Cristian RUGINA – Institute of Solid Mechanics of the Romanian Academy, C-tin Mille str. Nr. 15, sector 1, Bucharest, 10141, Romania, rugina.cristian@gmail.com

S

Tiberiu Adrian SALAORU – INCAS − National Institute for Aerospace Research "Elie Carafoli", B-dul Iuliu Maniu 220, Bucharest 061126, Romania, salaoru.tiberiu@incas.ro

Adriana SANDU – "POLITEHNICA" University of Bucharest, Splaiul Independenţei 313, 060042, Bucharest, Romania, adriana.sandu@upb.ro

Constantin SANDU – COMOTI – Romanian Gas Turbine Research and Development Institute, 220 D Iuliu Maniu Avenue, 061126 Bucharest 6, Romania, P.O. 76, P.O.B. 174, constantin.sandu@comoti.ro

Marin SANDU – "POLITEHNICA" University of Bucharest, Splaiul Independenţei 313, 060042, Bucharest, Romania, marin_sandu@yahoo.com

Stefan N. SAVULESCU – INCAS - National Institute for Aerospace Research "Elie Carafoli", Bucharest, Romania

Ioan SEBESAN – "POLITEHNICA" University of Bucharest, Faculty of Transports, Department of Railway rolling stock, Splaiul Independenţei 313, 060042, Bucharest, Romania, ioan_sebesan@yahoo.com

Stefan Ciprian STANCIU – "POLITEHNICA" University of Bucharest, Faculty of Aerospace Engineering, "Elie Carafoli" Department of Aerospace Science, Polizu 1-6, RO-011061, Bucharest, Romania

Adriana STEFAN – INCAS − National Institute for Aerospace Research "Elie Carafoli", Materials Unit, B-dul Iuliu Maniu 220, Bucharest 061126, Romania, stefan.adriana@incas.ro

Marius STOIA-DJESKA – "POLITEHNICA" University of Bucharest, Faculty of Aerospace Engineering, 1-7 Polizu St, 011061, Bucharest, Romania, marius.stoia@gmail.com

Adrian – Mihail STOICA – "POLITEHNICA" University of Bucharest, Faculty of Aerospace Engineering, Polizu Street 1-7, postal code 011061, sector 1, Bucharest, Romania, stoica.am@gmail.com

Corneliu STOICA – INCAS − National Institute for Aerospace Research "Elie Carafoli", B-dul Iuliu Maniu 220, Bucharest 061126, Romania, stoica.cornel@incas.ro

Ion STROE – "POLITEHNICA" University of Bucharest, Splaiul Independenţei 313, 060042, Bucharest, Romania, ion.stroe@gmail.com

T

Simion TATARU – AEROSPACE Consulting, B-dul Iuliu Maniu 220, Bucharest 061126, Romania, tataru.simion@incas.ro

Adrian TOADER – INCAS – National Institute for Aerospace Research “Elie Carafoli”, B-dul Iuliu Maniu 220, Bucharest 061126, Romania, toader.adrian@incas.ro

Kostoula TRIANTOU – Institute of Nuclear & Radiological Sciences, Energy, Technology& Safety, National Centre for Scientific Research Demokritos, Agia Paraskevi Attikis, P.O.Box 60037, 153 10, Athens, Greece, ktriantou@ipta.demokritos.gr

Mihai TUDOSE – INCAS – National Institute for Aerospace Research “Elie Carafoli”, B-dul Iuliu Maniu 220, Bucharest 061126, Romania, tudose.mihai@incas.ro

Raluca TURCU – Excelency Centre for Young Olympics – National Institute for Research and Development in Electrical Engineering ICPE CA, Splaiul Unirii, Nr. 313, Sector 3, 030138, Bucharest, Romania, raluca_turcu200@yahoo.co.uk

U

Ioan URSU – INCAS – National Institute for Aerospace Research “Elie Carafoli”, B-dul Iuliu Maniu 220, Bucharest 061126, Romania, ursu.ioan@incas.ro

V

Elena VAJAIAC – INCAS − National Institute for Aerospace Research “Elie Carafoli”, B-dul Iuliu Maniu 220, Bucharest 061126, Romania; University of Bucharest, Faculty of Physics, Bucharest – Magurele 077125, Romania, vajaiac.elena@incas.ro

W

Kaja WYMYSŁOWSKA – National Defence University of Warsaw, 00-910 Warszawa, al. Gen. A. Chruściela 103, Poland, kajawymyslowska@gmail.com

Z

Christian ZUBER – Deutsches Zentrum für Luft- und Raumfahrt e. V. (DLR), Linder Höhe, 51147 Köln, Germany, Christian.Zuber@dlr.de

Authors index

International Conference of Aerospace Sciences

"AEROSPATIAL 2014"

18 - 19 September 2014, Bucharest, Romania

Organizer

INCAS – National Institute for Aerospace Research "Elie Carafoli"
(under the aegis of The Romanian Academy)

Scientific Committee

- Mihai ARGHIR, Université de Poitiers, France
- Corneliu BERBENTE, POLITEHNICA University of Bucharest, Romania
- Heribert BIELER, Airbus operation GmbH; Bremen, Germany
- Ruxandra BOTEZ, École de technologie supérieure, Université de Quebec, Montreal, Canada
- Sterian DANAILA, POLITEHNICA University of Bucharest, Romania
- George S. DULIKRAVICH, Department of Mechanical and Materials Engineering, Florida International University, Miami, U.S.A.
- Horia ENE, Institute of Mathematics "Simion Stoilow" of The Romanian Academy, Bucharest, Romania
- Victor GIURGIUTIU, University of South Carolina, Department of Mechanical Engineering, Columbia, U.S.A.
- Charles HIRSCH, Vrije Universiteit Brussel Faculty of Applied Sciences, Department of Mechanical Engineering, Bruxelles, Belgium
- Vladimír HORÁK, University of Defence in Brno, Czech Republic
- Miroslav KELEMEN, the University of Security Management in Košice, Slovak Republic
- Jacques MANDLE, Thales Avionics, France
- Dan MATEESCU, McGill University, Montreal, Canada
- Catalin NAE, INCAS – National Institute for Aerospace Research "Elie Carafoli", Bucharest, Romania
- Adriana NASTASE, Aerodynamik des Fluges, RWTH - Aachen, Germany
- Pavel NEČAS, Permanent Representation of the Slovak Republic to the European Union, Brussels, Belgium
- Cornel OPRISIU, INCAS – National Institute for Aerospace Research "Elie Carafoli", Bucharest, Romania
- Olivier PIRONNEAU, Université Pierre et Marie Curie (Paris VI), LJLL, Paris, France
- Marius-Ioan PISO, ROSA – Romanian Agency, Bucharest, Romania
- Sorin RADNEF, INCAS – National Institute for Aerospace Research "Elie Carafoli", Bucharest, Romania
- Dimitris SARAVANOS, University of Patras, Department of Mechanical Engineering & Aeronautics, Applied Mechanics Laboratory, Patras, Greece
- George SAVU, COMOTI - National Research and Development Institute for Gas Turbines, Bucharest, Romania
- Dieter SCHOLZ, Hamburg University of Applied Sciences (HAW), Department of Automotive and Aeronautical Engineering, Aircraft Design and Systems Group (AERO), Hamburg, Germany
- Ion STROE, University POLITEHNICA of Bucharest, Romania

Organizing Committee

- Elena NEBANCEA, INCAS – National Institute for Aerospace Research "Elie Carafoli", Bucharest, Romania
- Claudia DOBRE, INCAS – National Institute for Aerospace Research "Elie Carafoli", Bucharest, Romania
- Simion TATARU, AEROSPACE Consulting, Bucharest, Romania
- Stefan BOGOS, INCAS – National Institute for Aerospace Research "Elie Carafoli", Bucharest, Romania
- Victor Mihai PRICOP, INCAS – National Institute for Aerospace Research "Elie Carafoli", Bucharest, Romania
- Emil COSTEA, INCAS – National Institute for Aerospace Research "Elie Carafoli", Bucharest, Romania

Secretarial Staff

- Andreea BOBONEA, INCAS – National Institute for Aerospace Research "Elie Carafoli", Bucharest, Romania
- Ana-Maria NECULAESCU, INCAS – National Institute for Aerospace Research "Elie Carafoli", Bucharest, Romania
- Daniela ENCIU, INCAS – National Institute for Aerospace Research "Elie Carafoli", Bucharest, Romania
- Marilena GHEMULET, INCAS – National Institute for Aerospace Research "Elie Carafoli", Bucharest, Romania

"AEROSPATIAL 2014"

Further information on the web site of
INCAS – National Institute for Aerospace Research "Elie Carafoli"

http://www.incas.ro
"AEROSPATIAL 2014" web site: http://aerospatial-2014.incas.ro/index.html

ISSN 2067 – 8614
ISSN-L 2067 – 8614
Romanian National Library
ISSN National Center

BUCHAREST
2014