Workshop on Clean Sky 2
dedicated to Academia and Clusters
Brussels
March 15th, 2013

Participation of
Dipartimento di Ingegneria Industriale
e dell’Informazione (DIII-SUN)
Second University of Naples
in Clean Sky activities

Speaker: Prof. Alberto CAVALLO
Summary

- DIII profile and skills
- FP6 Background
- SMART project
- MAS DE NADA project
- SUPREMAE project
- I-PRIMES project
- EPOCAL project
- FOSAS project
- Expectations for Clean Sky 2

Workshop on Clean Sky 2, March 15th 2013, Brussels
Established in 2012 from Department of Aerospace and Mechanical Engineering + Department of Information Engineering,

Strategic areas

• Aerospace and Mechanical Engineering
• Automation and Computer Science
• Electronics (Signal + Power)
• Telecommunication

Other fields of interests are Electrical Engineering, Chemical Engineering and Material Science, and close areas of applied Physics, Chemistry and Statistical Sciences.

www.diii.unina2.it
MOET FP6 Project

**BBCU** The BBCU (Buck Boost Converter Unit) is a bidirectional DC/DC converter able to deliver 6kW at low-voltage (i.e. 28V) side in Buck (or step-down) mode, and 12kW at high-voltage (i.e. 270V) side in Boost (or step-up) mode. BBCU is a cellular converter, where all the four cells are connected to each other in PIPO mode (Parallel Input, Parallel Output). The interleaving technique is used to reduce components size, (in particular the size of the inductor), current ripple, reduce EMI and to improve the reliability. Each cell is a boost full bridge converter, rated at 3kW.
Detecting faults from measurements (with ALENIA)

Fault detection, diagnosis and prognosis (related to TATEM FP6 Project)

Electric motor (faulty) simulator, to test diagnostic procedures (using statistics, fuzzy and dynamic system observers)
SMART project (Topic JTI-CS-2009-2-ECO-02-003)

SMART: **Saber Model Automatic Translation Tool**

SMART in a nutshell

- **Start date:** September 1st, 2010
- **End date:** August 31st, 2012
- **Topic value:** 200 k€
- **Consortium:** DII-SUN and Italsystem srl

**Current status**

Successfully concluded

Workshop on Clean Sky 2, March 15th 2013, Brussels
MAS DE NADA project (Topic JTI-CS-2012-1-ECO-02-013)

MAS DE NADA: Modeling and Advanced Software Development for Electrical Networks in Aeronautical Domain Analysis

Detailed SABER model for ENAM analysis

Power quality, stability and reliability test sw

I-PRIMES in a nutshell

- **Start date:** October 1st, 2012
- **End date:** March 31st, 2014
- **Topic value:** 250 k€
- **Consortium:** DII-SUN, Aeromechs srl

Current status

WP1 ongoing

Workshop on Clean Sky 2, March 15th 2013, Brussels
SUPREMAE project (Topic JTI-CS-2011-1-ECO-02-008)

SUPREMAE: \textbf{SU}pervised \textbf{Po}wer \textbf{R}egulation for \textbf{E}nergy \textbf{M}anagement of \textbf{A}eronautical \textbf{E}quipments

\textit{Intelligent Load Power Management concept}

- \textbf{Start date:} November 1st, 2011
- \textbf{End date:} May 31st, 2013
- \textbf{Topic value:} 300 k€
- \textbf{Consortium:} DII-SUN

\textit{Modelica based implementation}

I-LPM block

Workshop on Clean Sky 2, March 15th 2013, Brussels
I-PRIMES project (Topic JTI-CS-2011-3-ECO-02-012)

I-PRIMES: Intelligent Power Regulation using Innovative Modules for Energy Supervision

Master-Slave energy management approach

Electrical Test Bench (Regional A/C Configuration)

I-PRIMES Device

I-PRIMES in a nutshell

✓ **Start date:** June 1st, 2012
✓ **End date:** May 31st, 2014
✓ **Topic value:** 250 k€
✓ **Consortium:** DII-SUN, Aeromechs srl

Workshop on Clean Sky 2, March 15th 2013, Brussels

Implementation and rig installation

Current status

PDR just performed
EPOCAL project (Topic JTI-CS-2012-1-GRA-03-010)

EPOCAL: an **E**lectrical **P**ower **C**enter for **A**eronautical **L**oads

---

**EPOCAL in a nutshell**

- **Start date:** March 1st, 2013
- **End date:** August 31st, 2014
- **Topic value:** 300 k€
- **Consortium:** DII-SUN, Aeromechs srl

**Current status**

*Just started*

---

Example of decentralized EPDS

Implementation and rig installation

**EPOCAL power center**
FOSAS project (Topic JTI-CS-2009-1-GRA-05-10)

FOSAS: Fiber Optic Sensors Application for Structural Health Monitoring

Example of distributed strain measurement

Diagram showing the optical fiber paths along the composite panel employed during the ground test.

FOSAS in a nutshell

- **Start date:** January 1st, 2010
- **End date:** December 31st, 2010
- **Topic value:** 160 k€
- **Consortium:** CNR, DII-SUN

Current status

Successfully concluded

Work shop on Clean Sky 2, March 15th 2013, Brussels
In the frame of CLEAN SKY GRA ITD – NC Domain, DIII developed a *specific numerical model* (GRASM) simulating *aircraft trajectories* during typical flight mission segments, providing estimation of noise levels and pollutants emitted by the aircraft during flight paths.

**GRASM Main Objectives:**

- To simulate specific mission profiles and/or fixed departure/arrival trajectories providing aircraft and engine operational parameters on each flight segment.
- To estimate noise parameters during relevant flight mission segments taking into account aircraft aerodynamic and propulsion characteristics as well as ambient parameters.
- To estimate pollution levels emitted during each flight segment and to evaluate environmental impact according to selected Pollution indexes (CO$_2$, NOx).

**GRASM possible future application:**

- To simulate departure/arrival trajectories compliant with standard air traffic control rules to evaluate aircraft noise and pollutant emissions in real operational scenarios.
IMPACT DAMAGE ONSET AND GROWTH IN COMPOSITES

ACTIVITY: Development and experimental validation of numerical models for the simulation of impact induced delaminations onset and evolution in composite structures under service loading conditions.

APPROACH:

- Development of reliable (mesh and time step independent) models for the simulation of impact induced delamination growth
- Integration of the models in commercial Finite Element codes by user subroutines.
- Validation by comparison with thermography images of the delaminated area taken during the application of the mechanical load

APPLICATION EXAMPLE: Prediction of the increase in delaminated area $\Delta A$ as a function of the applied load for delaminated composite stiffened panels under compression. Comparisons among the developed E-SMXB model, standard Abaqus and experimental data (graph on the right) point out the added value of the developed model with respect to standard commercial tools.
Possible areas of activity for Clean Sky2

1. Intelligent Power Management logics and software

2. Intelligent power fault detection and management (isolation, diagnosis and prognosis) algorithms and software

3. Automatic Electric System Reconfiguration
Selected publications


Patents


Workshop on Clean Sky 2, March 15th 2013, Brussels
Thank you for your attention