March 9, 2012

Report on ONERA-Tohoku University Joint Workshop

"International Workshop on Simulation, Experiments and Optimisation for the Design of a Future Aviation"

February 22nd, 2012

Room Contensou, ONERA, Châtillon, France

The international workshop on "Simulation, Experiments and Optimisation for the Design of a Future Aviation" was held on February 22nd in Châtillon, jointly organized and supported by the French Aerospace Lab (ONERA) 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 simulation, experiments and optimization to be used for the improvement of a future aviation design. This 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 previous three Global COE workshops "*Multi-Objective Design Exploration*", "*International Workshop on Machine Learning for Aerospace*", "*Multi-Disciplinary / Multi-Objective Optimisation",* fundamental techniques for aerospace design problems and also the application were discussed. Design optimization is important technology for the design of a future aviation but simulation and experimental techniques are also important to advance the reliability of aircraft design and to increase the performance of aircraft. Therefore, in the present workshop, the topic is not restricted to optimization technique but various techniques to be used for the future aircraft design. The various cutting edge techniques and the future research direction are discussed among the participants from universities, research institutes and industries. There were 44 participants from five foreign countries and 6 from Japan. There were 14 invited talks (industry: 2, university: 6, and research institutes: 6).

The workshop was started with the presentation of Dr. Koji Shimoyama at Tohoku University. He presented the uncertainty quantification technique to sonic boom analysis, whose

technique is important to consider the fluctuation or distribution of various conditions in simulation. Dr. Andras Sobester (University of Southampton) showed the analysis of noise foot print through acoustic experiments and also the application of optimization for trajectory and mission of balloon. Dr. Emiliano Iuliano (Italian Aerospace Research Center CIRA), talked about their advanced POD-based design optimization technique and its application to airfoil and wing designs. Dr. Joel Brezillon (German Aerospace Center, DLR) presented the research applications using adjoint-based aerodynamic optimization. He also presented the latest development of coupled aero-structure ajoint technique, which has potential benefit to efficiently improve aerodynamic performance. Prof. Juan J. Alonso (Stanford University) had a special lecture about the recent adjoint method development for the low boom and low noise designs. The proposed approach was successfully demonstrated via 2D and 3D cases. Dr. Jean-Antoine Désidéri (French National Establishment for Research in Computer Science and Applied Mathematics, INRIA) presented their unique idea and efficient optimization method to be used in MDO context. Dr. Ingrid Lepot (CENAERO) showed their optimization framework and its application to trurbomachinery problems. Dr. Matthieu Meaux (Airbus/EADS) and Dr. Gilbert Rogé (Dassault Aviation) presented the design optimization applications in industrial context. Mr. Gerald Carrier and Dr. Itham Salah El Din (French Aerospace Lab, ONERA) presented their recent development of optimization methods including adjoint-based technologies for coupled aero-structure optimization and CMA-ES (Covariance Matrxi Adaptation Evolution Strategy) for global optimization. Dr. Daisuke Sasaki, Mr. Ryotaro Sakai, Mr. Yuma Fukushima, Mr. Masaya Oshimizu (Tohoku University) presented the research progress in CFD/CAA development and also the conceptual design of next-generation aircraft at Department of Aerospace Engineering. Through all the presentations, a lot of enthusiastic and useful discussion over the design optimization and simulation techniques useful for the aircraft design was conducted.

The present workshop provided the opportunity to share the idea of various numerical approaches to be used in future aircraft design. The challenging techniques presented in the workshop will be useful for the emerging MDO problems that are critical for the future aircraft development to improve the reliability of aircraft design and performance estimation. 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.

Picture 1: Participants of workshop