March 15, 2013

Report on University of Trieste-Tohoku University Joint Workshop

"International Workshop on Uncertainty Quantification and Design Optimization"

February 25th, 2013
Trieste, Italy

The international workshop on "Uncertainty Quantification and Design Optimization" was held on February 25th in Trieste, Italy, jointly organized by University of Trieste and Global COE program, *World Center of Education and Research for Trans-disciplinary Flow Dynamics*. The aim of the workshop was to discuss various cutting edge techniques of uncertainty quantification and its application to design optimization as robust design optimization. This workshop was held as one of activities of International Joint Laboratory "*Development of Design Exploration Method for Real-World Design Problem by International Collaborations*". In the preceding four Global COE workshops "*Multi-Objective Design Exploration*", "*International Workshop on Machine Learning for Aerospace*", "*Multi-Disciplinary/Multi-Objective Optimisation"*, and "*Simulation, Experiments and Optimisation for the Design of a Future Aviation*", fundamental techniques for aerospace design problems as well as the application were discussed. Design optimization with the consideration of aleatory and epistemic uncertainties is important for the design of realistic and reliable aerospace technologies. The various cutting edge techniques and the future research direction are discussed among the participants from universities and research institutes. There were 27 participants from 7 foreign countries and 3 from Japan. There were 6 invited talks.

The workshop was started with the introduction of the Global COE program, *World Center of Education and Research for Trans-disciplinary Flow Dynamics* and the International Joint Laboratory by Prof. Obayashi. Dr. Domenico Quagliarella (CIRA, Italy) presented concerning the cumulative distribution function and the generalized inverse distribution function optimization. The application to a natural laminar airfoil design was also shown. Prof. Emeritus Charles Hirsch (VUB/Numeca International, Belgium) talked about the importance of uncertainty quantification and robust design for virtual prototyping in industries. Dr. Bojan Niceno (PSI, Switzerland) presented about the uncertainty analysis of multi-phase flows in nuclear power plants. Prof. Massimiliano Vasile (University of Stratchclyde, UK) presented about the robust optimization of space systems. Prof. George Karniadakis (Brown University, USA) talked about the approach using multi-element probabilistic collocation method and analysis of variance. Prof. Pietro Congedo (INRIA, France) presented about semi-intrusive uncertainty quantification and robust design optimization using it. Prof. Carlo Poloni (University of Trieste, Italy) talked about

the importance of uncertainty quantification in the comparison of experiment and simulation. Dr. Sasaki (Kanazawa Institute of Technology) presented about Building-Cube Method and its applications aiming for future large scale optimizations. The talk from Dr. Misaka (Institute of Fluid Science, Tohoku University) was about the topology optimization of a flow channel as an example of optimization problems using the Building-Cube Method. Through all the presentations, a lot of enthusiastic and useful discussion over the uncertainty quantification and robust design optimization techniques was conducted.

This workshop provided an opportunity to share the idea of various numerical approaches to be used in industrial design including aircraft designs. This workshop must have been useful for all the participants to understand the current issues and potentials to tackle for the design of a future aviation.

Photos from the workshop