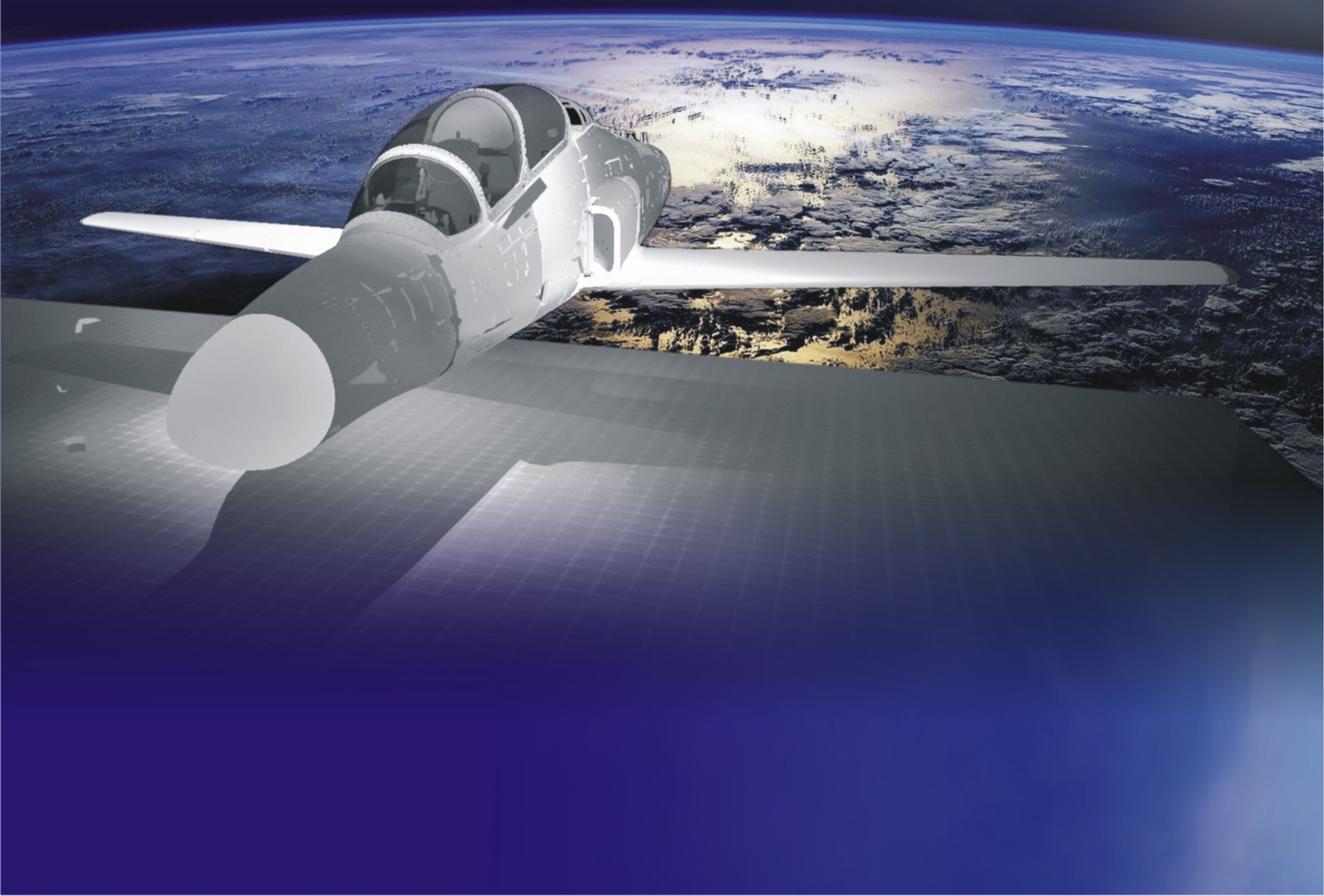
INCAS - National Institute for Aerospace Research "Elie Carafoli"
(under the aegis of The Romanian Academy)

Proceedings
of the International Conference of Aerospace Sciences
"AEROSPATIAL 2018"

25-26 October 2018

Bucharest, Romania



AEROSPATIAL 2018

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Editing: **Elena NEBANCEA**, INCAS – National Institute for Aerospace Research "Elie Carafoli"

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Ministry of Research and Innovation

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

International Conference of Aerospace Sciences, "AEROSPATIAL 2018"

25 – 26 October 2018, Bucharest, Romania

The conference is held under the aegis of the Ministry of Research and Innovation.

PROGRAM

Rooms		1	2	3
Time		**Day 1** *Thursday, 25 October 2018*		
8:30	18:45	**Registration**		
		"Elie CARAFOLI" Amphitheatre		
9:20	9:30	**Welcome** by Acad. **Dorel BANABIC**, President of the Technical Sciences Section of the Romanian Academy		
9:30	9:40	**Welcome** by Minister of Research and Innovation (TBA)		
9:40	9:50	**Welcome** by Gen. lt. (rez) **Dumitru-Dorin PRUNARIU**, Dr. Eng., Cosmonaut, Honorary Member of the Romanian Academy, Honorary President of the Romanian Space Agency		
9:50	10:00	**Welcome and introduction** by the Conference Dr. Eng. **Catalin NAE**, President & CEO, INCAS – National Institute for Aerospace Research "Elie Carafoli", Bucharest, Romania		
Plenary 10:00 – 11.00		**Chair: Catalin NAE** *(INCAS)*		
10:00	10:30	**"Research and design activity in Institute of Aviation performed with cooperation of Warsaw University of Technology and focused on novel aircraft configurations"** Plenary Lecture speech by Prof. **Zdobyslaw GORAJ** | Institute of Aviation, Poland		
10:30	11:00	**"High-Lift Aerodynamics – another 100 years anniversary"** Plenary Lecture speech by Dr. Ing. **Jochen WILD** | German Aerospace Center DLR, Germany		
11:00	11:15	*Coffee Break*		
Plenary 11:15 – 13.00		**Chair: Liviu COSEREANU** *(INCAS)*		
11:15	11:45	**"New radar techniques and their applications to aviation: from research to anticipation of operational needs"** Plenary Lecture speech by Prof. **Marc LESTURGIE** | ONERA, France		
11:45	12:15	**"Advanced Numerical Modeling of Impact and Other High Strain Rate Phenomena in Aeronautical Structures"** Plenary Lecture speech by Prof. **Ivica SMOJVER** | University of Zagreb, Croatia		
12:15	12:45	**"Various Wing Morphing Technologies Simulation and Experimental Tests Research"** Plenary Lecture speech by Prof. Dr. Eng. **Ruxandra Mihaela BOTEZ** | ETS, University of Quebec, Montreal, Canada		
12:45	13:00	**Book launch**: "Si noi am construit avioane IAR 93, 99, supersonicul 95" – **Mihail CALOMFIRESCU**		
13:00	14:00	*Lunch*		
Plenary 14:00 – 14.30		**Chair: Sorin S. RADNEF** *(INCAS)*		
14:00	14:30	**"Rotorcraft Transmissions: Improvement of traditional gearboxes, transmissions for new rotorcraft concepts, safety of drivetrains – approaches of TU Wien"** Plenary lecture speech by Univ.-Prof. Dipl.-Ing. Dr.-Ing. **Michael WEIGAND** | Vienna University of Technology, Austria		
Session 14:30 – 16:00		**"Elie CARAFOLI" Amphitheatre**	**"Nicolae TIPEI" Amphitheatre**	**"Conference room", et. 2, corp B**
Session Title		**Aerodynamics**	**Materials and Structures**	**Systems, Subsystems and Control in Aeronautics**
Session Chair(s)		**Sterian DĂNĂILĂ** *(UPB)* **Marius STOIA-DJESKA** *(UPB)*	**Victor MANOLIU** *(Aerospace Consulting)* **Adriana STEFAN** *(INCAS)* **Viorel ANGHEL** *(UPB)*	**Mircea LUPU** *(Transilvania University of Brasov)* **Laurentiu MORARU** *(UPB)*
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14:45	15:00	S1.2 **Estimation of Wind Tunnel Corrections Using Potential Models** *Ionuț BUNESCU, Sterian DĂNĂILĂ, Mihai-Victor PRICOP, Adrian DINA*	S4.2 **Special with Topic Additive Manufacturing** *Oleg YENTIN*	S5.2 **The absolute stabilization and optimal control of hydrofoil watercrafts** *Mircea LUPU, Cristian-George CONSTANTINESCU, Gheorghe RADU*
15:00	15:15	S1.3 **Nonlinear Lifting-Line Model using a Vector Formulation of the Unsteady Kutta-Joukowski Theorem** *Oliviu ŞUGAR GABOR*	S4.3 **FEM analysis of the helicopter landing gear hinge** *Juraj HUB*	S5.3 **Notes regarding the supply and drain pressure effects on a squeeze film damper** *Laurentiu MORARU*
15:15	15:30	S1.4 **The Sensitivities of the Surface Pressure for the Indirect Determination of the Mach Number and Angle of Attack of Supersonic Flows over Sharp and Multi-Slopes Wedge** *Marius STOIA-DJESKA, Florin FRUNZULICA and Florin MINGIREANU*	S4.4 **Lightweight vitreous carbon material: approaches to making open-pore cellular structure** *Oleg SMORYGO, Alexander MARUKOVICH, A. VAZHNOVA, Aliaksandr ILYUSHCHANKA, Adriana STEFAN, Cristina-Elisabeta PELIN*	S5.4 **Analysis of modern military jet trainer aircraft** *Ilie NICOLIN, Bogdan Adrian NICOLIN*
15:30	15:45	S1.5 **The Twisted Contact Structures in Turbulent Flows** *Horia DUMITRESCU, Vladimir CARDOS, Radu BOGATEANU*	S4.5 **Buckling Analysis of Straight Beams with different Boundary Conditions using an Integral Formulation of Corresponding Differential Equations** *Viorel ANGHEL*	S5.5 **Regulatory requirements concerning a new school and training military jet** *Ilie NICOLIN, Bogdan Adrian NICOLIN*
15:45	16:00	S1.6 **Using genetic algorithms to optimize aerodynamic profiles in incompressible flow** *Adrian DINA, Sterian DĂNĂILĂ, Mihai-Victor PRICOP, Ionut BUNESCU*	S4.6 **Finite Element Method Structural Analysis specific approaches for computing methods of aeronautical component** *Mircea BOCIOAGA, Ion DIMA*	S5.6 **How does the external hypotonic environment influence the pulsating liposome activity** *Dumitru POPESCU, Alin Gabriel POPESCU*
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Session Chair(s)		**Valentin SILIVESTRU** *(COMOTI)* **Valentin BUTOESCU** *(Aerospace Consulting)*		**Aurelian Andrei RADU** *(ISS)* **Doina NICOLAE** *(INOE)* **Ioan URSU** *(INCAS)*
16:00	16:15	S1.7 **Possible Design of a Future Electrical/BLI European Business/Passenger Aircraft with Dispersing of Shock Wave through Corona Effect** *Constantin SANDU, Valentin SILIVESTRU, Bogdan FILIPESCU, Constantin-Radu SANDU*	S4.7 **Temperature Effects on Damage Mechanisms of Hybrid Metal – Composite Bolted Joints Using SHM Testing Method** *Calin-Dumitru COMAN, Ion DIMA, Ştefan HOTHAZIE, George PELIN, Tiberiu SALAORU*	S5.1.1 **CONTUR – Status and Perspectives of a Project in Progress** *Aurelian Andrei RADU, Sabina STEFAN, Iulia SURUCEANU, Ioan URSU*
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Session 16:30 – 17:00		"Elie CARAFOLI" Amphitheatre	"Nicolae TIPEI" Amphitheatre	"Conference room", et. 2, corp B
Session Title		**Aerodynamics**	**Materials and Structures**	**Workshop Project "CONTUR"**
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16:45	17:00	S1.9 **Applications of the Coanda Effect in Aerospace Technology - a Review** *Alexandru DUMITRACHE, Florin FRUNZULICA, Horia DUMITRESCU*	S4.9 **Integrated UAS System for Intervention in Emergency Situations** *Adrian SALISTEAN, Doina TOMA, Claudia NICULESCU, Sabina OLARU*	S5.1.3 **Equilibrium stability of a 2-D wing with time delayed feedback control** *Daniela ENCIU, Andrei HALANAY, Aurelian Andrei RADU, Marius STOIA-DJESKA, George TECUCEANU, Ioan URSU*
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Session Title		**Astronautics and Astrophysics**	**Materials and Structures**	**Workshop Project "CONTUR"**
Session Chair(s)		**Corneliu BERBENTE** *(UPB)*	**Lorena DELEANU** *("Dunarea de Jos" University)*	
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17:15	17:30	S3.2 **Regression Rate Sensitivities for the Mathematical Modeling of Solid and Hybrid Rocket Motors** *Marius STOIA-DJESKA and Florin MINGIREANU*	S4.11 **Influence of the Additive Nature in Soybean Oil on Rheological Behavior** *George Catalin CRISTEA, Alexandru RĂDULESCU, Constantin GEORGESCU, Irina RĂDULESCU, Lorena DELEANU*	S5.1.5 **Data and Methods to Study the Clear Air Turbulence Cases in Romanian Aerian Space** *Livius BUZDUGAN, Denisa URLEA, Sabina STEFAN, Simona ANDREI, Cristian NECULA, Aurelian Andrei RADU*

Session 17:30 – 18:15		"Elie CARAFOLI" Amphitheatre	"Nicolae TIPEI" Amphitheatre	"Conference room", et. 2, corp B
Session Title		**Astronautics and Astrophysics**	**Flight Mechanics**	**Workshop Project "CONTUR"**
Session Chair(s)		**Constantin SANDU** *(COMOTI)*	**Ion STROE** *(UPB)* **Andrei CRAIFALEANU** *(UPB)*	
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17:45	**18:00**	S3.4 **Technology for Reaching of Alfa-Centaury Star by the End of This Century** *Constantin SANDU, Valentin SILIVESTRU, Constantin-Radu SANDU*	S2.2 **Dinamical problem for the aircraft's running on the ground** *Sorin RADNEF*	S5.1.7 **Developing new methodology for clear air turbulence event's detection by using a HSRL system** *Andreea CALCAN, Livio BELEGANTE, Doina NICOLAE, Magdalena ARDELEAN, Sorin VÂJÂIAC*
18:00	**18:15**	S3.5 **Using PID Controller and SDRE methods for tracking control of Spacecrafts in Closed-Rendezvous Process** *Thein Van NGUYEN, Ana-Maria BORDEI, Achim IONITA*	S2.3 **Horizontal Flight Dynamics Simulations Using a Simplified Airplane Model and Considering Wind Perturbation** *Dan N. DUMITRIU, Andrei CRAIFALEANU, Ion STROE*	S5.1.8 **BOUNDARY LAYER WIND TUNNEL FROM UTCB - a state of the art experimental infrastructure** *Alexandru Cezar VLĂDUȚ, Costin Ioan COȘOIU*
18:15	**18:30**	S3.6 **Kinematical Structure for the Three Body problem** *Sorin RADNEF*	S2.4 **Performance in Transition Flight of Quad Tandem UAV** *Andrei LUNGOCI, Achim IONITA*	
Session 18:30 – 18:45		"Elie CARAFOLI" Amphitheatre	"Nicolae TIPEI" Amphitheatre	"Conference room", et. 2, corp B
Session Title		**ATS and full Automation ATM**	**Management in Aerospace Activities**	
Session Chair(s)		**Sorin RADNEF** *(INCAS)*	**Dan N. DUMITRIU** *(SIMULTEC)*	
18:30	**18:45**	S7.1 **Optimising ATM – Modular Network Management** *Ionuț-Cristian PEREDERIC, Ionel SIMION*	S8.1 **The importance of pre-flight weather briefing for general aviation in Romania** *Vlad MARAZAN*	
19:00		**Gala Dinner – Restaurant "Turbotequila"**		

International Conference of Aerospace Sciences, "AEROSPATIAL 2018"
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Rooms		1	2	3
Time		**Day 2** ***Friday, 26 October 2018***		
8:30	16:30	**Registration**		
		"Elie CARAFOLI" Amphitheatre		
9:00	10:10	**The "Nicolae TIPEI" – Prize Award Ceremony**		
10:10	10:50	**The "Gheorghe VASILCA" – Prize Award Ceremony**		
10:50	11:30	**Celebrating Excellence in service of Romanian Aerospace Research, Gl.Fl.aer.(rez) Prof.univ. Nicolae-Florin ZĂGĂNESCU**		
11:30	11:40	**"Why are EO data important for the society?"** Plenary Lecture speech by **Dr. Bogdan ANTONESCU** | National R&D Institute for Optoelectronics INOE2000		
11:40	12:00	***Coffee Break***		
Plenary 12:00 – 13.00		**Chair: Catalin NAE** *(INCAS)*		
12:00	12:30	**"(R)evolutionizing aircraft structures: Advances, trends, needs"** Plenary Lecture speech by Prof. **Spiros PANTELAKIS** | Department of Mechanical Engineering & Aeronautics University of Patras, EASN, Greece		
12:30	13:00	**"Exploration of Supersonic Flow Over Flying Configurations (Part 2)"** Plenary Lecture speech by Prof. Dr. Ing. **Adriana NASTASE** | RWTH, Aachen University, Germany		
13:00	14:00	***Lunch***		
Session 14:00 – 15:00		"Elie CARAFOLI" Amphitheatre	"Nicolae TIPEI" Amphitheatre	"Conference room", et. 2, corp B
Session Title		**Experimental Investigations in Aerospace Sciences**	**Materials and Structures**	**Management in Aerospace Activities**
Session Chair(s)		**Gina MANDA** *(Victor Babes National Institute of Pathology)* **Ionel SIMION** *(UPB)*	**Victor MANOLIU** *(Aerospace Consulting)* **Radu-Robert PITICESCU** *(INCDMNR-IMNR)*	**Aurelian Virgil BALUTA** *(Spiru Haret University)* **Constantin OLIVOTTO** *(Aerospace Consulting)*
14:00	14:15	S6.1 **Altered redox signalling in normal cells exposed to space-relevant radiation** *Gina MANDA, Maria DOBRE, Ionela Victoria NEAGOE, Cristian POSTOLACHE, Marina NECHIFOR, Mariana BOBEICA, Theodor ASAVEI*	S4.12 **New proofs concerning the selective diffusion of Cr and of spinellic solid state reactions to the adhesion of a refractory enamel to a Ni-Cr supper alloys** *Catalin Eugen SFAT, Ion PENCEA, Victor MANOLIU, Gheorghe IONESCU, Mihai BRANZEI, Ramona Nicoleta TURCU, Mihaiță IOAN, Alexandru MATEI, Alina POPESCU-ARGES, Mihai Ovidiu COJOCARU, Mihai TÂRCOLEA*	S8.2 **Some consideration about R&D in aviation. Type of projects. The role of the Project Manager** *Constantin OLIVOTTO*
14:15	14:30	S6.2 **Virtual simulation of hip joint biomechanical behavior produced by exceeding +4G-force magnitude** *Patricia Isabela BRAILEANU, Ionel SIMION, Benyebka Bou-Saïd*	S4.13 **Evaluation of Aerospace Materials in Relation to the Thermal Gradient** *Victor MANOLIU, Gheorghe IONESCU, Mihail BOTAN, Radu-Robert PITICESCU, George Catalin CRISTEA*	S8.3 **Knowledge society and aviation. Requirements for development-based management** *Aurelian Virgil BALUTA*
14:30	14:45	S6.3 **Validation of an acoustic tool to determine the propeller rpm** *Nico van OOSTEN, Silviu Emil IONESCU*	S4.14 **Vitreous enamel used as high temperature protective coatings for hot parts from the turbo engine** *Alina DRAGOMIRESCU, Mihail BOȚAN, Victor MANOLIU, Gheorghe IONESCU, George Catalin CRISTEA, Adriana ŞTEFAN*	S8.4 **Aviation Safety Investigations** *Cristian TECUCEANU, Eugen SUCIU, Peter KALMUȚCHI*
14:45	15:00	S6.4 **Towards the effects of initial grain temperature and erosive burning on the combustion of homogeneous solid rocket propellants** *Doru SAFTA, Ioan ION*	S4.15 **Modern Advanced Thermal Protection Systems for hot components of re-entry vehicles, rocket trust chambers and jet engines** *Mihail BOTAN, Victor MANOLIU, Radu-Robert PITICESCU, Bogdan Stefan VASILE, Gheorghe IONESCU, Alina DRAGOMIRESCU, George Catalin CRISTEA*	S8.5 **Topical Issues in Aircraft Health Management with Applications to Jet Engines** *Sorin BERBENTE, Irina-Carmen ANDREI, Gabriela STROE*
Session 15:00 – 16:30		"Elie CARAFOLI" Amphitheatre	"Nicolae TIPEI" Amphitheatre	"Conference room", et. 2, corp B
Session Title		**Experimental Investigations in Aerospace Sciences**	**Round table - Romanian Cluster for Earth Observation (RO-CEO)**	**Management in Aerospace Activities**
Session Chair(s)			**15.00 – 16.30** **Simona ANDREI** *(National Institute of Research and Development for Optoelectronics-INOE 2000),* **Anca Liana COSTEA** *(S.C. TERRASIGNA SRL)*	**Casandra Venera (BALAN) PIETREANU** *(UPB)*

15:00	**15:15**	S6.5 **Concurrent engineering in designing a system for sensing gas leaks in harsh space environment** *George SUCIU, Andrei Sorin NEAMTU, Jenica NEAMTU, Dragos OVEZEA, Maria Cristina DITU, Alexandru DROSU, Gabriel PETRESCU*	**EARTH OBSERVATION: How can we capitalize the resources of a research niche in everyday life?** **(identifying the best methods for improving the knowledge transfer from research to users)** *Doina NICOLAE, Simona ANDREI, Anca Liana COSTEA, Mircea RADULIAN, Razvan MATEESCU, Vladimir GANCZ, Mugurel BALAN, Daniela FAUR, Ovidiu Ion TRAŞCU* **15.00 – 16.30**	S8.6 **Considerations regarding process control in aeronautical organizations in the context of improving safety and efficiency** *Valentin-Marian IORDACHE, Casandra Venera (BALAN) PIETREANU*
15:15	**15:30**	S6.6 **Experimental Investigations on the Possibility to Apply the Corrugated Sheet Metal Used in the Past at Junkers Aircraft for Noise Reduction of Future European Aircraft. Other Experiments Dedicated to Noise Reduction of Future European Aircraft** *Constantin SANDU, Marius DEACONU, Valentin SILIVESTRU, Constantin-Radu SANDU*		S8.7 **Romanian aeronautic industry evolution analysis from the structure, performance perspective and integration in the globalized structures of the aerospace industry** *Daniela MOCENCO*
15:30	**15:45**	S6.7 (Poster) **Pulse irradiation facility for simulating specific conditions at ELI-NP E5 Experimental Area** *Cristian POSTOLACHE, Viorel FUGARU, Mihail-Razvan IOAN, Aurelia CELAREL, Costel CENUSA*		S8.8 **Numerical Simulations for Fuel Aircraft Management System** *Irina-Carmen ANDREI, Gabriela STROE, Sorin BERBENTE*
15:45	**16:00**	S6.8 (Poster) **Evaluation of Dosimetry Systems for Radiobiological Researches at ELI-NP** *Viorel FUGARU, Cristian POSTOLACHE, Aurelia CELAREL, Costel CENUSA, Mihail-Razvan IOAN, Catalin Stelian TUTA*		S8.9 **Work Transfer in aviation, space and defense organization** *Manuela RUSU, Ilinca SOARE, Mihail BOTAN*
16:30		**Closing Ceremony**		

“Elie CARAFOLI” Amphitheatre

“Nicolae TIPEI” Amphitheatre

“Conference room”, et. 2, corp B

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***Note*:**

- ***The works are published in the volume by sections, in order of their presentation at the conference "AEROSPATIAL 2018, according to the Program of the conference (see the Program, pp. iii).***
- ***We mention that the authors is responsible for the correctness of the English language.***

PLENARY LECTURES

Exploration of Supersonic Flow over Flying Configurations (part 2)

Adriana NASTASE*

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Abstract: *The exploration of supersonic flow over flying configurations (FCs) was performed by using eight models designed by the author, The measurements of the lift and pitching moment coefficients and of the pressure coefficients on the upper side of the models were performed in the trisonic wind tunnel of DLR Cologne in the frame of the research projects of the author, sponsored by the DFG.r. The theoretical predicted pressure, lift and pitching moment coefficients are obtained by using the three-dimensional hyperbolic potential solutions and the corresponding software of the author. The aims of this exploration are: to check the capability of these shock less solutions to simulate the real world, to verify if these developed software are in good agreements with the experimental results and to determine the limits of the use of these solutions with characteristic surfaces, which are more economical. These solutions with characteristics are used by the author for the analytical hybridization of numerical solutions of the full Navier-Stoke PDEs and for the determination of high performant surrogate models, which are used in the first step of an iterative optimum-optimorum theory for the determination of the global optimized shapes of flying con-figurations. A comparison between the experimental and the theoretical results, for the global optimized delta wing model ADELA and for the equivalent double wedged delta wing models, is here performed.*

Key Words: *Supersonic Flow, Global Shape Optimization, Three-Dimensional Hyperbolic Potential Solutions, Experimental Results, Hybrid Navier-Stokes Solutions.*

1. INTRODUCTION

The exploration of supersonic flow over flying configurations was performed by using eight models designed by the author, namely: a wedged delta wing, a double wedged delta wing, a wedged delta wing fitted with a central conical fuselage, a wedged rectangular wing a cam-bered rectangular wing, a delta wing alone ADELA, global optimized at cruising Mach number $M_\infty = 2$, presented in the (Fig. 1) and two, more recent designed and experimental cheked, are the fully-integrated wing-fuselage configurations FADET I and FADET II; global optimized at $M_\infty = 2.2$ and, respectively, at $M_\infty = 3.$, presented in the (Fig. 2). All these models have sharp leading edges in order to avoid the bow shock wave. The six delta configurations have the same area of their planforms and the both rectangular wings have the same planforms The three global optimized flying configurations fulfil additionally the Kuta condition on their subsonic leading edges, in order to avoid the detachment of the flow along their leading edges, to conceal the induced drag and to increase the lift. The measurements of the lift, pitching moment and pressure coefficients on the upper side of the models were performed in the trisonic wind tunnel of DLR Cologne, in the frame of research projects of the author, sponsored by the DFG. Correlation and interpolation software, developed by the author were used by herself and by her young collaborators of Aero-dynamics of Flight, at RWTH, Aachen University, for the evaluation and for the plotting of these experimental results. The theoretical predicted pressure, lift and pitching moment coefficients, obtained by using the non-classical three-dimensional hyperbolic potential solutions and the corresponding software of the author are here used.

Fig. 1 Six of the models used for the exploration of supersonic flow

Section 1. Aerodynamics

Nonlinear Lifting-Line Model using a Vector Formulation of the Unsteady Kutta-Joukowski Theorem

Oliviu ŞUGAR GABOR*

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Abstract: *In this paper, a vector form of the unsteady Kutta-Joukowski theorem is derived and then used in the formulation of a general Lifting-Line Model capable of analysing a wide range of engineering problems of interest. The model is applicable to investigating lifting surfaces having low to moderate sweep, dihedral, out-of-plane features such as winglets, in both steady-state and unsteady cases. It features corrections of the span-wise circulation distribution based on available two-dimensional aerofoil experimental data, and stable wake relaxation through fictitious time marching. Potential applications include the conceptual and initial design of low-speed Unmanned Aerial Vehicles, the study of flapping flight or Wind Turbine blade design and analysis. Several verification and validation cases are presented, showing good agreement with experimental data and widely-used computational methods.*

1. INTRODUCTION

Since its original development almost a century ago [1], the Lifting-Line Theory (LLT) was extensively used to determine the aerodynamic performance of aircraft lifting surfaces, sails, propellers or wind turbines. The aerodynamic characteristics predicted by the theory were repeatedly proven to be in close agreement with experimental results, for straight wings with moderate to high aspect ratio. The solution of Prandtl's classical equation was in the form of an infinite sine series for the bound circulation distribution, truncated to a finite number of terms, whose coefficients were determined using a collocation method, as proposed by Glauert [2]. Other classical methods of determining the bound circulation distribution included those developed by Tani [3] and Multhopp [4]. Several authors have proposed modified versions of the original Lifting-Line Theory, to extend the applicability of the model to moderately-swept wing (Weissinger [5]) or make use of nonlinear aerofoil data to correct the circulation distribution (Sivells and Neely [6]).

With the increasing development and accessibility of computers, authors have also proposed numerical methods for solving Prandtl's lifting-line equation (for example, Anderson et al [7]). This has also led to a revisiting of some of the underlying hypothesis of the theory in an attempt to widen its applicability. Phillips and Snyder [8] presented a numerical Lifting-Line Model that used a three-dimensional vortex lifting law instead of the traditional two-dimensional form of the Kutta-Joukowski theorem, and successfully applied it to lifting surfaces with arbitrary sweep and dihedral angle. More recently, authors such as Gabor et al. [9]-[10] or Marten et al. [11] have replaced the two-dimensional theorem with its vector form, when performing quasi-steady-state calculations.

The Lifting-Line Theory represents a very useful tool for aircraft conceptual design phases. Piszkin and Levinsky [12] proposed a quasi-steady nonlinear lifting line model that included the effects of unsteady wake development. The model was intended to analyse wing rocking, wing drop, roll control loss and reversal under the influence of asymmetric stall. More recently, Gallay and Laurendeau [13] have presented a generalised nonlinear Lifting-Line Model suitable for the steady-state analysis of complex wing configurations. The method uses a database of high-fidelity two-dimensional CFD results for the aerofoil performance, and can analyse wings in both incompressible and compressible flows.

In the field of wind turbine design and analysis, the use of the Lifting-Line Theory coupled with unsteady wake models has become common practice in recent years. This is due to superior accuracy compared to the Blade Element Momentum (BEM) theory, which relies heavily on empiric induction factors, and significantly lower computational costs compared to a three-dimensional Unsteady Reynolds-Averaged Navier-Stokes (URANS) computation (see for example [14]). Not many attempts have been made to model flapping flight using the lifting-line approach. An unsteady Lifting-Line Theory to analyse the flapping of bird wing in forward flight was developed by Phlips et al. [15], but the effects of time-varying bound circulation was not accounted for. With its quasi-steady-state assumption, the model gave good results for

Experimental Investigations on the Possibility to Apply the Corrugated Sheet Metal Used in the Past at Junkers Aircraft for Noise Reduction of Future European Aircraft. Other Experiments Dedicated to Noise Reduction of Future European Aircraft

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Abstract: *This paper shows that corrugated skin used in the past at Junkers aircraft for increasing of fuselage's and wing's rigidity can lead to noise reduction and aerodynamic performance increasing of future European aircraft. If the pressure side of wing which is placed above the engine is corrugated, the jet noise reflected by wing will be scattered. The diffuse acoustic field created in this way has a lower intensity at ground level and correspondingly a lower impact on community. Similar, it is shown that if the underside of fuselage is corrugated, the noise emitted by the nose landing-gear and main landing-gear is scattered, too. Existence of this effect is demonstrated by some recent measurements done inside auto-tunnels covered at interior with corrugated sheet metal which indicated a reduction of maximum noise level with 30%. Some experiments done by authors at low scale on an Airbus A380 wing model (scale 1:375) shown that the jet-noise reflected by the corrugated skin of wing is smaller with 4 dB in the near field. Reintroducing of corrugated skin in manufacturing of modern aircraft is beneficial because, on a hand, it reduces the annoyance created by the jet-noise and landing-gear noise and, on the other hand, it permits manufacturing of stronger frames for passenger aircraft.*

Key Words*: aeroacoustics, psychoacoustics, noise reduction, annoyance*

1. INTRODUCTION

In the last time communities begun to be much affected by aircraft noise especially the communities living near airports.

The most of airports are located in the vicinity of cities and some of them are located even inside cities because in time cities extend to airports and finally incorporate them.

It is known that at the middle of the 20-th century, Junkers created an aircraft with corrugated skin over wing and fuselage.

This solution could be partially used in the next future in special areas of wing skin and fuselage for noise reduction through scattering both in the case of classic aircraft and BLI or Electric/BLI aircraft. Several possibilities of using the Junkers solution in manufacturing of future European aircraft are discussed in this paper.

The chapters of this paper are:

- **Aircraft noise seen through the point of view of psychoacoustics**, where some important aspects of human hearing in relation with aircraft noise are briefly explained;
- **Underlying of productive research directions for reduction of annoyance produced by aircraft**
- **Junkers 52 design solution**, where main features of its exception design are presented;
- **The case of present aircraft**, where it is shown that the existent aircraft have the drawback of a strong reflection of noise by wing and fuselage;
- **Applying of Junkers 52 solution at future aircraft**, where it is shown that the future aircraft should have corrugations on the pressure side of wings (over engines) and on the lower surface of fuselage;
- **The experimental facts**, where experiments or real facts are presented for sustaining the idea of reusing the Junkers corrugated skin for future aircraft;

Development of a genetic algorithm for aerodynamic shape optimization

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***Abstract**: The subject of optimization in aerodynamics is of great interest nowadays, especially with improved computation capabilities. A real-coded genetic algorithm (GA) for airfoil optimization is presented here in order to assess trade-offs in what regards obtaining both a reduced computation time and proper convergence. The choice of GAs is justified mainly by the high parallelization capabilities of this category of algorithms, but the fact that genetic algorithms are more likely to find the global optimum is also a great advantage. A panel method based, open-source flow solver is used for cost function evaluation in this stage and several airfoil parameterizations are investigated. The objective function is the aerodynamic efficiency, the algorithm's purpose being that of maximizing it. For uniquely defining an airfoil a range of 8 to 14 parameters are used, the parameterization method having a great influence on both the convergence time of the algorithm and the search space.*

***Key Words**: optimization, genetic algorithms, GA, parameterization*

1. INTRODUCTION

The subject of optimization is of great interest especially is aviation, where there is an ever-increasing necessity to obtain better aerodynamic performance, lighter structures and lower costs. A powerful tool in optimization is the use of genetic algorithms: they find a solution to a problem by the use of an evolutionary process where possible solutions are used to create new ones [1]. The evolutionary process is employed with the use of genetic operators, which as the name says, operate on the possible solutions in order to make them more fit.

Genetic algorithms have been successfully applied for diverse problems in aviation: optimization of a morphing wing-tip [2], aerodynamic and aeroacoustic optimization of rotorcraft airfoils [3], aerodynamic optimization of turbine blades [4] and the optimization of the centrifugal compressor's inlet guide vanes [5], just to name a few. In this paper we treat the subject of aerodynamic optimization of an airfoil and we employ three different parameterization methods in order to assess their influence on convergence and the quality of the solution.

The optimization problem can be formulated as in Equation 1 [6]:

$$\underset{\boldsymbol{x}}{\text{minimize}}\, f(\boldsymbol{x})\text{, subject to } \begin{cases} g_i(\boldsymbol{x}) \leq 0, i = 1{:}\,m \\ h_j(\boldsymbol{x}) = 0, j = 1{:}\,p \end{cases} \tag{1}$$

Here, $f(\boldsymbol{x}) = L/D$ is the fitness function, $\boldsymbol{x}$ is the vector representing the airfoil parameterization and $g_i(\boldsymbol{x})$ and $h_j(\boldsymbol{x})$ are constraints applied to the airfoil – in this case the constraints are structural, such as minimum thickness or maximum curvature. Although traditionally it is a minimization problem, here we want to maximize the fitness function. In order to achieve this, a real-coded genetic algorithm has been implemented.

2. METHODOLOGY

The current study involved the development of an optimization algorithm and the investigation of several parameterization methods. The structure of the genetic algorithm is presented in Fig. 1 and is similar to the one used in [7]. Optimization is achieved by the use of genetic operators: we start with an initial randomly generated population and we use genetic operators to evolve it such as to maximize the optimization function. The genetic operators used here are *Pass-through*, *Selection*, *Crossover*, *Perturbation-Mutation* and *Mutation*. Each one of it operates successively on the population until convergence is reached.

Section 2. Flight Mechanics

Horizontal Flight Dynamics Simulations using a Simplified Airplane Model and Considering Wind Perturbation

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***Abstract**: An in-house method of Newton-Euler inverse dynamics guidance based on a simplified airplane model in horizontal flight was proposed in a previous paper presented at NMAS 2018 workshop [1]. The goal was to guide the airplane between two locations situated at 100 km distance in the horizontal plane, considering some simplifying assumptions: • the airplane was considered a material point (no motion equations involving torques are considered here); • the thrust was constant in magnitude during the entire motion; • the airplane is inclined at time t with the rolling angle φ(t); • the main parameter for controlling the flight path was considered to be the sideslip angle β (angle between the thrust vector and the velocity vector); • the lift force balanced the weight, the centrifugal force and the wind perturbation lateral force; • the wind perturbation was considered linear by pieces of 10 km distance. So, the horizontal flight guidance parameter is the sideslip angle β, while the rolling angle φ is determined from the condition that the flight remains in the horizontal plane, which has to be permanently fulfilled. This paper presents several simulations validating the proposed inverse dynamics guidance tool for airplane horizontal flight. Various wind perturbation possibilities have been tested, considering this wind perturbation as linear by pieces during the horizontal flight. In conclusion, this guidance method worked well for the simplified horizontal flight case study.*

***Key Words**: guidance method, horizontal flight, inverse dynamics, simplified airplane motion, rolling angle, sideslip angle.*

1. PROBLEM

Since airplanes are omnipresent in human life for more than a century, elaborate aircraft dynamics complete 3D models can be found in the literature [2,3]. Interesting studies have been carried out also concerning optimal flight paths and speeds [4].

Even if the airplane flight in horizontal plane represents a very simplified motion, it is always useful to dispose of an in-house simulation tool for this simplified horizontal flight, considering wind perturbation. For this purpose, a simplified model for flight dynamics in horizontal plane with wind perturbation was considered, as proposed by several authors [5,6].

The simulations performed so far validate the proposed numerical guidance algorithm based on this simplified model [1].

Figure 1 shows a vertical view of the horizontal flight and airplane model, illustrating two of the three flight angles used by the simplified model: the yaw angle ψ_{abs} (angle between aircraft absolute velocity vector $\mathbf{V}_{abs}$ and $\mathbf{x}$ axis) and the sideslip angle β_{abs} (angle between the thrust vector $\mathbf{T}$ and the absolute velocity vector $\mathbf{V}_{abs}$). The other flight angles involved in this simplified flight dynamics model are: the flight path angle $\gamma = 0$ (for the horizontal flight) and the rolling angle φ, i.e., angle between the vertical plane and the plane of symmetry of the airplane.

Let us remark that the absolute velocity vector $\mathbf{V}_{abs}$ designates the velocity relative to the ground, i.e., with respect to the inertial frame (O; $\mathbf{x}$,$\mathbf{y}$), being written as the vector sum of the velocity of the airplane relative to the atmosphere $\mathbf{V}$ and the velocity of the atmosphere relative to the ground $\mathbf{w}$ (wind velocity):

$$\mathbf{V}_{abs} = \mathbf{V} + \mathbf{w} \tag{1}$$

The flight dynamics equations below involve the velocity of the airplane relative to the atmosphere $\mathbf{V}$, also the sideslip angle β and the yaw angle ψ are the ones relative to the atmosphere.

Section 3. Astronautics and Astrophysics

An Interpretation of the “Black Energy” in Universe by using a Hydro-Dynamical Analogy with Newton Gravity

(***EXTENDED ABSTRACT***)

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Abstract: *There are arguments that what we see now as “normal energy” (including the equivalent mass-energy) represents only 5% of the total energy of the Universe [1]. The rest is invisible in the sense that no widely accepted experimental proof exits to put it in evidence. In addition there is no accepted theory to explain the nature of this so called “black energy”. In this paper we propose an interpretation of the “black energy” also giving a possibility to follow its evolution in time by using an author hydro-dynamical model of the Newton gravity and a model of the early Universe; a connection between a part of this energy and “black holes” is as well proposed.*

Key Words: *fluid of HD-gravitons, variable gravity coefficient, emission, absorption*

1. INTRODUCTION

The supposition that the known matter and energy observed in our Universe does not represent all the existing ones is probably old enough. However in the last time quantitative values for the possible existing percentages of “black energy”(68.3%) and “black matter”(26.8%) were given [1].

A possible interpretation of such big percentages is suggested by our hydro-dynamical analogy with gravity [2]. The main idea of this model is the analogy between the Newton gravity force and the sources interaction in an incompressible fluid. In this case the fluid is formed of photon-like particles that we call ***“HD-gravitons”***. Our HD-graviton is the weakest possible particle in Universe having the wave length equal to the radius of the Universe. Thus it is very hard (if not impossible) to detect. Therefore at BIG BANG (better said BIG FLASH as the sound does not propagate through vacuum) the whole energy of the Universe is in the form of a single HD-graviton; that means that in fact what is now called “black energy” is the very energy of the created Universe and what one has rather to do is to explain the formation of the visible energy.

If E is an arbitrary amount of energy (other than HD-graviton) it can emit/absorb according to our hydro-dynamical analogy a rate of energy E' equal to:

$$E' = \theta_g E \, , \tag{1}$$

θ_g being the “rate intensity” ($\sec^{-1}$), positive for emission, negative for absorption. There is force of attraction for both emission and absorption, similar to the gravity force.

By comparing the Newton and the source forces one obtains an expression for the intensity θ_g. The form given in Ref. [2] is adapted to take into account the diminution of the HD-graviton intensity due to the Universe expansion and the variation of the universal coefficient of gravity with the age of universe t_u.

2. THE DETERMINATION OF THE TOTAL ENERGY OF THE UNIVERSE. THE TRANSFORMATION OF HD-GRAVITONS IN SUBSTANCE.

After BIG BANG (BIG FLASH) the created primary spherical photon-like particle is submitted –according to our model of the early Universe [3] - to a process of divisions in eleven equal spheres (the minimum number of equal spheres that can be inscribed in a given initial sphere, Fig.1). By attaching to any amount of

The Future of Air Space Industries Based on Space Advanced Research

Dark Energy Power and Dark Matter pre-physical structure

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Abstact: *Space Research is entering a new phase of knowledge. Theoretical Physics is going for the first time beyond the borders of Space Science by anticipating the nature of Dark Matter and Dark Energy. My brand-new theory called "THE ENERGY INTERDEPENDENCE THEORY", formulated in 2015, reveals that there is a total and inseparable energy interdependence among Dark Energy, Dark Matter, and Baryonic Matter. As a consequence, all materials in the four fundamental states of matter - solid, liquid, gas, and plasma - possess a huge additional power that can be modulated and extrapolated. Very high energy propulsion engineering, nano-mass fuel, new radio frequencies and communication speed based on the Dark Matter field, and new materials with variable structure are just some of the things that will benefit from the daily application of the Dark Energy Power and Dark Matter pre-physical structure.*

1. INTRODUCTION

Air Space industries future technologies will deal with the information gathered by Space advanced research concerning technical data of dark energy, dark matter, and pre-physical laws, including the Septrino field, which is the dark matter field.

Space agencies around the world have begun the race to better explore the Solar System, galaxies, and the Universe, to chase Space supremacy.

Nowadays, the first goal of the scientific community is to discover the nature of dark matter and dark energy. To ensure this accomplishment, Space agencies around the world will need more sophisticated technologies from Air Space industries.

More powerful engines, stronger and lighter spacecraft, new space detectors and telescopes, are just a few elements of a long list of necessary technologies to finally detect and analyze the most sought-after of all particles: the dark matter particle.

At this point, a question: are we ready to go beyond the borders of Physics and make the first step inside the new and unknown reality of pre-physical laws?

The answer is yes.

2. THE ENERGY INTERDEPENDENCE THEORY

My Theoretical Physics research is going for the first time beyond the borders of Physics and Space science by anticipating the nature of dark matter and dark energy.

In 2015 I formulated a brand new theory called 'The Energy Interdependence Theory'.

The theory states that:

1) pre-physical laws exist;
2) among baryonic matter, dark matter, and dark energy there is a total energy interdependence. No one can exist without the others;
3) dark energy leads to the formation of dark matter, and dark matter leads to the formation of baryonic matter;
4) the real consequence is that baryonic matter itself incorporates both dark energy and dark matter, which can be modulated artificially. Technologies of tomorrow will allow us to decode the process of matter formation.

This is a revolutionary concept of matter formation and a milestone for Physics.

Gravity, according to the theory, is a force generated by the dark matter energy of cohesion, which operates as positive pressure. It balances the pulse of the dark energy fluctuation, which acts as negative pressure in the formation and life of stars and planets.

The speed of light is not unvaried through spacetime, but variable. This fact depends on the amount of dark

Technology for Reaching of Alfa-Centaury Star by the End of This Century

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Abstract: *Our civilization is thinking to send a space-probe for reaching Alfa-Centauri star in this century. A problem is finding of the best solution for this project. Another problem is the duration of such a journey because the distance from Earth to that star is of 4.36 light-years which seems to be much over the technological possibilities of our civilization at this moment. NASA considers that the solution seems to be a sailing space-probe due to its small mass and absence of propellant needs. However, at very long distances by Sun, the sailing space-probe is much affected by the problem of decreasing of solar light intensity with d^2, d being the distance between the space-probe and Sun. This paper presents a new technology for increasing of propulsion force at the beginning of space-probe journey until it is 33% of the light speed, this permitting reaching of Alfa-Centauri in about 14.5 years, i.e. in a reasonable time. This new technology is based on a space-system composed of two opposite parabolic mirrors (large and small) which are placed face to face and have the same focal point. Such a system which is permanently oriented to the Sun generates a concentrated light beam which is oriented to the extremity of solar system. Due to the move of parabolic mirrors system around Sun, a large pitch light-spiral is created into space. The intensity of concentrated light-spiral can be of tens to hundreds times higher than the natural irradiation produced by Sun on Earth's orbit. Correspondingly, the propulsion force applied on the sailing space-probe will be of tens to hundreds times more than the propulsion force applied on classic sail space-probe navigating in proximity of Earth's orbit. The acceleration of such a sailing space-probe spacecraft is constant because the intensity of light in the concentrated light-spiral is constant, too, i.e. it does not depend by the distance between the space-probe and Sun. Such a space-mission will permit new checks of Special Theory of Relativity.*

1. INTRODUCTION

This paper proposes a new solution for propulsion of a solar sail space-probe which is capable to reach Alfa-Centauri star in this century. Firstly, the present design solutions for existing space-probes are discussed. It is explained why the present solutions which use rocket engines or electric propulsion are not feasible.
The main problem is the duration of such a journey because the distance from Earth to Alfa-Centauri star is 4.36 light-years. Reaching of such a distance seems to be much over the technological possibilities of our civilization at this moment.
NASA considers that a feasible solution is a sailing space-probe due to its small mass and absence of propellant needs. However, the intensity of sunlight decreases rapidly with the square of distance between the space-probe and the Sun. In this condition, the space-probe cannot be accelerated to a sufficient speed for reaching of Alfa-Centaury star in a reasonable time.
The authors of this paper propose a new solution for propulsion of space-probe with concentrated light having a constant intensity disregard the distance between the space-probe and Sun.
In addition, this new solution permits increasing of propulsion force at the beginning of space-probe journey until 33% of the light speed. This speed permits reaching of Alfa-Centauri star in about 14.5 years, i.e. in a reasonable time.

2. THE PRESENT DESIGN SOLUTIONS OF SPACE-PROBES

A space-probe designed for travelling to Alfa-Centauri star is called an 'interstellar probe' because it lefts the Solar System and enter the interstellar space. The region where the gravitational and energetic influence of Sun is insignificant begins practically at over 230,000 AU (3.6 light years). [1]

Using PID Controller and SDRE methods for tracking control of Spacecrafts in Closed-Rendezvous Process

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Abstract: *Rendezvous process of spacecrafts is one of major issues in study of aerospace engineering. And tracking control in Rendezvous process is very complex due to the requirement of fulfillment of conditions and constraints in order to execute control forces to bring Chaser toward Target. From the relative translational motion between the Chaser and the Target, the paper will implement a trajectory control in the Closed-Rendezvous stage by two different approaches: the first using PID Controllers, and the second using SDRE (State Dependent Riccati Equation) technique. Then based on obtained results, a comparison between two methods is carried out.*

Key Words: *Closed-Rendezvous, trajectory control, PID controller, SDRE.*

1. INTRODUCTION

Nowadays with desire of further exploration of space, studies relating to aerospace missions are more and more attracting attention of researchers. As the result, Rendezvous and Docking operations as one issue of that missions are also have been concentrated to study and improve, especially in the aspect of control. Among obtained results, there are some authors with their remarkable achievements at works applied plenty of advanced control method, such as: In [9], Guillermo Ortega used Fuzzy logic techniques for rendezvous and docking of two geostationary satellites; I. Lopez and C. R. McInnes used artificial potential function for autonomous Rendezvous, [8]; P. Singla, K. Subbarao, and J. K. Junkins used Adaptive Control for their study of Rendezvous and Docking, [7]; With robust parametric method, Dake Gu and Yindong Liu solved spacecraft rendezvous problem, [6].

In aerospace field, the State-Dependent Riccati Equation technique (SDRE) is widely applied in designing controller for nonlinear systems thanks to its simplicity and effectiveness. The use of the State-Dependent Riccati Equation (SDRE) is to provide feedback control for nonlinear systems by allowing nonlinearities in the system state.

Specifically, by imitating the Linear Quadratic Regulator (LQR) for linear systems, SDRE allows computing a sub-optimal solution of nonlinear control problem by solving online the Algebraic Riccati Equation (ARE). Then this method is used in lots of works related to Rendezvous problem to solve particular aims, [1-5].

This paper also uses SDRE approach for tracking control of spacecrafts in closed-Rendezvous range and applies it in the specific example. Besides, as one of the most popular control method, PID control method is employed here for solving the identical issue. When implementing Rendezvous operation, the V-bar approach is considered as approach strategy.

The paper does not intend to compare this method better than the other one and versa. However, based on the obtained results we will have an overview about performance of each method. Additionally, depending on the criteria of specified task such as: energy consumption or issue relating to time for steady state, we can choose suitable control method for desired purposes.

2. RELATIVE TRANSLATIONAL MOTION DYNAMICS

Commonly, in Rendezvous and Docking missions, local orbital frame centered on the Chaser, and the Target namely Local Vertical Local Horizontal (LVLH) frame, and an Earth – Centered Inertial frame are used to compute position vectors of spacecrafts. They are depicted as in Figure 1.

Section 4. Materials and Structures

Lightweight vitreous carbon material: approaches to making open-pore cellular structure

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Abstract: *Cellular vitreous carbons with the open-pore structure are attractive materials in some aerospace applications, such as the super-lightweight structural materials or sandwich core materials in the thermal protection systems. Cellular vitreous carbon (or VC foam) with the open-pore structure can be synthesized by pyrolysis of cellular precursor structures made from some types of resins, such as epoxy or phenolic resins. Several approaches elaborated at RPMI, Belarus can be applied to create the precursor resin foams. The replication approach ensures perfect open-pore structure with the porosity of >90% and high hydraulic permeability. The sacrificial template approach ensures lower porosity and hydraulic permeability, and higher specific strength. In the approach with the deformable space-holder granules in the sacrificial template, the foam porosity can be controlled in a wider range. The paper compares different methods of making the precursor resin foams and properties of VC structures synthesized by pyrolysis of these precursor foams.*

Key Words: *vitreous carbon, open-pore foam, replication approach, sacrificial template approach.*

1. INTRODUCTION

Cellular vitreous carbons with the open-pore structure (VC foams) are attractive materials in some aerospace applications, such as the super-lightweight structural materials or sandwich core materials in thermal protection systems [1]. This is due to an advantageous combination of thermo-physical and specific mechanical properties, low density and high operating temperatures. Thus, VC foams can operate at temperatures as high as above 2000^{o}C in anoxic environments, and their density can be as low as 0.05-0.03 g/cm^3. The open-pore structure of VC foams is very important in the applications mentioned above; this permeable structure ensures circulation of cooling media within the sandwich core and is not sensitive to exploitation under the vacuum or decompression conditions.

The open-pore VC foams can be synthesized by the pyrolysis of the preliminarily prepared precursor foams made from some types of resins, such as phenolic resin, epoxy resin, or furfuryl alcohol [3-9]. The pyrolysis is carried out in the inert gas flow (argon, nitrogen) at temperatures of >1000^{o}C. As a result, the resins are converted to carbon whereas the original cellular structure of the precursor foam remains unchanged, just undergoing certain volumetric changes. Carbon that is synthesized during pyrolysis has a disordered crystal structure with a not regular orientation between the graphite-like hexagonal layers. This carbon type is called vitreous or glassy carbon in the literature. The vitreous carbon attracts designers of structural components because it has low density (2/3 of the graphite theoretical density) and superior mechanical properties as compared to the same of graphite [3].

Thus, preparation of a precursor foam with the targeted cellular structure from a pyrolyzable resin is the key component of the VC foam synthesis process. The most widespread preparation process of the precursor resin foams is based on the replication approach in which structural elements (struts) of the reticulated polyurethane foam template are covered with a thin resin layer. After setting the resin, the open-pore cellular structure can be immediately pyrolyzed [5-8]. The VC foams synthesized by this method are also known as reticulated vitreous carbon (RVC) foams because they have typical reticulated foam structure consisting of the interconnected polyhedral cells. All classical precursor resin types can be used in this method. Another approach ensuring an open-pore cellular structure is based on the sacrificial template approach in which a template is made as a bed of the densely packed granules that can be impregnated with a precursor resin [4, 10]. After setting the resin, the template is leached away, and the resultant cellular structure can be

Buckling Analysis of Straight Beams with different Boundary Conditions using an Integral Formulation of the corresponding Differential Equations

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Abstract: *This work deals with structural stability analysis of straight beams, having different boundary conditions. The particular case of the beam on elastic foundation is also analyzed. The method of analysis is an approximate integral one, using structural flexibility functions (Green's functions). The differential equations governing the Euler buckling of such beams are put in integral form. This approach is a matrix one leading to an eigenvalue problem in the case of stability analysis. Different numerical examples concerning the calculation of the critical buckling loads are presented in comparison with the results of other methods. The obtained results show good agreement from engineering point of view.*

Key Words: *Straight Euler Beam, Green's Functions, Elastic Foundation, Buckling*

1. INTRODUCTION

Buckling of beams subjected to compression represents an important topic in the fields of mechanical, structural and aeronautical engineering.

The calculation of critical buckling loads pay a crucial role for such a compression members which are the object of many studies including static, dynamic and stability ones. Exact analytical solutions are available only for particular uniform beams in the case of usual boundary conditions. Such solutions were resumed in several books as [1-3].

When the flexural rigidity has a variation along the beam or there are continuous restraints, different numerical approaches have been developed besides the FEM.

One can enumerate for example energy methods, finite difference method [4], DQM (differential quadrature method, [5]), VIM (variational iteration method, [6]) and HAM (homotopy perturbation method, [7]). The structural flexibility functions (Green's functions) and their use in the structural static, dynamic, stability and aeroelastic analysis of beam like structures were presented in several works as [8-12]. The equation describing the bending deflection $w(x)$ of a non-uniform beam having bending stiffness $EI(x)$ and resting on an elastic foundation (characterised by the constant k), subjected to constant axial compression force P and transverse distributed force $p(x)$ (see fig. 1), takes the form [7]:

$$\frac{\partial^2}{\partial x^2}\left(EI(x)\frac{\partial^2 w}{\partial x^2}\right)+P\cdot\frac{\partial^2 w}{\partial x^2}+kw=p(x)\ . \tag{1}$$

Starting from the above equation, in this work several beam configurations with different boundary conditions including or not the presence of an elastic foundation and loaded in compression are analyzed in order to obtain the critical buckling loads.

The equation governing the bending behavior of the beam are solved using an integral form based on Green's functions.

This approach leads to an eigenvalue problem allowing the computation of the critical buckling loads. Several examples are then discussed in comparison with available results from literature.

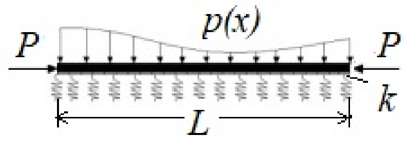

Fig. 1 – Beam resting on elastic foundation

Temperature Effects on Damage Mechanisms of Hybrid Metal – Composite Bolted Joints

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Abstract: *This paper presents the quasi-static thermo-mechanical loading effects on the progressive damage mechanisms and failure modes of the single-bolt, single-shear, hybrid metal-composite, bolted joints in aerospace applications. A three-dimensional finite element method (FEM) technique was used to model the countersunk head bolted joint in details, including geometric and frictional based contact full nonlinearities and using commercial software PATRAN as pre/post-processor. The progressive damage analysis (PDA) in laminated (CFRP / vinyl ester epoxy) composite material including nonlinear shear behavior, Hashin-type failure criteria and strain-based continuous degradation rules for different values of temperatures was made using SOL 400 NASTRAN solver. In order to validate the numerical results and close investigation of the fracture mechanisms for metal-composite bolted joints by determining ultimate failure loads, experiments were conducted in temperature controlled chamber. The results show that the thermal effects are not negligible on failure mechanism in hybrid aluminum-CFRP bolted joints having strong different thermal expansion coefficients. The complex 3D FEM model using advanced linear continuum solid-shell elements proved computational efficiency and ability to accurately predict the various failure modes as bearing and shear-shear out, including the temperature effects on the failure propagation and damage mechanism of hybrid metal-composite bolted joints.*

Key Words: *Progressive Damage, Temperature, Failure.*

1. INTRODUCTION

The aerospace industry became the most common application field for fiber-reinforced polymer matrix composites (PMCs) due to their lightweight properties [1]. These structural components are often assembled in conjunction with metal parts using mechanically fastened joints resulting in hybrid metal-composite joints which determinate some challenging problems for mechanical engineers. Poor designed hybrid joints is not only a source of failure, but could lead to a reduction in durability and reliability of the whole structure. Up to nowadays, the researchers studied the failure of composite bolted joints using a method that combines continuum damage mechanics (CDM) [2] with finite element analysis (FEA). In the CDM case, the local damage onset appears at a low values of applied load and damage accumulation is developed with increasing load according to damage propagation lows, which makes the method accurate and able to predict various failure modes. The major disadvantage of the CDM models is the huge amount of test data required for model calibrations. The progressive damage analysis (PDA) in composite materials, which is based on the stress-strain failure criterion, showed that the material orthotropic properties reduction due to damage initiation is essential for the stress field analysis [3-7]. A lot of PDA models in research field [8-11] incorporated shear nonlinearity, Hashin type failure criterion and constant elastic properties degradation low for orthotropic materials, which makes the method quite easy to implement and computational efficient. Because these properties degradation models used constant factors for elastic properties reduction due to damage growth, the models weren't be able to predict the bearing final failure.

Models containing continuous degradation rules started to appear in the literature [12], [13] to improve the numeric algorithm converge and to obtain a smoother loading-displacement curve. One major lack of these models is that they focused only on a few types of failure mode and not concerning on various joint failure modes. The composite progressive damage behavior is complex nonlinear phenomena and in conjunction with geometric and contact nonlinearities can lead to divergence of the finite element method (FEM) analysis, mostly in implicit numerical algorithms which implies that a lot of effort is paid for

Evaluation of the effective elastic out-of-plane properties of hexagonal honeycombs by considering the influence of curvature radius and adhesive layer

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Abstract: *Numerical modelling of honeycomb structures in aerospace engineering is too tedious and time consuming. The homogenization of these structures permits to obtain an equivalent orthotropic homogeneous solid and its elastic effective properties and thus realizing very efficient simulations. In a sandwich structure the most important effective constants of the core are the out-of-plane shear moduli* G_{23} *and* G_{13}*. These effective constants can be obtained analytically, numerically or, if available, can be taken from the producer's data sheets. In the last case they are generally obtained experimentally, but only for some thicknesses of the cores and sandwich faces. The analytical models usually neglect the curvature radius of the cell walls and the adhesive layer influence by using some additional hypotheses. In this paper a general parameterization of commercial honeycombs is first discussed. Then, neglecting the skin effect and considering the rigid skin effect, the out-of-plane properties of the core are obtained using a finite element analysis of a representative volume element. The numerical results are analyzed by comparing them to the ones given by the existing analytical models and/or experimental data and their advantages and pitfalls are discussed and explained. The results provide new insights into understanding the mechanics of honeycombs.*

Key Words*: Hexagonal honeycombs, Node bond adhesive, Finite element Analysis, Effective elastic properties, Adhesive thickness and fillet.*

1. INTRODUCTION

Honeycomb structures had found widespread applications in various fields as aerospace engineering, automotive, mechanical engineering, chemical engineering etc. Hexagonal honeycombs with double walls attached along the ribbon direction are called sometimes *commercial honeycombs*. The most important feature of the core is its relative density defined as the ratio between the effective density of the honeycomb material and that of the material from which the cell walls are made. The relative density can vary from 0.001 to, generally, 0.4 [1, 2]. A variety of materials have been used as basic materials to fabricate honeycombs, including paperboard, fibreglass, carbon fibre reinforced plastic, Nomex or Kevlar reinforced plastic, polypropylene and metals, mainly aluminium and steel.

By using the finite element method, the explicit modelling of the complete core leads to a significant increase of finite elements and degrees of freedom, therefore increasing the computational effort without real benefits for some practical problems. Usually, in a finite element analysis (FEA), the macroscopic model of a panel can be modelled as a layered composite Shell with sandwich option or as a solid structure in which the core is discretized with orthotropic brick elements [3]. The reliability of the continuum model strongly depends on the accuracy of the effective core properties.

If the honeycomb core is used in sandwich panels then the effective material properties are to be determined by considering the effect of the skins which are usually considered as being rigid. However, for the experimental determination of the in-plane elastic properties the honeycomb is tested without skins as done by Balawi and Abot [4] and by Karakoç and Freund [5]. Consequently, two categories of effective elastic constants can be evidenced: by neglecting the skin effect and considering the rigid skin effect [6, 7].

Many analytical relations for establishing the effective mechanical properties estimations are considered in the literature [2, 8]. Gibson and Ashby summarized the analytical formulas for relative density and the in-plane and out-of-plane properties of commercial honeycombs but by neglecting the curvature radius at the wall's intersection and the adhesive layer presence at the cell nodes. Masters and Evans [8] were the first to consider the radius of curvature at the intersection of the cell walls in an indirect way, that is by considering the hinging mode deformation, difficult to be generalized for various types of commercial honeycombs.

ACKNOWLEDGEMENTS

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Influence of Additive Concentration in Soybean Oil on Rheological and Tribological Behavior

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***Abstract**: The rheology of vegetal oils, additivated or not and the factors that influence their viscosity have been studied by specialists, in order to introduce these oils as lubricants in green industries as agriculture, food processing, transportation and for complying with environmental and health regulations; the vegetal oils are also envisaged as an eco-friendly alternative to similar mineral and synthetic products. This study presents the influence of nature and concentration of additive in soybean oil on its rheological and tribological behavior, reflected by shear stress - shear rate, viscosity - temperature curves and by the wear scar diameter (WSD) after testing the formulated lubricants on a four- ball machine.*

***Key Words:** soybean oil, black carbon, graphite, graphene, viscosity, shear rate*

1. INTRODUCTION

The rheology of vegetal oils, additivated or not, and the factors that influence their viscosity are studied by specialists, data being used for introducing these oils, as lubricants in green industries as agriculture and food processing, transports and to comply with environmental and health regulations, but also as an eco-friendly alternative to similar mineral and synthetic products [1], [2].

Quinchia et al. [3] reported a viscosity increase for low-viscosity vegetable oils (sunflower oil, high-oleic sunflower oil and soybean oil), at moderate temperatures when adding 3...4 %wt. ethylene–vinyl acetate copolymer. Additives based on allotropic phase of carbon are added in lubricants, but their influence on the rheological behavior of vegetal oil are still under research [4].

The purpose of this study is to evaluate rheological and tribological properties of non-additivated soybean oil and lubricants formulated with carbon nanoparticles (amorphous carbon, graphite and graphene), in different concentrations.

2. METHODOLOGY, EQUIPMENT AND MATERIALS

2.1 Materials

The refined soybean oil, as supplied by Prutul Galati has the following composition in fatty acids (in wt%): 0.11% acid myristic (C14:0), 12.7% palmitic acid (C16:0), 0.13% palmitoleic acid (C16:1), 0.05% heptadecanoic acid (C17:0), 5.40% stearic acid (C18:0), 21.60% oleic acid (C18:1), 52.40% linoleic acid (C18:2), 5.70% linolenic acid (C18:3), 0.25% arachidic acid (C20:0), 0.20% gondoic acid (C20:1), 0.50% eicosanoic acid (C20:2).

Additives were supplied by PlasmaChem [5]: nano amorphous carbon (average particle size ~ 13 nm), nano graphite (average particle radius: 400 - 450 nm), nano grafene (nano plates with a thickness of 1.4 nm and a particle size of up to 2 microns), each added in different concentrations (0.25%, 0.50%wt, 1.0%wt).

The experimental test equipment for evaluating the rheology of lubricants is a Brookfield CAP 2000+ rotational viscometer, controlled by a dedicated software, CAPCALC 32. In order to determine the rheological

Evaluation of Aerospace Materials in Relation to the Thermal Gradient

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Abstract: *The increasing of the flight performances of the turbo-engines and rockets impose the creation of the new testing equipment for TBC coatings, both for heating and cooling. Within this frame is described a new concept for a testing equipment for quick thermal shock testing at cooling. The concept of quick thermal test shock is relatively recent introduced in utilization. The first European standards were approved in 2011 and 2012. The works of the INCAS in the field of TBC coatings started in 1990, with vitro enamel materials. The testing of the TBC specimen is a complex one, being involved not only the support but also a number of substrates deposited by different methods. In order to evaluate solutions for new multilayer materials, functionally graded materials (FGM) elaborated in the last two decanis by the INCAS researches and the collaborators from the research institutes, partners at the FP7 international projects: TheBarCode, Hydra, ESPOSA, INCAS designed and achieved quick thermal shock installations and upgraded them as per contract requirements.*

Key Words*: thermal shock, thermal expansion, ceramic, multilayer*

1. INTRODUCTION

Why thermal shock?
Where it sees thermal shock?
The thermal shock is at heating and at cooling.

To increase turbine engine efficiency, better solutions are needed that can withstand hotter temperatures.

Today, aero and industrial gas turbine engines employ higher turbine inlet temperatures to improve efficiencies

Because today's turbines are subjected to temperatures of over 1500° C (2732° F), the new material solutions were obtained.

These materials are applied to transition ducts, combustors, heat shields, augmenters (afterburners), nozzle guide vanes, and blades (buckets).

For example the turbine inlet temperature of F-16 Fighting Falcon engine is 1,510°C.

Turbine inlet temperature: 2750F (1,510°C) - F110-GE-129 turbo fan engine [1].

The turbine inlet temperature of MiG35/MiG-35D is 1,407°C (2,565°F) [2].

Cooling and heating quick thermal shock.

At 10000 m altitude the temperature is about-50°C; if the engine stops cold air passes over the heated parts at over 1000°C.

So, the installation has been designed and realized in order to respond to a request.

In the Institute have developed over time several facilities for thermal shock testing of various materials developed by us, such as thermal barriers.

Since 90 years, initially used a furnace with a standardized access via a side door. Sample was introduced into the oven with the help of a clamp and maintained for a period of time. Then the sample was removed from the oven on a stand constructed from refractory material and cooled down with a jet of compressed air.

Section 5. Systems, Subsystems and Control in Aeronautics

Space Energy, a Source of Endless Energy and a Future Challenge in the Field of Space

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Abstract: *With each passing day, we are more aware that the numerous alternative and natural sources of energy (solar, nuclear, wind turbine, tidal and wave) are insufficient in the field of aerospace propulsion. Therefore, a new source of energy, endlessness, free, non-polluting, renewable and omnipresent will be discovered to meet the needs in the field of aerospace propulsion. More and more often today is discussed the subject regarding the energy of the electromagnetic fluctuations of free space, known as the Zero Point Energy or Energy of the Space. The question is more and more frequently related to how to tap this energy of space. As the great physicists say, attracting space energy is only possible by ordering the electromagnetic fluctuations characteristic of the zero point field, and that is how this enormous amount of energy is put to work. Based on quantum mechanics principles it has been established that between the known energy forms and the space energy, the element able to capture the energy of the zero point by ordination is the convergent spiral called vortex. Spiral convergent motion creates matter and energy through conoidal micro-vortices of elementary particles and energy quanta. Space energy tapping investigation has led to a new physic-mathematical paradigm regarding natural systems ordering and self-organization. In this scientific paper are solved some of the current problems, such as inertia and gravity, as effect of body interaction with Energy Field of the Zero Point.*

Key Words: *space, field, energy, zero point, capture, ordering, aerospace*

I. DEEP MYSTERY

1.1 WORLDWIDE

Nowadays biggest problem is to transfigure the disorder or chaos into order, so in other words into a new source of energy.

Science has proven that everything we attained and will do would lead to an increase of entropy and thereby of disorder.

"Studying living beings we can best appreciate how primitive is still physics" are the words of Albert Einstein, who want to emphasize that understanding the living systems and the new laws beyond the known physics will make us to understand the "functioning" of open systems, far from equilibrium.

All these systems receive a continuous influx of energy/ substance.

Recent discoveries highlight that nature has its own laws that open new horizons to physical, chemical and biochemical systems.

1.2 AEROSPACE DOMAIN

On the top of the problems that affect the aerospace industry is the fuel crisis. Three guidelines deal with aeronautical and space transport, respectively;

1. Fuel consumption reduction
2. Noise pollution reduction
3. Damping or even expelling, as far as possible, of chemical pollution.

It just so happens that, all of this are intimately linked to the energy sources we use today. Nowadays aerospace industry researches are focused on Free Energy, which was recommended by the great inventor N. Tesla, being available at any point in the Universe.

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The absolute stabilization and optimal control of hydrofoil watercrafts

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Abstract: *Hydrofoil watercrafts have a technology through which immersed wings are mounted under the hull. In the longitudinal movement case, these transversal wings are developing a carrying capacity which lifts the ship, thus decreasing the wet surface. The hydrodynamic lag decreases too, reaching economic fuel consumption as well. The paper deals with the analytic and graphic-numeric study, specifying the stable movement regime in the vicinity of the critical (equilibrium) points* v_1, v_2, v_3. *The asymptotical stability is highlighted by using the Liapunov criteria, too. The practical control (self-stabilization) is obtained by using an automate speed controller (scanner), depending on wings flaps and the ship attack angle compared to the horizontal. It may be observed that (1) is in the category of cuspidal-returns from the Catastrophes Theory and bifurcations. Transversal waves or wind disturbances causes a ship flutter effect. For hydrofoil dynamics, an optimal control is finally applied, using the minimal time criterion related to Lev Pontryagin's extremum principle.*

Key Words: *hydrofoil, longitudinal movement, asymptotical stability, catastrophes theory, mathematical model*

1. INTRODUCTION

Hydrofoil watercrafts have a technology through which fully submerged wings are mounted under the hull. In the longitudinal movement case, these transversal wings are developing a carrying capacity which lifts the ski, decreasing the wet surface in this way (figure 1).The hydrodynamic lag decreases too, reaching economic fuel consumption as well. The hydrofoil longitudinal movement equation (without rolling or gyration disturbances) in the speed space $\mathrm{v}(t)$ is:

$$\frac{dv}{dt} = T(v) - S(v) = F_3(v) \tag{1}$$

where *T(v)* is the traction force (motor or turbo-jet), and *S(v)* is the drag and lift forces resultant for the unity mass in the speed space *v(t)* is and *S(v)* is drag and lift resultant hydrodynamic forces for the unity mass ship. Generally, *T(v)* is linear or parabolic decreasing with the speed *v(t)* and *S(v)* has monotony intervals for this (H) model. In (H) model $F = F(v) = 0$, we have v_1,v_2, v_3 critical speed (equilibrium) specifying the stable regime in this vicinity. This provides a corresponding increase in speed $v_1 < v_2 < v_3$ and fuel efficiency (decreasing drag).

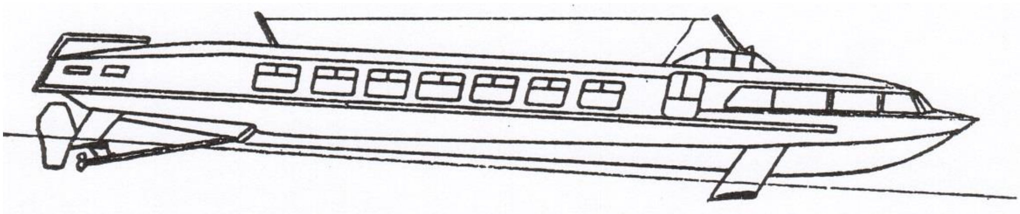

Fig. 1

Two transversal wings, provided with carrying capacity getting flaps, are mounted underneath the ship: in order to get a high carrying capacity and a great ship attack angle (measured towards the horizontal plane), the wing below the bow is greater than the wing below the stern (figure 2).

Notes regarding the supply and drain pressure effects on a squeeze film damper

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Abstract: *Squeeze film dampers (SFD) are perhaps the most efficient devices that, nowadays, can be used to control the shafts in airworthy turbo-compressors. Various other devices can be successfully used in land-based rotating machinery, however, due to space and weight constraints they can not be used for the lateral vibrations control in on-board ball bearings supported turbines. SFDs are basically thin oil films (surrounding the ball bearing housings), that, in conjunctions with various elastic elements and antirotational devices provide the stiffness and damping required for adequate shaft behavior. Fluid films in SFDs are strongly influenced by the oil supply and drain pressures. Some aspects regarding the effects of the supply and drain pressures on a SFD are discussed below.*

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

1. INTRODUCTION

Increasing turbomachinery performances requires continuous increase in shaft velocity; it is common nowadays for turbomachines to operate above several critical speeds. The dynamics of the shaft is therefore extremely important, hence the damping and stiffness of the supports (in conjunction with the stiffness of the rotors) must be carefully tuned. Land operating rotors can be installed on a wide variety of supports; both fluid film bearings and ball bearings are acceptable and (as, in many cases space and weight are not very critical concerns) various types of dampers can be included (as needed) in the supports to adequately adjust their dynamic coefficients.

In aviation, due to flight safety regulations, the rotors of the turbo-compressors in the aerospace propulsion systems must be supported by ball bearings. This requirement is natural giving the nature of the failure in ball bearings and in hydrodynamic fluid film bearings.

Failure of the fluid film bearings often occurs without early warning signs, however, ball bearings malfunction is usually preceded by (and associated with) vibrations which can be detected early enough to avoid catastrophic engine collapse in flight.

However, ball bearings have vary high stiffness and very low damping, so additional damping must be somehow introduced into the system for adequate behavior of the rotor.

Weight, on the other hand, is a very strong concern for aviation, and, in many cases space restrictions are also quite severe.

Consequently, most of the rotor supports tuning devices that can be utilized for land-based rotors are not suitable for air-worthy rotors. In many cases, the proper setting of the rotors' supports properties in aerospace engines can only be done with Squeeze Film Dampers (SFD).

Squeeze Film Dampers (SFD) are, basically, thin oil films that surround the location (usually a ball bearing housing) where additional damping is needed.

They are called Squeeze Film Dampers because, although they belong to the hydrodynamic bearings, the spinning of the surfaces separated by the oil film is restricted (to avoid journal bearing types of instabilities) and the hydrodynamic force is only due to the squeeze motion, the pressure supply and drain system and sealing. Figure 1 shows a schematic of a SFD with seals, pin and an element of an elastic support ("squirrel cage").

Squeeze Film Dampers have been subject of intense research for several decades and probably hundreds of papers have been dedicated to them, as shown, for example in Refs 0-0 however, choosing the proper stiffness and damping for a rotor is not an easy task, Ref. 0.

Cavitation may appear, especially when the supply and drain pressures are low, turbulence, Ref. 0, may play its role at high velocities, and moreover, fluid inertia may have a contribution at high Reynolds numbers, Refs. 0-0.

Analysis of modern military jet trainer aircraft

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Abstract: *New technical solutions and the application of modern technologies have led to combat aircraft configurations with a significant improvement in reliability, flight performance and operational performance through the creation of new features that enhance the ability to integrate sensors and process information. This pace of development has on one side created operational advantages, but on the other side made it increasingly expensive to use modern multi-purpose combat aircraft. In this context, the need for the use of modern military jet trainer aircraft has become more and more acute, the cost being reduced by about 10 times per hour of instruction in comparison to a jet fighter. The aim of this paper is to analyze the technological performances of the newest and most advanced jet trainers in the world and the development perspectives in the field, to determine the directions of development and the design of a new Romanian jet trainer to be used for school, training and light combat and to be competitive for the time period 2030-2040.*

Key Words: *analysis, military, jet, aircraft, trainer, modern.*

1. FOREWORD [1, 2, 3, 4, 5]

A jet trainer is a jet aircraft for use as a trainer, whether for basic or advanced flight training. Jet trainers are either custom designs or modifications of existing aircraft.

With the introduction of military jet-powered aircraft towards the end of the World War II it became a requirement to train pilots in the handling of such aircraft.

As training developed different air forces used jet trainers for different phases of training. Pilots who were picked to fly fighter or strike aircraft then went on to fly more advanced training aircraft.

As the jet trainer developed it was also used for weapon training, which led to some trainers being modified as light strike aircraft.

The two seating configurations for trainer aircraft are pilot and instructor in tandem, usually with the pilot in front and the instructor behind. The tandem configuration has the advantage of being closer to the normal working environment that a fast jet pilot is likely to encounter.

Given the expense of military pilot training, air forces typically conduct training in phases to eliminate unsuitable candidates. The cost to those air forces that do not follow a graduated training regimen is not just monetary but also in lives.

There are two main areas for instruction, flight training and operational training. In flight training a candidate seeks to develop their flying skills. In operational training the candidate learns to use his or her flying skills through simulated combat, attack and fighter techniques.

Modern advanced trainers feature programmable multi-function displays which can be programmed to simulate different electronic systems and scenarios. Most advanced trainers do not have radar systems of their own, but onboard systems can be programmed to simulate radar contacts. With datalinks and GPS, virtual radar systems can be created with similarly equipped aircraft relaying to each other their positions in real time and onboard computers creating a radar display based on this information [7]. The aim of programmable displays is to speed pilot training by replicating as far as possible the systems a pilot will find in an operational aircraft.

As the capabilities of front-line aircraft have increased, this has been reflected in increasingly sophisticated advanced trainers. As the costs of developing new aircraft have risen in real terms, it has become more likely that fewer aircraft will be designed specifically for the training role. The advanced trainer was often seen as a stepping stone by most nations in developing a fast jet design and manufacturing capability. With increasing costs, even major air forces will have difficulty reaching the economies of scale to justify development of new advanced trainers. Nations will be required to continue to push the modernisation of existing aircraft (some such as the Hawk dating from the 1970s) or co-operate in the development and procurement of advanced training aircraft. Furthermore, they must better utilise funding

Regulatory requirements concerning a new school and training military jet

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Abstract: *The requirements for the design of a new Romanian school and training military jet are in line with the EMAR - European Military Airworthiness Requirement. The Approval Regulation for the new school and training military jet is EMACC - European Military Airworthiness Certification Criteria. In addition to the basic regulation, the main categories of norms used for design, manufacturing and testing are as follows: AIR, MIL, NA, EN and SR EN etc. For each system used on the the new school and training military jet, Standard Defense 00-970 and NATO STANAG regulates the requirement to perform tests on a functional model. Each modeled system, in order to be tested, must meet the accuracy of reproduction of the original system.*

Key Words: *requirements, regulations, military, jet, school, training.*

1. FOREWORD [1]

Achieving economic performance in building and operating a new aircraft involves analyzing general requirements, including regulatory requirements, in relation to modern technologies and adapting technical solutions according to these requirements. Under these conditions, the level of demonstration by trial is diminished and costs can be reduced.

Currently, the European legislation has a dynamic character, with objectives related to implementing the adopted requirements, completing and standardizing working procedures, achieving consensus on national military regulations and achieving the integration perspective in a single regulation for civilian and military with specific parts, differentiated by the criteria currently adopted for civil aviation.

Conformity analysis allows, in the context of legislation in the field, correlation with the requirements of the Military Aeronautical Authority, the correct approach to compliance for the new school and training military jet.

Harmonization of airworthiness regulations is a European strategic decision to improve cooperation, strengthen technological competitiveness, industrial base and improve cohesion between airworthiness regulations, military and civilian-military commonwealth of European Union.

Objectives and benefits anticipated through the European strategy:

- Improving the safety of military aviation;
- Improving military-military and civil-military cooperation;
- Reducing time and costs for developing a new aircraft;
- Increasing competitiveness;
- Introducing a common approach to maintenance and repair of the aircraft;
- Recognition among the various military airworthiness authorities;
- Creating perspectives for outsourcing maintenance and repairs;
- Improvement of weapons systems;
- Recognition by civil aviation authorities;
- Increase interoperability in joint air operations.

In the framework of the MAWA (Military Airworthiness Authorities), the representatives of the Member States will promote a common set of harmonized European Airworthiness Requirements (EMAR), Acceptable Means of Compliance (AMC) and Guidance Material (GM). These will be included in national airworthiness regulations by all states. MAWA does not have the authority to impose airworthiness regulations on Member States. The international relations of MAWA and the way of collaboration are presented in Fig. 1. 1. Concluding the writing and approval of the Military Regulations is characterized by a legislative dynamics with a view to ratification of documents at the level of EU Member States, harmonization at European level and adoption of the final regulations.

3. CLONCLUSIONS [1]

The requirements for the new school and training military jet design are in line with the EMAR - European Military Airworthiness Requirement.
For the new school and training military jet, the Approval Regulation is EMACC - European Military Airworthiness Certification Criteria.
In addition to the basic regulation, the main categories of norms used for design, manufacture and testing are as follows: AIR, MIL, NA, EN and SR EN (former STAS) etc.

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ABBREVIATIONS

AJT: Advanced Jet Trainers,
EDA: European Defence Agency,
EDSTAR: European Standards Reference System,
FA: Fighter Attack,
LA: Light Attack,
LCA: Light Combat Aircraft,
LIFT: Lead in Fighter Trainer,
EASA: European Aviation and Safety Agency,
EMACC: European Military Airworthiness Certification Criteria,
EMAR: European Military Airworthiness Requirement,
EMJAAO: European Military Joint Airworthiness Authorities Organisation,
MAA: Military Aviation Authority,
MAWA: Military Airworthiness Authorities.

Section 6. Experimental Investigations in Aerospace Sciences

Validation of an acoustic tool to determine the propeller rpm

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Abstract: *For noise certification of small propeller aircraft, ICAO Annex 16, Chapter 10 requires the measurement of propeller speed with an independent device. For this, usually an optical tachometer is used. However, in some applications with twin-engine aircraft, the propeller location is such that rpm measurement with an optical tachometer is not feasible and other devices may not be mounted. Therefore, an alternative method was developed, based on the acoustic signal of the propellers. An alternative method based on vibration levels was also derived. The paper begins with a brief introduction on noise certification and the equipment required to be installed on-board of the aircraft. Experimental laboratory tests are then presented for the tool development, and a section describing real conditions results obtained on-board of a twin-engine aircraft during flight tests, is included. The paper continues with a comparative analysis between the results from the acoustic and vibration signals and actual rpm measurement from engine instruments, used to validate the rpm detector tool.*

Key Words: *rpm detection, acoustics, vibrations, signal processing*

1. INTRODUCTION

For noise certification of small propeller aircraft, ICAO Annex 16, Chapter 10 [1] prescribes the flight test procedure and the methodology to correct measured noise levels to specific reference conditions. One of the main parameters that influences the noise level is the Helical Tip Mach number (HTM) of the propeller, which is a function of air speed and temperature and propeller rotational speed, with the latter the dominant element.

Usually the HTM during the actual tests differs from the reference value and thus a correction needs to be applied.

For this reason, an accurate determination of the propeller speed is of utmost importance for the resulting certification noise level.

Chapter 10 requires the measurement of propeller speed with an independent device. For this, usually an optical tachometer is used, more or less perpendicular to the propeller plane. However, in some of the noise certification projects that ANOTEC had to perform on twin-engine aircraft, the possible location for the tachometer was such that a very low angle relative to the propeller plane was existing, for which the optical tachometer doesn't work accurately. An alternative method, based on on-board measurement of noise and vibration levels, was therefore developed.

2. METHODS DESCRIPTION

The acoustic tool to determine the propeller rpm was developed with two methods for a better tuning of the raw wave signals. Methods comparisons are presented in the next chapters where the authors are seeking experimental tests with standard rpm measurements as reference.

The most important stage is to gather information about the noise source itself. For propeller aircrafts the most important information to consider before analyzing the signals, is the maximum RPM, the number of blades and the number of engines.

The number of engines can be used to underline asynchronous detection aspects and estimate instantaneous RPM differences between engines. The number of blades and the maximum RPM are used to establish the frequency domain of interest.

The key aspect of both methods is to obtain a good resolution of the Fast Fourier Transform (FFT) in time and frequency, because the main input for the detection algorithm is the spectrogram of a well-known frequency domain.

Concurrent engineering in designing a system for sensing gas leaks in harsh space environment

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Abstract: *Leak monitoring is an essential operation that must be taken into consideration while making the design of a spatial vehicle. In order to make these vehicles function correctly in space and to avoid disasters, one needs to integrate multiple sensors to determine the exact concentrations of fuels such as hydrogen, hydrazine, hydrocarbon or oxygen which are frequently used while launching a space vehicle. These concentrations are important, as hydrogen-oxygen mixtures can ignite with a very small amount of energy. Moreover, it is almost impossible for people to sense the presence of hydrogen, as this gas is odorless and colorless. In the propulsion industry, hydrogen leaks generated several disasters. In 1990 such an error affected the propulsion system while workers were on the launching platform. They were forced to abort all the current processes until the source of leakage could be identified. Another example is the APOLLO 13 mission that took place in 1970 when N.A.S.A aimed to land on the Moon. Two days after the launch there has been a malfunction of the electrical system which caused an explosion leading to the loss of oxygen in both tanks. The crew used a module called lifeboat on their way back to Earth where they completed the landing. The goal of this paper is the describe the concept of an intelligent system that will monitor the presence of oxygen, hydrogen gas in harsh space environments such as vacuum, temperature variations and also beta and gamma radiations. Therefore, some aspects such as the weight of the device or environmental conditions must be taken into consideration when doing concurrent engineering. Micro and nanotechnologies allow the presence of multiple sensors without increasing the size, the weight or the energy consumption. Also, they must resist harsh conditions from space.*

1. INTRODUCTION

In order to ensure safe travel through space, there have to be less unpredicted situations that cannot be fixed. Over time, gas leaks became a problem that must be taken into consideration since events such as the STS-35 mission must be avoided.

This paper aims to describe an intelligent system that will monitor the gases such as oxygen, hydrogen in conditions that involve vacuum, radiations or temperature variations.

This article will present the basic theory applied to gas sensors, details on experiments that were performed, a brief characterization of the sensors and the results that were obtained.

Monitoring gas leaks have been investigated using wireless sensors networks on terrestrial structures and spacecraft. For example, the authors in [1] surveyed general leak monitoring methods, analyzing challenges of the space environment, such as meteoroids and space debris impacts, charged particles radiation, temperature cycling, vacuum environment, etc. damaging sealed structures, and demonstrating that only a multi-sensor data fusion method allows diagnosing the leaks and the leakage rate thus allowing for rapid leak detection and location in sealed spacecraft structures. This method is validated by a ground experiment, confirming that the spacecraft sealed structure leak reason, location and leakage rate can be detected accurately and effectively.

Another method to real-time detect spacecraft damage and determining gas leaks accurately is by using an acoustic sensor array to detect the acoustic signal which is emitted from the damage of the spacecraft on orbit, calculating the difference of arrival and beamforming algorithm to locate the damage and leakage [2]. As such, the extent of the spacecraft damage is assessed according to the nonlinear ultrasonic method,

Experimental Investigations on the Possibility to Apply the Corrugated Sheet Metal Used in the Past at Junkers Aircraft for Noise Reduction of Future European Aircraft. Other Experiments Dedicated to Noise Reduction of Future European Aircraft

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Abstract: *This paper shows that corrugated skin used in the past at Junkers aircraft for increasing of fuselage's and wing's rigidity can lead to noise reduction and aerodynamic performance increasing of future European aircraft. If the pressure side of wing which is placed above the engine is corrugated, the jet noise reflected by wing will be scattered. The diffuse acoustic field created in this way has a lower intensity at ground level and correspondingly a lower impact on community. Similar, it is shown that if the underside of fuselage is corrugated, the noise emitted by the nose landing-gear and main landing-gear is scattered, too. Existence of this effect is demonstrated by some recent measurements done inside auto-tunnels covered at interior with corrugated sheet metal which indicated a reduction of maximum noise level with 30%. Some experiments done by authors at low scale on an Airbus A380 wing model (scale 1:375) shown that the jet-noise reflected by the corrugated skin of wing is smaller with 4 dB in the near field. Reintroducing of corrugated skin in manufacturing of modern aircraft is beneficial because, on a hand, it reduces the annoyance created by the jet-noise and landing-gear noise and, on the other hand, it permits manufacturing of stronger frames for passenger aircraft.*

Key Words*: aeroacoustics, psychoacoustics, noise reduction, annoyance*

1. INTRODUCTION

In the last time communities begun to be much affected by aircraft noise especially the communities living near airports.

The most of airports are located in the vicinity of cities and some of them are located even inside cities because in time cities extend to airports and finally incorporate them.

It is known that at the middle of the 20-th century, Junkers created an aircraft with corrugated skin over wing and fuselage.

This solution could be partially used in the next future in special areas of wing skin and fuselage for noise reduction through scattering both in the case of classic aircraft and BLI or Electric/BLI aircraft.

Several possibilities of using the Junkers solution in manufacturing of future European aircraft are discussed in this paper.

The chapters of this paper are:

- **Aircraft noise seen through the point of view of psychoacoustics**, where some important aspects of human hearing in relation with aircraft noise are briefly explained;
- **Underlying of productive research directions for reduction of annoyance produced by aircraft**
- **Junkers 52 design solution**, where main features of its exception design are presented;
- **The case of present aircraft**, where it is shown that the existent aircraft have the drawback of a strong reflection of noise by wing and fuselage;
- **Applying of Junkers 52 solution at future aircraft**, where it is shown that the future aircraft should have corrugations on the pressure side of wings (over engines) and on the lower surface of fuselage;
- **The experimental facts**, where experiments or real facts are presented for sustaining the idea of reusing the Junkers corrugated skin for future aircraft;

Section 8. Management in Aerospace Activities

Some Considerations About R&D in Aviation Type of Projects. The Role of the Project Manager

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***Abstract**: Aviation industry is one of the important parts in the industrial global world product. The R&D projects are indispensable for this industry and the future is now for many projects in development in Europe. For the airplanes development in time some specific historical milestones are presented for civil and military aviation. The categories of projects in aviation field are presented keeping in account the destination of projects, the specific targets and the financial and human resources. In this context, the number of aviation projects is in an exponential increase and diversification and concerns different aspects from airplane design to airports control and environmental survey. A special analysis is dedicated for actual European projects in development. Regarding the management of R&D projects some consideration are done about projects presentation, team formation and how to select a team leader. New technology and new techniques are defined as important future developments. The qualities of Project Manager are defined and some leader ways of work are presented too.*

***Key Words**: Aviation R&D projects, Airplane Development, Type of R&D projects in aviation, Management of Projects, Team Work, Project Manager Activities.*

1. INTRODUCTION

The scope of this paper is to high-light some characteristics of R&D in aviation and to summarize some ideas about new fields of interest, perspective and the ways to propose valuable projects especially in EU. A particular attention is done in this context to the work of the Project Manager and of his team.

To focus our ideas and to reduce the fantastic quantities of data covering the big number of area in the R&D field we intend to general analyze the situation of R&D for airplanes in time and in world, for civil and military program and not interfere with data about rotorcraft , drones and aero spatial activities. The analysis is done with data from civil and military aviation because of many interdependencies.

2. R&D IN AVIATION, IMPORTANT MILESTONES

In a very suggestive image (Fig 1) the historical development of the aviation is presented from balloons to the last fighters and the idea of this image is from technical point of view: What was done in only 100 years!!

Fig.1

Knowledge society and aviation. Requirements for development-based management

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Abstract: *The article presents the relationship between the demands of knowledge society and aviation management. The impact of the knowledge society is stronger on high-tech industries, such as aviation. The requirements of the knowledge society act both for the operation of the entire branch of activity and for the management of the aviation companies. Being since its emergence in the avant-garde of development, aviation has shown many directions for future evolution of society and economy. Presenting the way aviation has interacted with the progress of society and the economy, both in the world and in Romania, can offer lessons for the future. Everyone wishes that the positive role of aviation in its first century of existence be amplified in the new stage of development and that the evolutions that have led to loss of human lives and property be drastically limited.*

Key Words: *knowledge society, aviation, science and technology, education and human resources*

JEL Classification: *O32 Management of technological Innovation and R&D*

1. INTRODUCTION

The stage of development in our times has the name <knowledge society>. First of all, the aviation will have a role on the value chain. The aviation will be part of the changes in consumer preferences, of the <new consumption> in knowledge society. Some concepts of the aviation may be valuable to understand the knowledge society. The new stage of development means new correlations in society and the increase of the global role of aviation. In knowledge society there are special requirements to develop the aviation in the field of education and human resources. In knowledge society science, technology and information are resources of development for aviation and for all the economy.

The knowledge society as a new stage of development is the subject of a lot of studies. All of them are focused on general problems, as a rule on national, regional or global level. In this paper I want to have a point of view about the impact in knowledge society of a branch, aviation, with a tradition of 100 years in the top of the new technologies.

2. CONSUMPTION IN THE KNOWLEDGE SOCIETY. THE ROLE OF AVIATION ON THE VALUE CHAIN IN THE KNOWLEDGE SOCIETY

The knowledge society must not forget that the focus must be on man. The development of aviation as part of human progress in the knowledge society will, in its turn, take account of this requirement. The need to keep man, not the technique, at the center of research has been formulated since the 20th century, when the rapid advances of industrial society made the first skirmishes from the natural objective of development. One of the formulations then demanded that, for balancing the development of mankind, it would be good not to let it go blindly and wholly in the direction of technique "[3]. Appropriate consumption of real needs may be the link between the progress of technology and human development, both in industrial society and especially in the knowledge society. Essentially the main objective in the knowledge society is the high quality of life for all people everywhere [5].

The economic theory has demonstrated the link between knowledge and the proper use of resources, namely their allocation according to the needs. We understand easily that a satisfactory level of consumption can not be achieved for the vast majority of people unless it is made an efficient allocation of the available limited resources. The economic problem of society is thus not merely a problem of how to allocate “given” resources. It is rather a problem how to secure the best use of resources known to any of the members of the society, for ends whose relative importance only these individuals know [15].

Aviation Safety Investigations

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Abstract: *Aviation safety investigation is a basic tool to enable increase of transportation safety. Despite rumors around major safety occurrences in civil aviation, the aviation level of safety is continuously increasing. Aviation keeps its position as the safest mean of transportation. Lessons driven from the investigation of the accidents and serious incidents are further processed for development of the safety regulatory system (legislation and regulations at national and international level) as well as R&D of aircraft and air traffic management equipment and systems. The papers is intended to present as well the Civil Aviation Safety Investigation and Analysis Authority (AIAS) as some of examples of investigations, enabling better cooperation in the investigation of severe safety occurrences, a process involving not only specific procedure but as well expertise, materials and systems testing and often research work which extends beyond the limits of the safety investigation authority.*

1. INTRODUCTION

Aviation safety investigations are the main source of improvement of safety in the branch of civil aviation. The main lessons drawn from the investigation conducted on the serious occurrences are the source of improvements for all aviation industry stakeholders, i.e. air operators, carriers & general aviation, air traffic management & services, aerodromes and aerodrome services, and the aircraft manufacturing industry, mainly its research and development (R&D) branches which enable the integration of those lessons within the current and new designs.

Lessons driven by the investigation of the accidents and serious incidents are further processed for development of the safety regulatory system (legislation and regulations at national and international level) as well as R&D of aircraft and air traffic management equipment and systems.

In Romania, the tasks related to aviation safety investigations are fulfilled by the designated safety investigation authority "The Civil Aviation Safety Investigation and Analysis Authority" (Autoritatea de Investigații și Analiză pentru Siguranța Aviației Civile), usual abbreviations AIAS (in Romanian) or SIAA (in English).

In conducting its activity AIAS is an independent body, not related to any judicial, regulatory or safety authority as well as to any air operator/air carriers, aeronautical agents. The independence is also granted in relation to any involved party which could enter in a conflict of interest with the AIAS tasks or duties.

The investigations conducted by AIAS are separated and independent from all other kind of investigations or enquiries related to an aviation occurrence. AIAS has no involvement in establishing legal responsibilities or accountabilities.

The main pillars for the civil aviation safety investigations are the Annex 13 to Chicago Convention on International Civil Aviation, the Regulation (EU) No 996/2010 of the European Parliament and of the Council of 20 October 2010 on the investigation and prevention of accidents and incidents in civil aviation and repealing Directive 94/56/EC and the Regulation (EU) No 376/2014 of the European Parliament and of the Council of 3 April 2014 on the reporting, analysis and follow-up of occurrences in civil aviation, amending Regulation (EU) No 996/2010 of the European Parliament and of the Council and repealing Directive 2003/42/EC of the European Parliament and of the Council and Commission Regulations (EC) No 1321/2007 and (EC) No 1330/2007.

Currently the national legal and regulatory frame of the AIAS investigations is defined by following acts:

1. Romanian Air Code, reinforced by Law No. 399/2005, Government Ordinance No. 19/2011, Law No. 187/2012 and Law No. 98/2014 (with the latest amendment on July 11, 2014);

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Topical Issues in Aircraft Health Management with Applications to Jet Engines

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***Abstract**: Aircraft Health Management Technology for jet engines represents a very important problem, since it develops a large impact on reducing the engine life cycle costs, improving the fuel efficiency, increasing the engines durability and life cycle. This actual technology is high-end and in order to enable an improved level of performance that far exceeds that of today's, the propulsion systems must be compliant with terms of reduction of harmful emissions, maximization of fuel efficiency and minimization of noise, while improving system's affordability and safety.*
Aircraft Health Management Technology includes multiple goals of aircraft propulsion control, diagnostics problems, prognostics realized, and their proper integration in control systems. Modern control for Aircraft Health Management Technology is based on improved control techniques and therefore provides improved aircraft propulsion system performances.
The study presented in this paper approaches a new concept, of attractive interest currently, that is the intelligent control; in this context, the Health Management of jet engines is crucial, being focused on engine controllers which are designed to match certain operability and performance constraints.
Automated Engine Health Management has the capacity to significantly reduce the maintenance effort and propulsion systems' logistical footprint. In order to prioritize and resolve problems in the field of support engineering there are required more detailed data on equipment reliability and failures detection and management; the equipment design, operations and maintenance procedures and tooling are also very important.

***Key Words:** Aircraft Health Management**,** control systems, jet engines, propulsion control*

1. INTRODUCTION

Aircraft Health Management Technology for jet engines includes a wide range of applications and standardized procedures, customized for each significant part or assembly which has been proven crucial for the safe operation of the aircraft, for all the jet engine running regimes and flight regimes supposed by the flight envelope and the aircraft's flight missions.

From the jet engine's stand point, the concept of Aircraft Health Management **AHM** turns to focus on Engine Health Management **EHM**, which further is based on Engine Condition Monitoring **ECM**.

In this paper will be pointed out the most significant topical issues of the Aircraft Health Management AHM with application to jet engines, that is Engine Health Management EHM and Engine Condition Monitoring ECM.

By the means of the AHM and consequently EHM & ECM, a series of long-term significant benefits are obtained by each of the main players in the aviation industry, namely: both the designers of aircrafts and jet engine, the manufacturers, the factors involved in operation of civil, commercial and military airplanes.

The key benefits with regards to the jet engines are related to reducing the engine life cycle costs, improving the fuel efficiency, increasing the engines durability and life cycle.

The importance of AHM & EHM can be highlighted from the economic stand point; thus, the financial impact can be tough, with severe effects acting on both those directly involved and indirectly, on potential beneficiaries of the aviation industry.

Just as an example, DHL as a beneficiary of aviation operational services, estimates that the costs of an aircraft on ground **AOG** can rise up to 925000 euro per day, [2].

Another example, which highlights the importance of AHM & EHM from the financial point of view, is the structure of an airline's operating costs, as indicated in Table 1:

Considerations regarding control processes in aeronautical organizations in the context of improving safety and efficiency

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Abstract: *In modern aeronautical systems, one of the biggest challenges for management structures is to maintain control at all levels. Operational safety and efficiency impose the need to control all the associated risks and hazards; thus, in order to achieve organizational performance, a very important aspect is to establish and develop a strong organization in respect with operations and objectives. Nevertheless, performance cannot be achieved without control; the continuous technological development and the environmental variabilities have a great impact on organizational management processes. Organizations are very complex and they will continue to expand due to the increasing demands of flight operations. The capacity to adapt, considering the permanent transformations in the society, represents a continuous process that needs to be carefully carried in order to diminish or eliminate the errors that may occur due to organizational factors. Controlling each operational step from the beginning represents the premises for obtaining stability and performance.*

Key Words*: Safety rules****,*** *control processes, management control system, organizational control*

1. INTRODUCTION

In the second half of twentieth century, the confidence in air transport has increased, as it is a fast and efficient means over short, medium and long distances; safety has improved, the volume of civil aviation has increased and demands are in continuous growing. Social and economic benefits of aviation are substantial, while the adjacent costs are significant and steadily rising.

Safety state of operations in commercial aviation has an impressive development throughout history. This performance is remarkable, given the industry worldwide growth, the implementation of new technologies, deregulation/liberalization/privatization and global economic context. Among others, this development is the result of continuous joint and common agreed efforts by those involved in the aeronautical environment throughout years; shareholders, board of directors, engine and aircraft manufacturers, airlines, governmental and regulatory structures [1]

Maintaining and improving the performance level is a difficult and continuous process.

Most of the improvements regarding safety from different aeronautical sectors are the joint efforts concentrated on well-known and defined problems that have led to innovative technological solutions. Development of communication, navigation, air surveillance and weather conditions equipment are helping various aeronautical organizations to be more aware and careful about operational risk and to avoid or manage them.

At the same time, new challenges arise. The structure of latest generation of aircrafts is made of composite materials which need different procedures during maintenance and inspection processes as opposed to past generations aircrafts. The development of long range large aircrafts imposed new standards regarding performance and reliability standpoint.

The success of an organization is to achieve the established objectives in the context of challenges and economic situation at a given time; the most important element it is represented by the human resource which has to know and master the modern methods and procedures and the operating modes of the technological assets. They should also be aware of their involvement, the quality of work and responsibilities at group, team and management level [2].

In our present days, control has become an essential element in organizations; throughout time, studies and lessons learned followed by actions in terms of organizational development have improved control in aeronautical systems. Aviation has become a complex system in which the error margin is very low; studies and events (incidents or accidents) have shown that without a strong management system, personnel involvement – well-defined culture -, safety processes, continuously adapting to new demands, desire for

Numerical Simulations for Fuel Aircraft Management System

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***Abstract**: The Fuel Management Systems for civil aircrafts have a direct impact on the airlines profitability, competitiveness and sustainability, because the fuel represents the largest cost for airlines, on average 32% of overall operating costs, extra costs can frequently be taken into account, due to increasing the time of approach, straight-in landing versus circle to land. The core philosophy of the Fuel Management Systems, targeted to aircraft safety, must be focused on the most important aspects regarding the efficient operation of an airline and its proper management expressed in terms of efficacy, efficiency, effectiveness; an actual concern of great interest concern is the adequate fuel management. In this paper, a thorough study based on the state of art detailed investigation, with numerical simulations for significant study cases which are relevant to implement robust fuel management processes in purpose to increase the internal efficiencies and to reduce the global expenses, was carried on. In this paper, fuel management solutions and specific mode of their implementation are presented. The benefits of Fuel Aircraft Management Systems are multiple related and refer to: minimizing the costs, reducing the workload, continuous improvement of internal and external data sharing, reducing the unnecessary communications, control fuel spend, making better decisions, improving cash flow and creating a more cohesive approach to Fuel Aircraft Management System. The applications of Fuel Aircraft Management System are beneficial to the aviation industry, and particularly, this study brings a significant contribution to the topic, i.e. advances in Fuel Aircraft Management System.*

***Key Words:** Aviation industry, automatic control, engine control, Fuel Aircraft Management System*

1. INTRODUCTION

There is a continuous demand for effectiveness of performances versus costs and resources, for all the players involved in the aviation industry, from design to manufacturing, operation, maintenance, repair and overhaul. In case of commercial airliners, as well as other civil aircraft operators, since the fuel costs represent the largest costs for airlines, on average 32% of overall operating costs (with frequent occurrence of extra costs due to increasing the time of approach, straight-in landing versus circle to land), it is of utmost interest for airlines the profitability, competitiveness and sustainability; within this context, the Fuel Management Systems represents an important key instrument for aircraft safety, efficient airline operation and its proper management expressed in terms of efficacy, efficiency, effectiveness.

Based on this motivation, the adequate fuel management, in conjunction with adequate aircraft engine control, Engine Condition Monitoring/ Engine Health Monitoring / Advanced Health Monitoring represent an actual concern of great interest.

Aircraft Health Management Technology for jet engines includes a wide range of applications and standardized procedures, customized for each significant part or assembly which has been proven crucial for the safe operation of the aircraft, for all the jet engine running regimes and flight regimes supposed by the flight envelope and the aircraft's flight missions. From the jet engine's stand point, the concept of Aircraft Health Management **AHM** turns to focus on Engine Health Management **EHM**, which further is based on Engine Condition Monitoring **ECM**. Aircraft Health Management AHM with application to jet engines can be expressed by Engine Health Management EHM and Engine Condition Monitoring ECM. The main goal and benefit of the Engine Condition Monitoring ECM is the cost reduction, from the most important key points: 1/ operational, 2/ financial, 3/ Maintenance, Repair and Overhaul MRO.

By the means of the AHM and consequently EHM & ECM, a series of long-term significant benefits are obtained by each of the main players in the aviation industry, namely: both the designers of aircrafts and jet engine, the manufacturers, the factors involved in operation of civil, commercial and military airplanes. The key benefits with regards to the jet engines are related to reducing the engine life cycle costs, improving the fuel efficiency, increasing the engines durability and life cycle.

Work Transfer in aviation, space and defense organization

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Abstract: *Certification of the quality management system for aviation, space and defense organizations, according to EN 9100: 2018 / AS 9100D standard includes a requirement for the control of work transfer. This paper presents the work transfer activity for an applicative aerospace project using Work Transfer Management Guidance Material from IAQG - International Aerospace Quality Group, section 7.1.2.*

Key Words: *work transfer, EN 9100:2018/ AS 9100D, IAQG.*

1. INTRODUCTION

The organization shall establish, implement, and maintain a process to plan and control the temporary or permanent transfer of work, to ensure the continuing conformity of the work to requirements. The process shall ensure that work transfer impacts and risks are managed [1].

Aviation, space and defense organizations continuously change the source of supply or manufacturing of a component, a component package or assembly across a company or its external supply chain.

Such movement of the work (products and associated activities) from one manufacturing site to another (internal or external) is refferred to as "Work Transfer".

Work transfers often cause On Time / On Quality issues because they are not properly manged.

Possible reasons for deciding to launch a transfer of work include:

- Capacity increase;
- Procurement strategy (Need for second source to secure the supply chain);
- Cost reduction;
- Performance improvements;
- New technology.

There are different types of Work Transfers, which depend on the locations of the activity before and after transfer:

- From a customer (currently the manufacture) to its supplier: **Make to Buy**
- From a supplier to its customer (becoming the manufacturer): **Buy to Make**
- Change from Supplier A to supplier B: **Buy to Buy**
- Change of site in same organization: **Make to Make**

These types of transfer are equally applicable to any level of sub-tier suppliers.[2]

2. WORK TRANSFER MANAGEMENT PROCESS

2.1 Gate Review and Decision Process

The successful transfer of work from one site to another is dependent on a phase-gated rewiew process, [2].

Project: The development of certification capabilities for materials and hybrid structures in the aerospace industry [4].

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