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Session: A Time: 10:30 AM Room: L11
Student Name(s): Alena Probst
Institution: Universität Stuttgart, Germany
Paper Title: A Generic Trade-off of Asteroid Mining Mission Concepts for Near-Earth Asteroids
Paper link: http://www.pegasus-europe.org/AIAA_Pegasus/Papers/UniStuttgart_Probst.pdf

ABSTRACT

The usage of raw material originating from asteroids plays a big role in future space exploration missions. Space resources such as water, metals and semi-conductors can support the supplies of human missions and the maintenance of their spacecraft (S/C). The research on asteroids does not only hold economic advantages but also answers to scientific questions concerning the origin and formation of the universe. Thus, the scope of this paper is to investigate concepts for asteroid mining missions. First, this article gives a short introduction on Near-Earth Asteroids (NEAs) specifying their known, physical properties. Then, possibilities for mission concepts are described with the objective to extract material for further utilization as well as important characteristic options. On the basis of the orbital data of all known objects of the NEA subgroups Apollo, Aten, and Amor, nine mining mission concepts are compared by means of four criteria: Δv, propellant mass, system complexity, and transfer periods. The concepts include one in-situ mining concept and eight asteroid captures on different mining orbits. The study leads to a final trade-off that ranks the different concepts according to the criteria results.

Session: B Time: 10:30 AM Room: L10
Student Name(s): Alice Attardo
Institution: "Sapienza" Università di Roma, Italy
Paper Title: Vibroacoustic Analysis for Qualification of VEGA Upper Stage
Paper link: http://www.pegasus-europe.org/AIAA_Pegasus/Papers/UniRM_Attardo.pdf

ABSTRACT

Main scope of the work is to numerically assess the MP Configuration acoustic qualification. So, after giving an overview of the experimental and numerical results and approaches, this paper reports the comparison of the Payload Fairing Transmission Loss (TL) and Noise Reduction (NR) for the QF and the MP Configurations. These are very important parameters because the Payload Fairing internal acoustic field is a direct input load for the Payload. Moreover, from the MP Configuration model also the acoustic field inside VESPA PLA is evaluated giving other necessary information to achieve the future VEGA upper part qualification. Finally several improvements to the numerical models are envisaged as possible future developments of this work. The results obtained are a relevant step forward for the acoustic qualification of aerospace structures by using numerical approach.

Session: C Time: 10:30 AM Room: D
Student Name(s): Andrea Mannarino
Institution: Politecnico di Milano, Italy
Paper Title: Nonlinear Aeroelastic Reduced Order Modeling By Recurrent Neural Networks
Paper link: http://www.pegasus-europe.org/AIAA_Pegasus/Papers/PoliMI_Mannarino.pdf

ABSTRACT

Nowadays, viable estimations of transonic aerodynamic loads can be obtained through the tools of computational fluid dynamics. Nonetheless, even with an increasing available computer power, the costs of solving the related non-linear medium-high fidelity models still impede their widespread use in conceptual/preliminary aircraft design phases, whereas the related nonlinearities might critically affect design decisions. Therefore, it is of utmost importance to develop methods capable of providing adequately precise reduced order models, compressing large-order aerodynamic systems within a highly reduced number of states. This work tackles such an aim through a discrete time recursive neural network formulation, identifying reduced order aerodynamic models through a training based on input-output data obtained from high-fidelity simulations of the aerodynamic problem alone. The soundness of such an approach is verified by checking limit cycles oscillations inferred from such a reduced neural system against precise Euler based response analyses.

Session: A Time: 11:00 AM Room: L11
Student Name(s): Bartomeu Massuti Ballester
Institution: Universität Stuttgart, Germany
Paper Title: Improvement and charectization of a miniaturized Plasma Simulation facility for Basic Investigation
Paper link: http://www.pegasus-europe.org/AIAA_Pegasus/Papers/UniStuttgart_Massuti.pdf

ABSTRACT

For the initial characterization of IPG6-S, a cavity calorimeter has been built to measure the plasma power and the respective efficiencies in order to assess the facility's operational envelope. A complete map of power consumption, power coupling and plasma power has been done for air as working gas at a pressure range between 60 and 260 Pa. This corresponds to several tests with injected mass flow rates between 20 and 220 mg/s in steps of 20 mg/s. As a result of the measurements mean specific enthalpy range for IPG6-S has been determined to be varying from 1 to 7.5 MJ/kg. The power supply is working in both continuous and pulse modes. First experiments in the latter mode have been taken by adjusting the pulse and pause times (1-10ms). Moreover, tests using CO2 as working gas have been performed. The obtained data is compared with respective conditions using air and they represent the first steps in the characterization of the generator with this gas.

Session: B Time: 11:00 AM Room: L10
Student Name(s): Lorenzo Succi
Institution: Politecnico di Torino, Italy
Paper Title: Aeroelastic behavior of launcher thermal insulation panel, accounting for various aerodynamic and structural models
Paper link: http://www.pegasus-europe.org/AIAA_Pegasus/Papers/PoliTO_Succi.pdf

ABSTRACT

Versatile Thermal Insulation panels, have been introduced for the first time with U.S. space launchers during the '60, and immediately represented an element of high complexity, due the wide range of design parameters and the difficult operating conditions. Cases of flutter affecting VTI panels, have been observed since the first applications, stimulating the development of theories able to predict the phenomenon with sufficient accuracy. Numerical study of the panel flutter, has led to the development of different structural and aerodynamic models, useful for investigate this aeroelastic stability. The quasi-steady Piston Theory formulation may be applied only above M =1.5, reducing the study capability to the supersonic range. This work proposes an un-steady formulation of the Piston Theory, derived by Vedeneev, aiming to extend its range of validity also for 1.3 <M< 1.5. Various comparison between these aerodynamic theories, have been carried out in order to underline the main differences in the previous range of Mach and in the accuracy with which the critical conditions are detected. Hand in hand, have been tested different structural models, of increasing complexity, based on 1D and 2D formulation, and also panels with a more advanced structure, multi-layer and sandwich and for last, a typical VTI configuration consists of a semi-circle sandwich panel. Using Shell models such as Equivalent Single Layer or Layer Wise, you may observe relevant variations in final results, highlighting the necessity of more complex structural models in Multi-Layered panels.

Session: C Time: 11:00 AM Room: D
Student Name(s): Francesca Fusi
Institution: Politecnico di Milano, Italy
Paper Title: Numerical Modelling of Non-classical Aileron Buzz
Paper link: http://www.pegasus-europe.org/AIAA_Pegasus/Papers/PoliMI_Fusi.pdf

ABSTRACT

A computational study of non-classical aileron buzz is presented, which focuses on the modelling of the aerodynamics. To this end, two models of the aerodynamic sub-system are presented: on one hand a high-fidelity CFD model is employed and on the other hand a reduced-order model of the unsteady aerodynamics is developed. First, the CFD-based direct simulations point out that the system response is affected by mesh size and geometric description. The results obtained with the CFD-based model also provide the sets of data required to develop the reduced-order model of the unsteady aerodynamics. In particular, a linear low-order model for the aerodynamics is developed, leveraging the idea of a set of second-order sub-systems. From the reduced-order model of the aerodynamic a low-order aeroelastic system is determined, which proves to be effective for a limited range of conditions, due to the linearity assumption.

Session: A Time: 11:30 AM Room: L11
Student Name(s): Zaida Cabrera Gómez
Institution: Universidad de Sevilla, Spain
Paper Title: Preliminary Energy Budget Determination of Cubesats for Different Orbit Types, Orientations and Control Cases.
Paper link: http://www.pegasus-europe.org/AIAA_Pegasus/Papers/ETSI_CabreraGomez.pdf

ABSTRACT

In this study, power generation analysis of a 3Unit CubeSat is carried out. A 3U cubesat is almost 3 times the 1U Cubesat with dimensions of cm and a maximum mass of 4kg. The orbits chosen are dusk-dawn and high-noon orbit, Sun Synchronous Orbit which are used by most CubeSats. Two different orientations of the CubeSat are considered: side, i.e. I1=Iminor and side, i.e. I2=Iminor . To carry out the simulations, a Matlab code is developed, which propagates the orbital position and attitude of the satellite, calculates the Sun position vector and the angles between the Sun position vector and each of the satellite's surface normals. As a result, it outputs the power generation on each surface at each simulation step. The code can be used for any kind of Keplerian orbits and different spacecraft geometries by changing only a few lines. In the orbit simulation, just the oblateness of the Earth is considered as perturbation. The second most important LEO perturbation, the atmospheric drag, is not considered. The eclipse period is computed using a geometrical approach, which compares well with simulations done using the commercial software STK. The attitude control considered in the study is only the three-axis control by a reaction wheel traid. The results obtained for the controlled case is compared with the ones for the uncontrolled case, and the necessity of three-axis control is shown. The best solution for obtaining the most power is provided by a dusk-dawn orbit with I1=Iminor. This orbit provides 56% more power than the same configuration in a high noon orbit, 57% more than the same orbit with I2=Iminor and 26% more than the high-noon orbit with I2=Iminor. The same analysis can be carried out for spin stabilized spacecraft, and the results can be used to decide on the spin speed in a trade-off between the power generation and the stabilization. The calculations present and ideal power budget since environmental losses are not taken into account. However, considering that such losses are similar for all the cases, the predictions are representative.

Session: B Time: 11:30 AM Room: L10
Student Name(s): John Alan Pascoe
Institution: TU Delft, The Netherlands
Paper Title: Disbonding of Bonded Repairs
Paper link: http://www.pegasus-europe.org/AIAA_Pegasus/Papers/TUDelft_Pascoe.pdf

ABSTRACT

A model was developed to predict disbond growth in simple adhesively bonded patch configurations. Disbond growth was predicted by linking the growth rate to the strain energy release rate (SERR) by the well-known Paris relation. The SERR was calculated as a function of disbond length by means of finite element analysis (FEA), employing the virtual crack closure technique (VCCT). By iteratively combining this relation of SERR as a function of disbond length with the Paris relation, the disbond length could be predicted. Fatigue testing of physical specimens was performed in order to first calibrate and later attempt to validate the model. Although the results strongly suggest the model is correct, insufficient quality of the disbond length measurements during the validation experiments prevented a proper validation.

Session: C Time: 11:30 AM Room: D
Student Name(s): Danilo Ciliberti
Institution: Università degli Studi di Napoli "Federico II", Italy
Paper Title: A new vertical tailplane sideforce evaluation procedure
Paper link: http://www.pegasus-europe.org/AIAA_Pegasus/Papers/UniNA_Ciliberti.pdf

ABSTRACT

The objective of this work is to define a new procedure to evaluate the sideforce generated by the vertical tailplane of a transport airplane and hence its directional stability. A reliable tailplane design needs an accurate estimation of the stability derivatives, usually calculated with semi-empirical methods in a preliminary phase, which derive from NACA results of the first half of the XX century. These NACA reports are based on obsolete aircraft geometries and give quite different results for certain configurations. In the actual work semi-empirical methods have been compared for a regional transport airplane and then a deep CFD investigation on typical regional transport aircraft shape has been developed to better understand the aerodynamic interference among the airplane components. Numerical results have been summed up in a new simple procedure, alternate to semi-empirical methods, to evaluate the vertical tailplane sideforce derivative.

Session: A Time: 12:00 PM Room: L11
Student Name(s): Valérie Auxire
Institution: École de l'Air de Salon de Provence, France
Paper Title: Optimization of a colloid thruster for nanosatellites
Paper link: http://www.pegasus-europe.org/AIAA_Pegasus/Papers/EcoleAir_Auxire.pdf

ABSTRACT

New kinds of propulsion technologies, including electrostatic thrusters, are more and more involved in spacecraft design in order to control the orbit and attitude during a space mission. The aim of this paper is to give an overview of the physical phenomena involved and propose a design optimization of a light colloid electrostatic thruster to increase the total thrust and specifc impulse. The first step has consisted in performing numerical computations in order to display the trajectory of droplets and compute the resulting thrust for a virtual thruster with adjustable multiple electrodes. This first phase has led to converge towards an optimum design in terms of number of electrodes and separation between each of them. To confirm these computational results, a single capillary with a double electrodes configuration has been designed and tested on a experimental bench. Unfortunately, the experimental results with the final optimum double electrode configuration, albeit promising, were not usable due to a probe issue.

Session: B Time: 12:00 PM Room: L10
Student Name(s): Ekaterina Shishkova
Institution: Moscow Aviation institute, Russia
Paper Title: Practical use of the international standard ISO 9001-2008 at aerospace enterprises
Paper link: http://www.pegasus-europe.org/AIAA_Pegasus/Papers/MAI_Shishkova.pdf

ABSTRACT

The object of the present work is understanding promotion of ISO 9001-2008 points and mechanisms of implementation its requirements in practice. The standard "ISO 9001-2008: Quality management systems – Requirements" (hereinafter referred to as Standard 9001) contains the totality of minimal requirements to quality management system (hereinafter referred to as QMS). Compliance with the requirements indicates the ability of the organization to supply production, that meets the requirements of consumers, and the presence of purpose to increase the consumers' satisfaction by means of effective QMS use. Implementation of the Standard 9001 requirements is only the first step on the way of effective QMS construction. It does not ensure stable success on market itself. It should be noted that requirements of the Standard 9001 are invariant and may be used by every organization regardless of its activities, size, structure etc. Thereby, organization has wide field for self-expression in QMS designing on the basis of Standard 9001 requirements. It is limited only by resources and imagination. This work is aimed at avoidance formal approach to the activity of QMS designing on the basis of Standard 9001 and promotion of creative use of it.

Session: C Time: 12:00 PM Room: D
Student Name(s): Giuseppe Calise
Institution: Università degli Studi di Napoli "Federico II", Italy
Paper Title: Numerical investigations on Ahmed body for drag reductions with unsteady fluid injection
Paper link: http://www.pegasus-europe.org/AIAA_Pegasus/Papers/UniNA_Calise.pdf

ABSTRACT

Reducing aerodynamic drag and fuel consumption are the key features for automotive manufacturers. Among the many different approaches that may be persecuted, the active drag control systems ensure optimal results. The field of wing drag reduction by means of boundary-layer control has been explored for more than a decade and this paper demonstrates that some techniques are suitable in the automotive engineering as well. Active control systems depend on a number of parameters as mass flow rate, inflow angle, position. Numerical simulations allow to vary all of these parameters in order to understand their relative effectiveness. Numerical studies can also support the setup process of experimental investigations. Two different systems, respectively unsteady blowing system and synthetic jet system, are analyzed by both two-dimensional and three-dimensional simulations. The results show a better behavior of synthetic jet system than unsteady blowing system, causing reduction of drag.

Session: A Time: 12:30 PM Room: L11
Student Name(s): Johannes Scheller
Institution: Institut Supérieur de l'Aéronautique et de l'Espace, Toulouse, France
Paper Title: Baremetal message passing API for manycore systems
Paper link: http://www.pegasus-europe.org/AIAA_Pegasus/Papers/ISAE_Scheller.pdf

ABSTRACT

This paper describes a bare-metal multiple instruction, multiple data message passing library for the Intel Single Chip Cloud Computer. The library's design, the derived notion of a global time across the cores and the verification of the send and receive functions are highlighted. Finally, a use-case example implementing a pseudo AFDX network shows that the message passing performance is not limited by the mesh network but by the workloads of the cores.

Session: B Time: 12:30 PM Room: L10
Student Name(s): Vadim Gilimkhanov, Sergei Ivanov
Institution: Ufa State Aviation Technical University, Russia
Paper Title: Robotic local heat treatment of welded joint of aircraft engine blisk's blades
Paper link: http://www.pegasus-europe.org/AIAA_Pegasus/Papers/Usatu_Gilimkhanov.pdf

ABSTRACT

This report reveals the technology of robotic local heat treatment of welding joint of aircraft engine blisk's blades in the purpose to reduce the value of residual stresses in welding zone. The influence of heat treatment parameters to the temperature distribution were calculated with CAE (computer-aided engineering) software ANSYS for choosing the most suitable parameters of heat treatment.

Session: C Time: 12:30 PM Room: D
Student Name(s): Witold Krusz
Institution: Warsaw University of Technology
Paper Title: Aerodynamic Design of Ducted propeller for MOSPUS project
Paper link: http://www.pegasus-europe.org/AIAA_Pegasus/Papers/WUT_Krusz.pdf

ABSTRACT

Ducted propellers and fans were widely used in 1960's for experimental flying objects propulsion systems. In present days this kind of drive is more popular than a few years ago and is widely uses in UAV's. The main advantage of using shrouded propeller is reduction of induced drag, if distance between propeller tip and duct is small enough. It also provides noise reduction and safety. Well-designed ducted propeller working in flow velocity 25m/s have 10% better efficiency than classic propeller, in static flow condition it is possible to achieve 25%. Conventional propeller gets more efficient from 45 m/s. Better performance of ducted propeller is also results of occurrence of under pressure in duct inlet which produces additional thrust force. Aerodynamics advantages of ducted propellers have in opposition few structural disadvantages like vibration problems, structural stiffness and weight increase. Application of composites materials can suppress all of these problems. MOSPUS program provides application of ducted propeller system in aircraft tail part which makes opportunity to install stream rudders. Thrusters can provide better aircraft control in extreme maneuvers, and they are insensitive to the flow condition. The MOSPUS program leads to create small general aviation joined wing airplane. Application of ducted fan could also provide safer exploitation in small and bad organized airfields.

Session: A Time: 2:30 PM Room: L11
Student Name(s): Francesco Capolupo
Institution: Institut Supérieur de l'Aéronautique et de l'Espace, Toulouse, France
Paper Title: Optical Staged Control for Separated Spacecraft Interferometry: from System Identification to Testbed Validation
Paper link: http://www.pegasus-europe.org/AIAA_Pegasus/Papers/ISAE_Capolupo.pdf

ABSTRACT

The objective of this work is to prove the feasibility of a Separated Spacecraft Interfer¬ometry mission involving two or more SPHERES satellites and a combiner satellite, and design and test the optical path length control system needed to achieve a precise optical path length difference control. The Synthetic Imaging Maneuver Optimization (SIMO) testbed of the MIT Space Systems Laboratory provides the hardware environment on which the control algorithm is tested and validated. Starting from a system identification process, the dynamical behavior of the SIMO testbed's phasing subsystem is analyzed, and a representative phasing loop simulator is developed on Simulink. The simulator also takes into account all the disturbances that act on the phasing loop and affect the phasing performances. A simple and robust staged control system is designed on the simulator, and implemented and tested on the SIMO testbed. The results obtained on the testbed are used to validate both the simulator and the overall control architecture. At the end we identify any issues concerning the actual testbed's hardware/software architecture and we conclude on the feasibility of a Separated Spacecraft Interferometry mission involving SPHERES satellites.

Session: B Time: 2:30 PM Room: L10
Student Name(s): Georg Scholz
Institution: Technische Universität Braunschweig, Germany
Paper Title: Extension of an Adaptive Flight Controller for the Compensation of Limited Actuator Dynamics
Paper link: http://www.pegasus-europe.org/AIAA_Pegasus/Papers/TUBraunschweig_Scholz.pdf

ABSTRACT

A model based concept for flight control of small unmanned aerial systems (UAS) using nonlinear inverse dynamics (NID) and pseudo control hedging (PCH) is presented. Due to performance optimization and challenges like e.g. atmospheric disturbances the NID control algorithm has been chosen. PCH prevents the controller from receiving "bad" signals through a reference model, which is used to generate desired dynamic behavior of the aircraft. By using NID and PCH the dynamics within the whole flight envelope can be linearized without changing an operating point. The control architecture is tested in simulations of a second order system and a small aircraft. In order to optimize the system, a hardware in the loop (HIL) simulation is used to identify the actuator dynamics of the actual aircraft. The results of the UAS using the NID controller show an improvement compared to conventional controllers regarding the quality of control. It is shown that the use of NID and PCH as a flight control strategy leads to challenges concerning the choice of the parameters. Furthermore a solution based on the results from the second order system simulations is created and successfully tested on the UAS simulation.

Session: C Time: 2:30 PM Room: D
Student Name(s): Javier Crespo Anadon
Institution: Universidad Politécnica de Madrid, Spain
Paper Title: Development of a 2-D throughflow model to simulate the action of the fan and OGV of an aircraft engine without knowing the exact blade geometry
Paper link: http://www.pegasus-europe.org/AIAA_Pegasus/Papers/UPM_CrespoAnadon.pdf

ABSTRACT

The purpose of this work is to evaluate a 2-D axisymmetric throughflow method to approximate the action of the fan and OGV of an aircraft engine. This model represents the action of the physical blade geometries by adding source terms in the momentum and energy equations in the fan and OGV regions. The effect of blockage in said regions is simulated by means of a porous region. The evaluation of the model is carried out by coding the method and compiling it in a RANS CFD solver. The combination of the CFD and the code are tested on two situations: the NASA rotor 67, which will be used to measure its accuracy, and a generic nacelle so as to test its applicability.

Session: A Time: 3:00 PM Room: L11
Student Name(s): Romain Serra
Institution: Institut Supérieur de l'Aéronautique et de l'Espace, Toulouse, France
Paper Title: Constrained optimization of high-thrust geostationary transfer starting from non-standard injection orbits
Paper link: http://www.pegasus-europe.org/AIAA_Pegasus/Papers/ISAE_Serra.pdf

ABSTRACT

In this paper, the optimization of high-thrust orbital transfer is considered. The initial orbit consists of any orbit that could possibly result from a non-standard injection phase. The target orbit is the geostationary orbit. The optimization criterion is minimum fuel consumption. Several constraints on the final state and the burns are taken into account. The problem is formulated as a finite dimension optimization problem by use of a direct shooting method. It is then solved by mixing Nonlinear Programming and use of mathematical properties of the solutions. Constraints on the thrust direction are handled with a homotopic method to improve convergence. At first, only Keplerian dynamics are considered. Then a way to extend the method to orbital perturbations is proposed. This method was tested in a special case by taking into account Earth oblateness.

Session: B Time: 3:00 PM Room: L10
Student Name(s): Jaroslav Halgasik
Institution: Czech Technical University in Prague
Paper Title: Low-cost Modular UAV Control Unit
Paper link: http://www.pegasus-europe.org/AIAA_Pegasus/Papers/CTU_Halgasik.pdf

ABSTRACT

This paper described design, development, tuning and verification of a low-cost control unit for small unmanned aerial vehicle developed at the Department of Control Engineering, FEE CTU in Prague within a students project. This control unit can be used for control of fixed wing aircraft as well as helicopters, multi-rotor vehicles or blimps or other type of vehicles. Such vehicles can be built using RC models kits and toys, or developed from scratch using available parts like drives, controllers, servos. Hardware configurations of the on-board unit as well as of the ground station are presented in detail, and related software components are described and elaborated. First flight experiments that were executed in Summer 2012 are presented to show readinness of the presented solution for intended applications.

Session: C Time: 3:00 PM Room: D
Student Name(s): Marco Leonardi
Institution: "Sapienza" Università di Roma, Italy
Paper Title: A Linearized Euler Equation based model to investigate longitudinal combustion instabilities
Paper link: http://www.pegasus-europe.org/AIAA_Pegasus/Papers/UniRM_Leonardi.pdf

ABSTRACT

A one-dimensional non stationary Linearized Euler Equations (LEE) model to study longitudinal combustion instabilities is implemented and validated. The model obtains the exact solution for longitudinal modes in terms of frequency content and spatial mode shapes. The key features of the LEE solver, with respect to classic acoustic methods, is to naturally account for the presence of entropy waves, mean flow effects and more realistic boundary conditions. Calculated resonant frequencies are compared with the literature available data produced both from numerical simulations and experiments. Comparison shows a general good agreement in terms of calculated frequencies whereas calculated growth rates follow a similar trend but do not match exactly with the reference ones. The mismatching with experimental tests can be ascribed to the absence of a modelling function for the unsteady heat release. Furthermore, results highlight the presence of spurious frequencies. These frequencies are related to the combined presence of a sudden area expansion and a stationary flame. A deeper investigation shows that the growth rate values of spurious frequencies are strongly influenced by flame position, growing when the flame moves downstream to the domain outlet, and boundary conditions, reaching values closed to the natural frequency growth rates when natural boundary conditions are applied.

Session: A Time: 3:30 PM Room: L11
Student Name(s): Riccardo Benvenuto, Riccardo Carta
Institution: Politecnico di Milano, Italy
Paper Title: Active debris removal system based on tethered-nets: experimental results
Paper link: http://www.pegasus-europe.org/AIAA_Pegasus/Papers/PoliMI_Benvenuto-Carta.pdf

ABSTRACT

The space debris issue has become extremely relevant in the last years due to the high number of inactive orbiting objects along operational orbits, and effective solutions to eliminate such debris are currently under investigation. To pursue this aim, this work treats the design and experimental investigation of a tethered-net and net gun device, intended to shoot a conical or pyramidal shaped net dragged by four terminal masses, whose task is to wrap a target debris, which will be later de-orbited exploiting a tether that links the chaser satellite to the net. Being the simulation of a real operational environment (i.e. microgravity) hardly achievable so far, this work is focused on setting up a testing facility to characterize, validate and test the proposed active capture system simulating at best the orbital operative conditions even in a 1g affected environment. Being the phenomenon very fast, the Earth gravitational field does not influence the deployment dynamics, thus a good match between ground and microgravity tests is possible. After some insights about the main components and mechanisms making part of the experimental device, an analysis of the net motion through high-speed video imaging is provided. A special focus is put on the trajectory of the net vertices and on the net deployment evolution: this second point is particularly crucial for the maneuver outcome. Finally, a comparison between previous dynamic simulations, supporting the experimental design itself, and experimental results of the net deployment is presented: positive aspects, as well as negative fallouts, of modeling tethered-nets with the mass-spring approach are discussed.

Session: B Time: 3:30 PM Room: L10
Student Name(s): Elias Plaza
Institution: Universidad de Sevilla, Spain
Paper Title: Development of Advanced Automatic Control Strategies for Unmanned Aerial Vehicles
Paper link: http://www.pegasus-europe.org/AIAA_Pegasus/Papers/ETSI_Plaza.pdf

ABSTRACT

This paper presents a design approach to control systems which enables autonomous waypoints tracking capability to a radio-control aircraft. First, an aircraft mathematical model will be estimated and then the model will be linearizated around the selected operation point in order to design the controllers. Sensors and actuators issues are taken into account within this approach. Next step is the setting-up of control strategies and the controllers design. Four different types of controllers (PID, LQR, H-infinite, and MPC) are considered in the study and viability will be assessed. Finally, all these control elements are introduced within a flight simulator, building a Virtual Framework for Testing, and system performance will be evaluated under real environment conditions. We will show that an advanced control system can be better than classic designs for this mission in most conditions. Key words: Aircraft modeling, Flight Mechanics, Aerodynamic, Propeller Propulsion, Inertial Sensor, GNSS, Servo-actuator, Systems Stability, Waypoints Tracking, MPC, H-infinite, PID, LQR, Flight Simulator.

Session: C Time: 3:30 PM Room: D
Student Name(s): Marco Sanitate
Institution: Politecnico di Torino, Italy
Paper Title: Optimal Design of Hybrid Recket Motors for Small Launchers
Paper link: http://www.pegasus-europe.org/AIAA_Pegasus/Papers/PoliTO_Sanitate.pdf

ABSTRACT

This paper explores the possibility of using a hybrid-propellant rocket motor to equip the final stage of a three-stage space launcher, with solid-propellant first and second stages. Based on the benchmark mission performed by the European Vega launcher and using the assigned characteristics of the first two stages, the design of the hybrid-propellant motor and the ascent trajectory are simultaneously optimized with the final goal of maximizing the payload mass. The design parameters of the upper stage are optimized by using evolutionary algorithms, while an indirect optimization method is applied to the trajectory. The numerical procedure provides the main engine design parameters, its geometry and the control law (thrust magnitude and direction during the third stage trajectory). Results show that a hybrid rocket motor could be a viable option for equipping the upper stage of a small, low-coast launcher: it would provide better performance compared to a solid-propellant third and liquid-propellant fourth stage; in addition, this technology is inherently more economical and safe.

Session: A Time: 4:00 PM Room: L11
Student Name(s): Fabio Pontanari
Institution: Politecnico di Torino, Italy
Paper Title: Conceptual design of a Hand Exoskeleton for space Extravehicular Activities
Paper link: http://www.pegasus-europe.org/AIAA_Pegasus/Papers/PoliTO_Pontanari.pdf

ABSTRACT

The hands are the principal part of the body that astronauts use to interface themselves with the outer environment in space. The effort performed with the hands is for this reason the most important source of fatigue for the astronauts. The objective of the paper is to study the possibility of project and develop an external device, which can be easily hooked and removed from the spacesuit, to reduce the hand effort in performing flexion, extension and grasping. This device must reproduce the behavior and the physiology of the moving hand without reducing hand sensitivity and range of movement. Astronaut fatigue reduction will allow longer and more efficient EVAs in the sense that the performance of the astronauts will be constant for the entire time of permanence outside the spacecraft.

Session: B Time: 4:00 PM Room: L10
Student Name(s): Hildo Bijl
Institution: TU Delft, The Netherlands
Paper Title: Guaranteed globally optimal continuous reinforcement learning
Paper link: http://www.pegasus-europe.org/AIAA_Pegasus/Papers/TUDelft_Bijl.pdf

ABSTRACT

Self-learning and adaptable autopilots have the potential to prevent aircraft crashes. However, before they will be applied, there must be guarantees that the resulting controllers satisfy certain performance requirements, and these guarantees have - at least for continuous reinforcement learning (RL) controllers - not been provided. In fact, guaranteeing convergence of continuous reinforcement learning (RL) algorithms has long been an open problem. It has been accomplished for a few special (often linear) cases. Also convergence proofs to locally optimal policies have been established. But attempts to design an algorithm with proven convergence to the globally optimal policy for a general RL problem have been met with little success. This article examines the issues behind guaranteeing convergence of an RL algorithm to the optimal policy. It then continues by presenting Interval Q-learning: a novel continuous RL algorithm with guaranteed convergence to the optimal policy for deterministic model-free RL problems with continuous value functions. Next to a convergence proof, also bounds on the speed at which this algorithm converges are given. This algorithm is then applied to a practical application. This experiment first of all shows that, for RL problems with a large number of state/action parameters, large amounts of runtime and memory space are required. However, the experiment also shows that the algorithm indeed works as the theory predicts, thus confirming that convergence to the optimal policy is guaranteed. Finally, a look is given to how the algorithm can be used to improve aircraft safety.

Session: C Time: 4:00 PM Room: D
Student Name(s): Jan Auersvald
Institution: Czech Technical University in Prague
Paper Title: Altimeter module for unmanned aerial vehicles
Paper link: http://www.pegasus-europe.org/AIAA_Pegasus/Papers/CTU_Auersvald.pdf

ABSTRACT

This paper describes a new type of an altimeter module primary designed for small unmanned aerial vehicles as the source of altitude information. The measurement of altitude is based on a barometric principle. A barometric pressure is measured by a differential pressure sensor which uses a resettable reference volume. This configuration is aimed at high accuracy altitude measurements when low cost is required. The choice of a pressure sensor, reference volume, design of auxiliary compensation circuit, principle of height calculation, and experimental results are presented.

Session: A Time: 4:45 PM Room: L11
Student Name(s): Stefan Gregucci
Institution: Università degli Studi di Pisa, Italy
Paper Title: "Low cost" and "low tech" method to assembly and qualify solar panels for small satellite applications
Paper link: http://www.pegasus-europe.org/AIAA_Pegasus/Papers/UniPI_Gregucci.pdf

ABSTRACT

This paper presents the activities carried out in collaboration between the University of Pisa, Alta SpA and GAUSS Srl for the development, testing and integration of a photovoltaic panel for the UniSat-5 small spacecraft in preparation of a flight scheduled for early 2013. The approach adopted, aimed at reducing cost and developing "low tech" techniques to assembly and qualify solar panel for small satellite applications, uses a printed circuit board designed to optimize the use of surface partially occupied for power generation, where bare cells are installed by means of a double-sided insulating adhesive tape and each cell is covered with cerium doped borosilicate glass, using a controlled volatility silicone. Bonding was performed with a dedicated vacuum bag technique, developed in-house. This method achieves a significant cost reduction with respect to traditional techniques, while retaining high performance and reliable repeatability and avoiding complex technological procedures during the integration. Mechanical testing was performed as a part of the integration with UniSat-5. The panels manufactured during the development programme were subject to electrical characterization to evaluate the current-voltage characteristic curve and the efficiency of the array and to thermal vacuum tests according to ECSS standards to estimate the outgassing properties of the protoflight model. For both, a low cost experimental setup was developed on purpose. The recorded flight unit total mass loss (TML) is well under the acceptable limits, so that the panel was accepted for space flight. In-orbit validation of the panel is expected with the upcoming flight of UniSat-5 in space. The techniques and procedures developed under this programme allow for quick and inexpensive manufacture of reliable solar arrays, specially suited for micro-and nano-satellites.

Session: B Time: 4:45 PM Room: L10
Student Name(s): Kuno Jandaurek
Institution: RWTH Aachen, Germany
Paper Title: Analysis of Test Procedures During Aircraft Development Regarding Ecological Aspects
Paper link: http://www.pegasus-europe.org/AIAA_Pegasus/Papers/RWTH_Jandaurek.pdf

ABSTRACT

In modern and innovative enterprises a sustainable business model, including sustainable products, is becoming increasingly important, also in the aviation industry. Thereby, products and technologies are not only assessed by pure economic but also by ecological and social factors along their whole life cycle. This paper presents a methodology to determine the ecological impacts caused during the testing and certification phase of a transport category aircraft, certified in accordance to CS-25/FAR25 regulations.

Session: C Time: 4:45 PM Room: D
Student Name(s): Pablo Gauna Medrano
Institution: Universidad Politécnica de Madrid, Spain
Paper Title: Noise contour calculation from measured data
Paper link: http://www.pegasus-europe.org/AIAA_Pegasus/Papers/UPM_GaunaMedrano.pdf

ABSTRACT

Noise is nowadays the most important environmental affection in the airport surroundings. As the air transport is growing continuously, the number of planes overflying the cities is also increasing and the noise problem doesn´t seem to decrease in the next years. Lisbon airport is an exceptional example of this problem as it is located into the city and its operational routes pass over very populated areas. To measure the noise impact nowadays the most used tool are the noise contours over a map around the airport. Those noise contours are calculated from flight reports and data from the aircraft manufacturers. This work tries to propose a method to obtain the noise contours for the runway 03/21 from Lisbon airport from measures instead of the data given by the airport and the different aircraft manufacturers. Not 24 hour measures are needed to obtain the noise contours with this method due to the definition of the "typical hours", average hours depending on the aircraft type and the part of the day. As part of future study a proposal from the author (Multiple threshold), of defining two thresholds in the 03 runway, one for D and E type planes and the other one for C or lower type planes, is described as an idea for decrease the noise levels in the approximation maneuver to that runway.

Session: A Time: 5:15 PM Room: L11
Student Name(s): Konstantin Pushkin
Institution: Moscow Aviation institute, Russia
Paper Title: Controlled hydrogen generator for independent power plants based on oxygen-hydrogen fuel cells
Paper link: http://www.pegasus-europe.org/AIAA_Pegasus/Papers/MAI_Pushkin.pdf

ABSTRACT

We have discovered the solution of hydrogen generator creation. It could be obtained by producing of hydrogen in hydronic electrochemical cells (ECC) with aluminium anode which acts as an electrochemically controlled hydrogen source and an additional electric power unit working as a part of combined power plant (PP) with O2/H2 fuel cells (FC). As a result of the experimental and theoretic research of the working processes running in the hydronic ECC we have received the data on correlation of electrochemical properties of the new element base in the context of the examined hydrogen source, the basic quantitative data describing the operation of the hydronic ECC as a hydrogen generator with various component compositions, and we have developed the methods of the hydronic ECC design studies. We have shown that the use of the combined PP "hydronic ECC + O2/H2 FC" presents an effective and safe solution of the problem of hydrogen storage for the independent PP based on O2/H2 FC. The use of such combined PP is efficient and promising both for space systems and land usage.

Session: B Time: 5:15 PM Room: L10
Student Name(s): Victor Gómez González, Emilio José Izquierdo Collado
Institution: Royal Institute of Technology (KTH), Stockholm, Sweden
Paper Title: The Cormorán project: a new concept in commercial aircraft design
Paper link: http://www.pegasus-europe.org/AIAA_Pegasus/Papers/KTH_Izquierdo-Gomez.pdf

ABSTRACT

This paper presents a new revolutionary design in commercial aircraft: the conventional vertical and horizontal tails are not present as generally known, and their contribution to the manoeuvering of the aircraft, namely the presence of the rudder and the elevators, is achieved by locating them at the wingtips and in the canard, respectively. Substituting the horizontal tail with the canard, the possibility of dividing the fuel between the wing (where it is located conventionally) and the canard allows the pilot to change the center of gravity during the flight with more freedom, while the effect of the elevators continues present. Locating the vertical stabilizers at the wingtips combines the effect of the vertical stabilizer and the winglet all in one, with the corresponding lost of weight. In this sense, the aerodynamic, stability and aeroelastic characteristics of an aircraft such as the one described have been analyzed using different modules belonging to CEASIOM program, and the results are very encouraging, showing that it is really feasible to change the current concept of the commercial aircraft without penalizing the performance.

Session: C Time: 5:15 PM Room: D
Student Name(s): Andrea Villa Garcia
Institution: Universidad Politécnica de Madrid, Spain
Paper Title: Analysis of the Validation objectives of the TITAN concept of Operations (Turnaround Integration in Trajectory and network)
Paper link: http://www.pegasus-europe.org/AIAA_Pegasus/Papers/UPM_VillaGarcia.pdf

ABSTRACT

This paper details the TITAN Concept of Operations Validation objectives analysis. TITAN is an advanced turnaround Operational Concept performed as an integral part of the aircraft trajectory. It is based on the principles of Collaborative Decision Making (CDM) and System Wide Information Management (SWIM). The TITAN validation approach was based on the application of the European Operational Concept Validation Methodology (E-OCVM). The Validation objectives assessment was performed through the analysis of simulation results from a discrete event, extended network queuing simulation model. Conclusions obtained from the validation activities show that the TITAN Operational Concept is able to deliver the expected performances in terms of efficiency, predictability, flexibility and cost-effectiveness. This paper describes the process, the results and the analysis performed in the validation.

Session: A Time: 5:45 PM Room: L11
Student Name(s): Anna Gudkova
Institution: National Aerospace University KhAI, Kharkiv, Ukraine
Paper Title: Development of Thermal Stabiization Method of Solar Cells for Pulse I-V Characteristics Measurement
Paper link: http://www.pegasus-europe.org/AIAA_Pegasus/Papers/KHAI_Gudkova.pdf

ABSTRACT

Power supply of satellites was the first professional application of photovoltaics. Firstly military activities were in the foreground of space power supply, and currently commercial applications play an important role as well: powering satellites for telecommunication, remote sensing, navigation, etc. Solar cells for space application work in wider temperature range than it is indicated by manufacturer. The presence of inequality of elements characteristics to the published data can lead to malfunction of the whole solar array, which is inadmissible for space conditions. In this work we propose the method of solar cells thermal stabilization when measuring their current-voltage characteristics. This method is to be applied for solar cells I-V characteristics measurement under the pulse solar radiation simulator. This method allow confirming given solar cell parameters and considering all temperature working range of solar cell (e.g. for solar batteries experimental development).

Session: B Time: 5:45 PM Room: L10

END

Session: C Time: 5:45 PM Room: D
Student Name(s): Jean-Baptiste Dargelosse
Institution: ENAC Toulouse, France
Paper Title: Air Travel passenger's choice model: A case of study of IAG's South Atlantic routes
Paper link: http://www.pegasus-europe.org/AIAA_Pegasus/Papers/ENAC_Dargelosse.pdf

ABSTRACT

Completed in January 2011, the merger of British Airways and Iberia formed a third European airline group, along with Air France/KLM and Lufthansa Group. This paper aims to explore the potential strategies enabling IAG to develop its market share on its South-Atlantic network – the only fast growing market where the airline group enjoys a leadership position. Logit models are used for investigating the demand drivers for the London–Sao Paulo city pair. Main outcomes of the study, additional frequencies to South America from Madrid Barajas Airport and the implementation of a premium economy class by Iberia are highlighted as viable strategies to develop IAG’s market share on the South-Atlantic market.