Advanced Design Concepts and Practice (ADCP)

ADCP 2015 Winter Workshop

http://adcp2012.com

Special track: Design, Simulation and Experiment of Aircrafts
专题：飞机设计、仿真和试验

Venue: Meeting room 4304, Building 9003, Tsinghua University

Time: 9.00am-5.00pm, Dec. 3rd, 2015

Organizer

Design Institute

Mechanical Engineering Department

Tsinghua University

清华大学机械系设计所

2015, December

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Chair: Professor Ji Linhong, Mechanical Engineering Dept., Tsinghua University

Invited Presentations

1. Professor Qian Wei 钱卫教授, 大连理工大学航空航天学院
School of Aeronauticics and Astronautics, Dalian University of Technology
Lecture topic: Transonic wind tunnel testing of aeroelastic wing model of large transport aircrafts
报告题目：大型运输机机翼弹性相似模型跨声速风洞气动弹性试验

2. Dr. Andrea Da Ronch
Faculty of Engineering and the Environment, University of Southampton, UK
Lecture Topic: Rapid Aeroelastic Loads Assessment Using CFD

3. Mr. Wang Yongzhi 王永志
China Academy of Aerospace Aerodynamics
中国航天空气动力技术研究院
Lecture topic: Adaptive feedback/feedforward control design for gust loads alleviation of flexible aircraft
报告题目：阵风减缓控制设计

3. Ms. Xuan Hao, 郝璇
China Academy of Aerospace Aerodynamics
中国航天空气动力技术研究院
Lecture Topic: Research on Aerodynamic Noise
报告题目：气动噪声研究

Organizer

清华大学机械系设计所
Design Institute, Mechanical Engineering Department. Tsinghua University

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Introduction to the Workshop

The goal of ADCP workshops is to bring advanced theories, methods, technology and tools to the design and evaluation of complex systems, with a focus on computational design and evaluation methods and tools. ADCP2015 Winter Workshop offers a special track on aircraft design, simulation and experiments towards international collaboration projects.

ADCP2011 was held in Beijing on July 6-8th of 2011. ADCP2012 was held in Karlsruhe, Germany, on May 8th of 2012. ADCP2013 was held in Beijing on August 16th. In 2012. ADCP 2014 was held in Stuttgart, Germany, 26 September 2014. ADCP2015 was held in Hangzhou, September 18-20th, 2015. Other workshops include: ADCP2012 Summer Workshop held at TU Delft on August 17th, ADCP2012 Fall Workshop held in Beijing on November 8th, ADCP2014 Spring Workshop held in Beijing in 2014, ADCP2014 Summer Workshop was held in Beijing on June 24th, 2014.

Map to the meeting room

Introduction to the speakers

1. Professor Qian Wei 钱卫教授

School of Aeronauticics and Astronautics, Dalian University of Technology

大连理工大学航天航空学院

Professor Qian was research fellow and Level 1 expert when working in Aviation Industry of China before 2014. He has over 25 years of work experiences in aero-elastic design of aircraft including experiment design evaluation and numerical simulations.

钱卫教授毕业于北京航天航空大学飞机设计与应用力学系固体力学专业。曾经担任沈阳飞机设计研究所高级工程师、研究员、中国航空工业集团公司一级专家，现为大连理工大学航空航天学院教授。主要研究方向：飞机结构动力学仿真与地面试验，飞机静、动气动弹性设计，内容涉及结构动力学、颤振、非定常气动力、静气动弹性等方面的仿真、地面试验、风洞试验、飞行试验等。同时还从事飞机设计的多学科优化。主持了多个型号飞机强度设计系统结构动力学分系统的设计研发工作，参与过多个研究课题（863、973、总装预研、自然科学基金），并担任过多个课题的负责人。

Lecture topic:

Transonic wind tunnel testing of aeroelastic wing model of large transport aircrafts

大型运输机机翼弹性相似模型跨声速风洞气动弹性试验

2. Dr. Andrea Da Ronch

Faculty of Engineering and the Environment, University of Southampton, UK

Dr Andrea Da Ronch (ADR) is a New Frontiers Fellow and Lecturer of Aircraft Structural Design at UOS, and an Industry Secondee at Airbus Operations Ltd, U.K. ADR has a PhD degree (2012) in Computational Aeroelasticity and Flight Dynamics from the University of Liverpool, UK. His research interests are in computational fluid dynamics (CFD) methods for aeroelasticity and flight dynamics, and in the development of nonlinear model reduction techniques for large computational models. The impact of his research activities has garnered considerable international visibility within the aeroelastics and flight dynamics communities: his initial involvement with the Next generation Conceptual Aero-Structural Sizing (NeoCASS, https://www.neocass.org/) software has now been superseded by an active role in the development of the Computerised Environment for Aircraft Synthesis and Integrated Optimisation Methods (CEASIOM, http://www.ceasiom.com/) software, considered one of the world's most mature software tools for integrated aircraft design. ADR is also conducting cutting-edge research of very flexible aircraft, from rapid CFD methods for loads assessment over the flight envelope to control synthesis design based on linear/nonlinear and adaptive feedback/feedforward algorithms.

ADR is currently Principle Investigator (PI) of three research projects. ADR is PI of the project "Fast Nonlinear Aeroelastic Search for Loads Assessment" awarded by the Royal Academy of Engineering (RAEng) under the Netwon Research Collaboration Programme with Beihang University, China, as overseas partner. Before joining the

UOS, ADR has been an active member of the EU-funded SimSAC project (FP6) and the EPSRC-funded FlexFlight project.

Lecture topic: **Rapid Aeroelastic Loads Assessment using CFD**

Abstract: Aircraft design procedures for structural sizing and topological configuration often focus on the aeroelastic behaviour of the vehicle due to the catastrophic potential of the associated fluid structure interactions. Computational tools currently used in industry for aeroelastic loads assessments fall into the extremes of high fidelity simulations, such as Computational Fluid Dynamics (CFD) models with an integrated Computational Structural Model (CSM), versus rapid linear methods. Heavy computational burdens of the former approach prevent it from being used in aircraft design processes. As such, recent challenges in industrial aircraft aerodynamics have been to decrease the calculation costs of high accuracy aeroelastic loads assessment from months to days, and to increase the fidelity of methods used early on in design processes. This study aims to make progress in this area through production of a novel improved fidelity rapid method which will challenge the simplifications and unsound conventions currently widely adopted in industrial aircraft design. Methods used in the work utilise a recent Infinite Swept Wing '2.5D' Navier-Stokes solver implemented by the research group in the DLR Tau code. Viscous data from the 2.5D solver is then coupled with an inviscid Vortex Lattice Method using an iterative angle of attack correction, providing three dimensional results with viscous effects at the cost of two dimensional simulations. Once validated, the method is applied to the Onera M6 wing and the DLR F4 wing body at low transonic conditions. In both cases, the current method has shown good agreement with experimental data and 3D simulations. Upcoming developments in the work will extend to model to include fuselage corrections, before testing its performance with the high lift DLR F11 (KH3Y) configuration.

3. Mr. Wang Yongzhi 王永志

中国航天空气动力技术研究院

China Academy of Aerospace Aerodynamics (CAAA)

Mr. Yongzhi Wang is an engineer with over 10 years of work experience in aerospace. He graduated from Beijing University of Aeronautics and Astronautics with M.Sc. degree in Aircraft Design in 2005. From October 2013 to October 2014, he visited the University of Southampton and worked in gust loads alleviation and adaptive control field. His research interests are in aircraft conceptual design and preliminary design, fluid and structure interaction, adaptive feedback/feedforward control.

报告题目：阵风减缓控制设计

Lecture topic: Adaptive feedback/feedforward control design for gust loads alleviation of flexible aircraft

摘要:主要介绍如下内容，一、数值模拟分析工具建立，（1）二维翼型阵风响应模型，（2）气动-结构-飞行力学耦合模型，（3）阵风模型，（4）自适应前馈/反

馈控制律设计，（5）数值模拟的例子；二、飞行试验准备，（1）试验平台介绍，（2）试验方案，（3）试验状态模拟结果；三、下一步工作。

3. Ms. Xuan Hao

中国航天空气动力技术研究院

China Academy of Aerospace Aerodynamics (CAAA)

Ms. Xuan Hao obtained master degree in Beijing University of Aeronautics and Astronautics in 2006. She is senior engineer and has over 10 years of work experiences in aero-acoustics, high lift devices design, CFD and CAA analysis, and aero-acoustic wind tunnel testing.

报告题目：气动噪声研究

Lecture Topic: Research on Aerodynamic Noise

Program

December 3rd, 2015 9.00am-5.00pm		
Time	Topics	Speakers
9.00-9.10am	Welcome and Introduction	Chair Prof. Ji Linhong
	Session 1: Lectures	
9.10-10.00am	Transonic wind tunnel testing of aeroelastic wing model of large transport aircrafts 大型运输机机翼弹性相似模型跨声速风洞气动弹性试验	Professor Qian Wei Dalian University of Technology 钱卫教授,大连理工大学
10.00-10.10am	Break	
10.10-11.00m	Rapid Aeroelastic Loads Assessment Using CFD	Dr. Andrea Da Ronch University of Southampton
11.00-11.10am	Break	
11.10-11.40am	Adaptive feedback/feedforward control design for gust loads alleviation of flexible aircraft 阵风减缓控制设计	Mr. Wang Yongzhi China Academy of Aerospace Aerodynamics 王永志,中国航天空气动力技术研究院
11.40-12.10am	Research on Aerodynamic Noise 气动噪声研究	Ms. Xuan Hao China Academy of Aerospace Aerodynamics 郝璇，中国航天空气动力技术研究院
12.10-13.30pm	Lunch Break	
	Session 2: Project Discussion	Chair: Prof. Ji Linhong
13.30-14.30pm	Introduction to the project and funding resources	
14.30-14.40pm	Break	
14.40-17.30pm	Discussion on current project proposal and future work	