2017 INTERNATIONAL ADVANCED AERO-ACOUSTICS WORKSHOP

2017 年度国际气动声学高级研讨会

2017 1st AAAW Beijing CHINA

中国 北京

29-30 Nov 2017 11 月 29-30 日

Preface

Aerodynamics and acoustics are both long time studied subjects, which have histories of more than 100 years. Aeroacoustics is a relative-newly established field defined as flow induced sound, i.e. a combination of aerodynamics and acoustics. Aeroacoustics nowadays plays decisive roles in current aircraft and aero-engine design. Aero-acoustic noise control of large passenger aircraft involves many aspects, e.g. airworthiness requirement, safety, environment, legal regulation, and passenger comfort. It is one of the key features in the systematic design of large passenger aircraft. Increasingly stringent airworthiness requirement for civil aviation drives much research on the topic of aircraft noise. With the development of the aero-acoustic subject and noise reduction technology, the noise level of current civil aircraft products gradually reduced.

In recent years, the US and European airworthiness authorities and the International Civil Aviation Organization have increased the airworthiness requirements on civil aircraft noise. For instance, FAR-36 in the US, JAR-36 in Europe and CAR-36 in China. At present, Europe is carrying out the fourth phase of the aircraft noise airworthiness regulations, and the upcoming fifth phase noise requirements compared to the fourth stage requires an overall noise reduction of 8EPNdB. The Advisory Council for Aviation Research and Innovation in Europe (ACARE) plans in 2020 and 2050, as compared to 2000, a decrease of the civil aircraft noise level by 50% and 65%, respectively. At the same time, NASA in the USA has also developed its ambitious "N+2" and "N+3" programs, in which by 2020 and 2050 compared to the current fourth stage airworthiness requirements, cumulative noise reductions need to be achieved by 42EPNdB and 71EPNdB, respectively.

Since the ground-breaking work of Lighthill in the 1950s, aero-acoustics rapidly evolved as an independent subject in theoretical studies but also in many engineering applications. Especially in the recent decades, with increasing restriction for aircraft noise countries in Europe and America have made great progress in aero-acoustics, of which many key technologies have been applied in aviation industry. On the other hand, the continuous efforts in large-passenger aircraft design in China, the development of aero-acoustics receives increasingly attention, especially in the field of the airframe noise. In order to improve the competitiveness in the international civil aircraft market, the Chinese government and industry recently have launched multiple research projects on the topic of aviation noise problems.

The international advanced aero-acoustics workshop will be held at Beihang University on November 29th-30th, 2017. The workshop is hosted by the Beihang University and sponsored by the Commercial Aircraft Corporation of China Ltd. (COMAC), Aviation Industry Corporation of China (AVIC), etc. The seminar invited 14 international well-known experts in the field of aero-acoustics give talks in the fundamental theory, experiment technology, numerical simulation and engineering applications in aero-acoustics. The aim of this workshop to promote the worldwide academic exchanges in aero-acoustics, and seeking future collaboration to explore the advanced technology in aviation aero-acoustics.

引言

空气动力学学科和古典声学学科都是有着百年以上的发展历史，而气动声学是建立在空气动力学和声学基础之上的一门新兴的交叉学科，该学科的快速发展为解决航空发动机、飞机气动噪声问题起到了决定性的作用。大型客机气动噪声的控制涉及飞机适航、安全、舒适等多方面，是大型客机设计系统的关键环节之一。随着气动声学的发展和降噪技术的进步，国外民机产品的噪声水平逐步降低，相应对于民机的噪声适航条例也越发严格。在近期欧美适航当局以及国际民航组织对民机噪声都有严格的要求，比如美国 FAA 有 FAR-36、欧洲有联合适航标准第 36 部、国际民航公约有附件 16（第 I 卷）《环境保护国际标准和建议措施》，此外我国也给出了相应的民机噪声适航条例 CAR-36。目前欧洲正在执行第四阶段的飞机噪声适航条例，而即将实施的第五阶段噪声要求相比于第四阶段还要再降低 8EPNdB。欧洲航空研究咨询委员会（ACARE）计划到 2020 年和 2050 年民机的噪声水平相比于 2000 年分别降低 50%和 65%。同时美国 NASA 也制定了雄心勃勃的 “N+2” 和 “N+3” 计划，即到 2020 年和 2050 年相比于目前第四阶段的适航要求累加噪声降低 42EPNdB 和 71EPNdB。

纵观气动声学学科发展，从上个世纪五十年代 Lighthill 在气动声学方面所做的开创性工作至今，作为一门独立的学科分支，气动声学无论是在理论上还是在实验实践方面发展很快。特别是在近 20 年来，随着航空噪声适航条例要求的不断提高，在欧美发达国家航空气动声学学科得到了长足的进步，许多关键技术已在航空领域得到工程应用。相对而言，我国的气动声学学科发展相对缓慢，特别是在飞机机体气动噪声方面的研究起步较晚，与欧美发达国家相比存在相当的差距。随着我国研制 C919、ARJ21-700、MA700 和双通道宽体客机等的进展，特别是为了获得新飞机的适航证，气动噪声指标已经成为我国民用飞机研制领域的瓶颈技术之一。同时为了提高国际市场竞争力，我国新一代民机必须实现贯穿整个研制过程噪声指标控制。因此，急需要快速提高我国气动声学学科研究水平和工程应用能力以应对未来民用设计方面的严峻挑战。

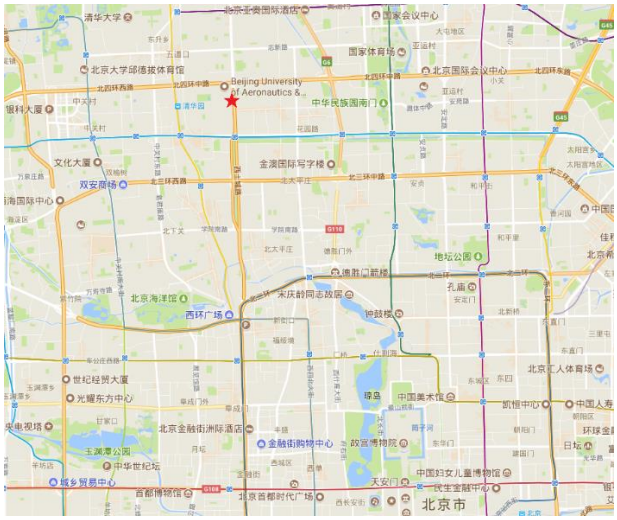
本次国际气动声学高级研讨会初步拟定 2017 年 11 月 29 日~11 月 30 日在北京航空航天大学举办。会议由北京航空航天大学和中国力学学会主办，中国商用飞机有限责任公司和中国航空工业集团等赞助。本次高级研讨邀请到多名国际气动声学领域的知名专家，将分别在基础理论、实验技术、数值模拟、工程应用等方面进行专场报告，旨在促进世界范围内气动声学领域的学术交流，共同探讨该本领域的先进技术，推动我国航空声学的快速发展。

Workshop information

General information

Date: 29-30th Nov 2017

Location: Beihang University



General Schedule

Date	Morning		Afternoon		Night
28 Nov 2017	Registration				Dinner
29 Nov 2017	Opening ceremony	1st Session	2nd Session	Beihang Aeroacoustic Windtunnel Visiting	Dinner
30 Nov 2017	3rd Session		4th Session		Dinner

Organization

Host Beihang University

The Chinese Society of Theoretical and Applied Mechanics

Co-organizers

Beihang University

Peking University

Tsinghua University

TU Munich

TU Braunschweig

TU Delft

Sponsors

Commercial Aircraft Corporation of China Ltd. (COMAC)

Aviation Industry Corporation of China (AVIC)

China Aerodynamics Research and Development Center (CARDC)

Beijing CA Acoustics Co. Ltd.

MicroVEC PTE. Ltd.

Organizing committee

Chairman: Jiachun LI (Academician of CAS)
Chunxuan LI (Beihang University)

Vice Chairman:
Rinie AKKERMANS (TU Braunschweig)
Zhuoyi DUAN (AVIC)
Kecen HAN (COMAC)
Xiaofeng SUN (Beihang University)
Jinjun WANG (Beihang University)

General Secretary:
Peiqing LIU （Beihang University）lpq@buaa.edu.cn

Academic committee:

Ramesh AGARWAL	Wen BAI	Peter BRANDSTÄTT
Cyrille BREARD	Damiano CASALINO	Peng CHEN
Jan Werner DELFS	Georg EITELBERG	John EKATERINARIS
Song FU	Xiangyu HU	Jun HUA
Xiaodong JING	Xiaodong LI	Zhoufu LI
Fulvio SCARANO	Zhensu SHE	Mao SUN
Yifeng SUN	Zhigang YANG	

Event Secretary:
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Hao GUO guohao@buaa.edu.cn
Weishuang LU lws_313@ buaa.edu.cn
Qiulin QU qql@buaa.edu.cn

Registration

Registration Fee: 1500 RMB (before 28th Nov 00:00 GMT+8 Beijing Time)
2000 RMB (on the day)
Registration Fee for students: 1000 RMB (before 28th Nov 00:00 GMT+8 Beijing Time)
1500 RMB (on the day)
Note: for group registration (beyond 10) please contact Prof Peiqing LIU lpq@buaa.edu.cn

Program Schedule

217-11-28 Tuesday

Workshop sign-up: whole day from 8:00 am

Location: Vision Hotel Lobby

Welcome Dinner

Location: Vision Hotel 3rd floor Dining Hall

Time: 18:00 pm - 20:00 pm

217-11-29 Wednesday

Opening Ceremony

Location: Beihang New Main Building 1st Lecture Hall

8:30am-9:20am Opening ceremony
Starting Speech from the Chairman of AAAW
Welcome Speech from the President of Beihang University

9:20am-9:40am Group Photo
In front of the New Main Building

Session 1

Chair: Ramesh K. AGARWAL

Location: Beihang New Main Building 1st Lecture Hall

9:40am -10:30am **Jan Werner DELFS DLR**
"Airframe related aeroacoustics - Research at DLR"

10:30am - 10:50am Tea Break

10:50am - 11:40am **Cyrille BREARD COMAC**

"Aircraft noise during aircraft development from design to entry of service: achievements and needs"

11:40am - 12:30pm **Zhensu SHE** **Peking University**
"Theory of turbulent boundary layer and its derived turbulence model: progress and perspective"

12:30pm - 13:30pm Lunch break
Location: Beihang Training Center Canteen

Session 2
Chair: Jan Werner DELFS
Location: Beihang New Main Building 1st Lecture Hall

13:30pm - 14:20pm **Georg EITELBERG** **DNW**
"Current trends in aeroacoustic testing in DNW and in TU Delft"

14:20pm - 15:10pm **Ramesh K. AGARWAL** **Washington University in St. Louis**
"A Unified Time-Domain/Frequency-Domain Methodology for Computational Acoustics"

15:10pm -15:30pm Tea Break

15:30pm -16:00pm **Song FU / Zhixiang XIAO** **Tsinghua University**
"Studies of unsteady flows and airframe noise past landing gear-like geometries"

16:00pm - 16:30pm **Peiqing LIU/Hao GUO** **Beihang University**
"Aeroacoustic experimental study on landing gears and high lift devices in D5 wind tunnel"

16:30pm -18:00 pm Visiting Beihang D5 Aeroacoustic Windtunnel on Sha He Campus

18:00 pm - 20:00 pm Dinner at Yang Fang Mongolian Hotpot Restaurant

217-11-30 Thursday

Session 3

Chair: Georg EITELBERG

Location: Beihang New Main Building 1st Lecture Hall

8:30am - 9:20am **John EKATERINARIS** **Embry-Riddle Aeronautical University**
"On the use of centered, upwind, and high order shock capturing numerical schemes for aeroacoustics"

9:20am -10:10am **Zhigang YANG** **Tongji Univerity**
"Vehicle aero-acoustic design"

10:10am -10:30am Tea Break

10:30am - 11:20am **Fulvio SCARANO** **TU Delft**
"Aeroacoustic noise generation mechanisms: hearing or seeing?"

11:20am - 12:10pm **Peng CHEN** **CARDC**
"Aeroacoustic Experiment on Main Rotor of Helicopter in Anechoic Wind Tunnel"

12:10pm - 12:40pm **Xiaofeng SUN / Lin DU** **Beihang University**
"Sound generation from moving boundaries"

12:40pm - 13:40pm Lunch break
Location: Beihang Training Center Canteen

Session 4

Chair: John EKATERINARIS

Location: Beihang New Main Building 1st Lecture Hall

13:40pm - 14:30pm **Damiano CASALINO** **TU Delft**
"On the usage of the Lattice-Boltzmann method for aircraft and rotorcraft aeroacoustics: from fundamental research to engineering deployment"

14:30pm - 15:20pm **Xiangyu HU** **TU Munich**
"A high-order targeted ENO scheme for large-eddy simulation of incompressible and compressible turbulence"

15:20pm - 15:40pm Tea Break

15:40pm - 16:30pm **Peter BRANDSTÄTT** **Fraunhofer IBP**
"Noise Reduction technology in large acoustic infrastructure"

16:30pm - 17:20pm **Xiaodong LI** **Beihang University**
"High Order Numerical Simulation of Noise Generation from Complex Flows"

17:20pm - 18:10pm **Rinie AKKERMANS** **TU Braunschweig**
"CROR noise radiation and its mitigation"

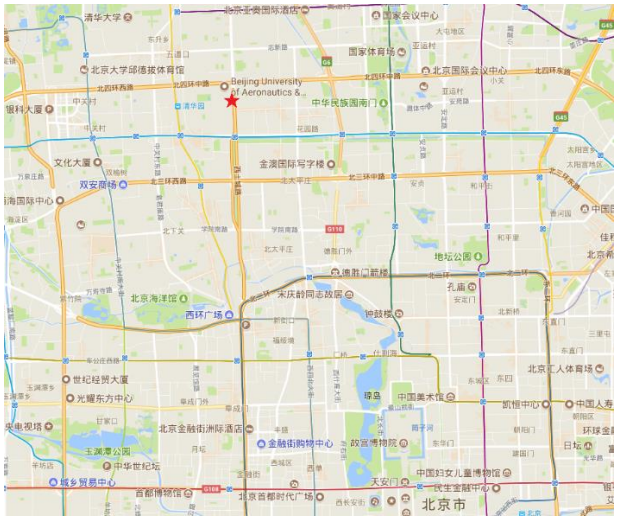
18:10pm - 20:00pm Dinner at Red Oriental Restaurant

研讨会日程

会议信息

日期: 2017 年 11 月 29-30 日

地址: 北京航空航天大学



日程

日期	上午		下午		晚上
2017 年 11 月 28 日	注册				晚餐
2017 年 11 月 29 日	开幕	场次 1	场次 2	参观北航 D5 风洞	晚餐
2017 年 11 月 30 日	场次 3		场次 4 闭幕		晚餐

研讨会组织机构

主办单位： 北京航空航天大学
中国力学学会流体力学专业委员会

联合承办单位:

北京航空航天大学
北京大学
清华大学
慕尼黑工业大学
布伦瑞克工业大学
荷兰代尔夫特理工大学

赞助:

中国商用飞机有限责任公司（COMAC）
中国航空工业集团(AVIC)
中国空气动力研究与发展中心（CARDC)
北京科奥克声学技术有限公司
北京立方天地科技发展有限责任公司
北京凯英信业科技股份有限公司

组委会:

主任:

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李椿萱（北京航空航天大学）

副主任:

Rinie AKKERMANS (布伦瑞克工业大学)

段卓毅（中航工业）

韩克岑（商飞上飞院）

孙晓峰（北京航空航天大学）

王晋军（北京航空航天大学）

秘书长:

刘沛清（北京航空航天大学）lpq@buaa.edu.cn

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Peter BRANDSTÄTT（弗劳恩霍夫建筑物理研究所）

Cyrille BREARD（商飞上飞院）

Damiano CASALINO（代尔夫特理工大学）

Jan Werner DELFS（德宇航）

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Xiangyu HU（慕尼黑工大）

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会议注册

注册费: 1500 元 (2017 年 11 月 28 日 0 点之前)；
2000 元 (2017 年 11 月 28 日当天及以后)
学生注册费: 1000 元(2017 年 11 月 28 日 0 点之前)；
1500 元(2017 年 11 月 28 日当天及以后)
备注: 团体（10 人以上）注册请联系 刘沛清 教授 lpq@buaa.edu.cn

汇款地址：
单位全称：北京航空航天大学
账号：0200006209026400229
开户行：工商银行北京东升路支行
注：提交时请备注参会名称、注册单位及注册人姓名

日程具体安排

2017 年 11 月 28 日 星期二

会议注册: 全天 自 早 8:00
地点: 唯实酒店一层大厅

晚餐
地点: 唯实酒店三层自助餐厅
时间: 晚上 18:00 - 20:00

2017 年 11 月 29 日 星期三

开幕式

地点: 北航新主楼第一报告厅

上午 8:30 - 9:20 开幕式
李家春院士代表组委会宣读会议主旨
徐惠彬校长为会议致辞

上午 9:20 - 9:40 集体合影
于 新主楼前

场次 1

主持: Ramesh K. AGARWAL

地点: 北航新主楼第一报告厅

上午 9:40 - 10:30 **Jan Werner DELFS 德宇航 DLR**
"Airframe related aeroacoustics - Research at DLR"

上午 10:30 - 10:50 茶歇

上午 10:50 - 11:40 **Cyrille BREARD 中国商飞 COMAC**
"Aircraft noise during aircraft development from design to entry of service: achievements and needs"

上午 11:40 - 12:30 **佘振苏· 北京大学**
"Theory of turbulent boundary layer and its derived turbulence model: progress and perspective"

中午 12:30 - 13:30 午餐
地点: 北航培训餐厅

场次 2

主持: Jan Werner DELFS

地点: 北航新主楼第一报告厅

下午 13:30 - 14:20 **Georg EITELBERG DNW**
"Current trends in aeroacoustic testing in DNW and in TU Delft"

下午 14:20 - 15:10 **Ramesh K. AGARWAL 圣路易斯华盛顿大学**

"A Unified Time-Domain/Frequency-Domain Methodology for Computational Acoustics"

下午 15:10 -15:30　茶歇

下午 15:30 -16:00　**符松 / 肖志祥　清华大学**
"Studies of unsteady flows and airframe noise past landing gear-like geometries"

下午 16:00 - 16:30　**刘沛清 / 郭昊　北京航空航天大学**
"Aeroacoustic experimental study on landing gears and high lift devices in D5 wind tunnel"

下午 16:30 -18:00　参观北航 D5 气动声学风洞（乘车前往沙河校区）

晚上 18:00 - 20:00　晚餐 于 阳坊大都火锅饭店

2017 年 11 月 30 日 星期四

场次 3
主持: Georg EITELBERG
地点: 北航新主楼第一报告厅

上午 8:30 - 9:20　**John EKATERINARIS　美国安柏瑞德航空航天大学**
"On the use of centered, upwind, and high order shock capturing numerical schemes for aeroacoustics"

上午 9:20 -10:10　**杨志刚　同济大学**
"Vehicle aero-acoustic design"

上午 10:10 -10:30　茶歇

上午 10:30 - 11:20　**Fulvio SCARANO　代尔夫特理工大学**
"Aeroacoustic noise generation mechanisms: hearing or seeing?"

上午 11:20 - 12:10　**陈鹏　中国空气动力研究与发展中心**
"Aeroacoustic Experiment on Main Rotor of Helicopter in Anechoic Wind Tunnel"

上午 12:10 - 12:40　**孙晓峰 / 杜林　北京航空航天大学**
"Sound generation from moving boundaries"

中午 12:40 - 13:40　午餐

地点: 北航培训餐厅

场次 4

主持: John EKATERINARIS

地点: 北航新主楼第一报告厅

下午 13:40 - 14:30 **Damiano CASALINO** **代尔夫特理工大学**

"On the usage of the Lattice-Boltzmann method for aircraft and rotorcraft aeroacoustics: from fundamental research to engineering deployment"

下午 14:30 - 15:20 **胡湘渝** **慕尼黑工业大学**

"A high-order targeted ENO scheme for large-eddy simulation of incompressible and compressible turbulence"

下午 15:20 - 15:40 茶歇

下午 15:40 - 16:30 **Peter BRANDSTÄTT** **弗劳恩霍夫建筑物理研究所**

"Noise Reduction technology in large acoustic infrastructure"

下午 16:30 - 17:20 **李晓东** **北京航空航天大学**

"High Order Numerical Simulation of Noise Generation from Complex Flows"

下午 17:20 - 18:10 **Rinie AKKERMANS** **布伦瑞克工大**

"CROR noise radiation and its mitigation"

晚上 18:10 - 20:00 晚餐 于 东方红饭店

Prof Ramesh K. AGARWAL

Lecture Title: A Unified Time-Domain/Frequency-Domain Methodology for Computational Acoustics

Dr. Ramesh K. Agarwal is the William Palm Professor of Engineering in the department of Mechanical Engineering and Materials Science at Washington University in St. Louis. From 1994 to 2001, he was the Sam Bloomfield Distinguished Professor and Executive Director of the National Institute for Aviation Research at Wichita State University in Kansas. From 1978 to 1994, he was the Program Director and McDonnell Douglas Fellow at McDonnell Douglas Research Laboratories in St. Louis. Dr. Agarwal received PhD in Aeronautical Sciences from Stanford University in 1975, M.S. in Aeronautical Engineering from the University of Minnesota in 1969 and B.S. in Mechanical Engineering from Indian Institute of Technology, Kharagpur, India in 1968. Over a period of 40 years, Professor Agarwal has worked in various areas of Computational Science and Engineering - Computational Fluid Dynamics (CFD), Computational Acoustics and Electromagnetics, and Multi-disciplinary Design Optimization. He is the author and coauthor of over 250 archival publications. He has given many plenary, keynote and invited lectures at various national and international conferences worldwide in over sixty countries.

A method for directly computing the acoustic signatures without a wave equation analogy is presented. The governing acoustic equations are derived from the unsteady Euler equations by linearizing about a steady mean flow and assuming a single frequency disturbance. A pseudo-time variable is introduced and the entire set of equations is driven to convergence by a point-implicit four-stage Runge-Kutta time-marching finite volume scheme. The spatial terms are discretized by a fourth-order dispersion-relation-preserving scheme with a sixth-order dissipation operator to damp out the physically non-realizable spurious modes which are the artifact of discretization. A new formulation of far-field radiation boundary condition based on the modal analysis of the similarity form of the linearized Euler equations is presented along with the well-known Perfectly Matched Layer (PML) formulation. The method is applied to compute the acoustic radiation from compact and non-compact oscillating airfoils in the presence of mean flow, acoustic radiation due to blade-vortex-interaction and airfoil/gust interactions, acoustic scattering from airfoils, and wave propagation in ducts. Results are compared with known analytical solutions and the results of other investigators where applicable.

Prof Rinie AKKERMANS

Technische Universität Braunschweig

Lecture Title: CROR noise radiation and its mitigation.

Rinie Akkermans is a Professor in turbulence and aeroacoustics at the TU Braunschweig in Germany. He holds an MSc degree in Aerospace Engineering from the TU Delft and a Dr.-degree from the Eindhoven University of technology on the topic of two-dimensional turbulence (both in the Netherlands). After obtaining the Dr.-degree, he worked for four years at the German Aerospace Center DLR on aeroacoustics of propeller engines. Since starting his professorship at the TU Braunschweig beginning 2014, he is doctoral advisor of 4 PhD student (two external with Volkswagen AG) and responsible for research and education related to turbulence and aeroacoustics.

Aircraft noise is a significant nuisance for the community around airports. Depending on the flight condition of an aircraft, the dominant noise sources can be identified as engine or airframe noise (e.g., during take-off or landing). During this presentation, I will address installation effects of the Contra-Rotating Open Rotor (CROR). Such CROR engines (two propellers in tandem configuration that rotate in opposite direction) suffer from a more pronounced sound radiation as compared to turbofan engines due to the high tip Mach number and the absence of a duct. I will talk about the isolated and installed CROR noise radiation. Finally, I will consider front-rotor trailing-edge blowing as a means of reducing interaction noise of Open Rotors.

Prof Peter BRANDSTÄTT

Fraunhofer IBP

Lecture Title: Noise Reduction technology in large acoustic infrastructure

First study of Building Physics at Applied University of Technics HfT in Stuttgart, then Master of Science Study in Sound and Vibration and Ph.D. at Institute of Sound and Vibration Research ISVR, Southampton.
Employment as researcher at University Stuttgart and then at Fraunhofer IBP since 1997 in the Acoustics department with a specialization on duct acoustics and silencer design. Since 1999 position as Group Manager Noise Control and since 2008 additionally Group Manager of Vehicle Acoustics. He became Head of Department Acoustics in 2016.

Since 1999, Lecturer at HfT Stuttgart in the Faculty of Fundamentals and Building Physics on Duct Acoustics and Noise Control.
The Lecture will first introduce Fraunhofer IBP as a research institution. Then the lecture will cover the evolution and conversion of aerodynamic wind tunnels to aero-acoustic ones. Different concepts and components are presented that are employed to reduce the fan noise in the duct and to create an acoustic free field in the plenum. Some details are given on concepts and components developed by Fraunhofer. Examples of realized wind tunnels will be shown together with achieved acoustic properties.

Prof Cyrille BREARD

Lecture Title: Aircraft noise during aircraft development from design to entry of service: achievements and needs.

Cyrille Breard is currently holding the position of C919 program Noise & Emission Manager at Shanghai Aircraft Design and Research Institute (SADRI), the product development branch of Commercial Aircraft Corporation of China, Ltd (COMAC). Main development activities cover community noise, cabin comfort, ramp noise and sonic fatigue as well as emission. And top of his responsibilities, he is extremely involved in broad activities across the company, such as marketing research, flight test center, risk management, system requirements, organization change. He provides technical advices to China member during Civil Aviation Environmental Protection meeting under ICAO for noise and emission.

In 2012, he was awarded by the Recruitment Program of Global Experts (Thousand Talents Program) from CPC Central Organization Department. In September 2012, he received the National Friendship Award from the Chinese government. In 2013, he was awarded for his outstanding performance at COMAC. He regularly advises and shares his proposal with State Administration of Foreigner Experts Affair. (SAFEA), which is an administrative agency of the State Council of the People's Republic of China responsible for certifying foreign experts to provide expertise in mainland China.
Aircraft noise development program involves highly integrated system from diverse disciplines such as weight, propulsion, structure, stress, aerodynamic, avionics, flight control, etc··· And aircraft noise is, without doubt, no exception to it. From aircraft system perspectives, noise control and design guideline must be included in the design phase as early as possible in order to reach aircraft noise requirements. The different requirements defined the early design phase provide a conventional breakdown of the work package that must blend into the organization. The presentation will focus on the new achievements at COMAC for different programs. Then needs in aeracoustics within industrial perspectives will be presented.

Prof Damiano CASALINO

Lecture Title: On the usage of the Lattice-Boltzmann method for aircraft and rotorcraft aeroacoustics: from fundamental research to engineering deployment.

Prof Casalino receives his aeronautic engineering degree in Turin Polytechnic, and PhD in fluid-dynamics and acoustics from Turin Polytechnic and Ecole Centrale de Lyon respectively. He has research interests in aeroacoustics that cover frequency-domain CAA for duct acoustics and installation effects, sound propagation in sheared flows, integral methods, stochastic noise generation, advanced experimental techniques for space launcher noise, helicopter trajectory optimization, vortex-airfoil interaction noise, liner optimization. He is the chair of Aeroacoustics in the Aerospace faculty of Delft University of Technology, and senior director of aerospace application management at Exa Corporation. His focus is on the industrial exploitation of the lattice Boltzmann method for airframe and engine noise prediction. He is author and co-author of about thirty archival journal publications in the field of aeroacoustics.

The present seminar introduces the Lattice-Boltzmann Method (LBM) in the framework of aerospace engineering, with a particular focus on some aeroacoustic applications. In the first part of the seminar, benchmark studies are presented in the field of airframe, aero-engine and helicopter blade-vortex interaction noise. The scalability of the computational model for full aircraft noise simulations is discussed in relation with the ultimate goal of integrating CFD/CAA simulations in the process of aircraft noise certification. The second part of the seminar is focused on the usage of LBM simulations to investigate, at a more fundamental level, the mechanism of aeroacoustic resonance occurring between two facing annular cavities. This phenomenon has been initially observed in the framework of code benchmarking for aircraft landing gear noise, and has been successively investigated by performing a geometrical parametric study. The analysis has revealed that a retroaction mechanism can take place between shear-layer vortical fluctuations and a combination of round cavity modes and cross-flow acoustic modes. The properties of the modes have been elucidated by filtering the unsteady flow in narrow bands around the tonal frequencies and investigating the azimuthal structure of the fluctuation field.

Prof Peng CHEN 陈鹏

CARDC

Lecture Title: Aeroacoutic Experiment on Main Rotor of Helicoptor in Anechoic Wind Tunnel

An anechoic wind tunnel, with test section 5.5m in width and 4m in height, began to run since 2013 at China Aerodynamics Research and Development Center (CARDC). Because of its low background noise level and excellent flow quality. The wind tunnel is suitable to explore the aerodynamic noise generated by helicopter rotor. In this presentation, firstly, typical experiments associating with the aerodynamic noise generated by various vehicles which have been fulfilled in the wind tunnel are briefly introduced. To study the flow-generated noise by the helicopter rotor, rotor rigs and various measurement techniques has been established in succession. It is presented in the part 2 in this presentation. Finally, this presentation gives an idea of supressing the rotor noise.

Prof Jan Werner DELFS

Lecture Title: Airframe related aeroacoustics - Research at DLR

Prof Jan Werner Delfs is DGLR chairman of "flow acoustics and aviation noise", German representative CEAS Aeroacoustics specialist committee and AIAA member and associate member of "Aeroacoustics Technical Committee ". He received his Ph,D degree from TU Braunschweig in 1994. After that, he worked as University assistant C1 at Institute of Fluid Mechanics and Fluid in Machines Karlsruhe University. Between 1996 and 2002, he was a Scientific employee at DLR Institute for Aerodynamics and Flow Technology. Since 2002, he has been the head Technical Acoustics Institute of Aerodynamics and Flow Technology of DLR (German Aerospace Center, Braunschweig, Germany) and at the same time the professorship for Technical Acoustics TU Braunschweig.

As the sound generation in turbofan engines has decreased the significance of airframe related sound has increased. For example in landing approach the sound associated with the airframe may even dominate the overall sound radiation of an aircraft. The influence of the airframe on aerosound is threefold: i) Airframe components subjected to either their own turbulent boundary layer flow or to installation related turbulent flow act as sources of sound, ii) The aerodynamic influence of the airframe may considerably change the sound generation of the propulsion system, in particular of propellers, iii) the airframe may change the radiation characteristics of engine noise due to reflection and diffraction of the sound waves at the aircraft surface as well as refraction and scattering effects of the vortical flow in its vicinity. The presentation gives an overview about prominent sources of airframe component noise as well as acoustic and source installation effects related to the airframe. Results of research at DLR will be presented on the numerical and experimental simulation of airframe component noise along with noise reduction technology. Recent work on aeroacoustic installation effects and their significance for exterior noise will be discussed as well.

Prof Georg EITELBERG

Lecture Title: Current trends in aeroacoustic testing in DNW and in TU Delft

Georg Eitelberg obtained the degree of Dipl.-Ing. (graduate engineering qualification) from the University of Karlsruhe in Germany in 1980 and the degree of Dr.-Ing. from the same University in 1983 for work performed as research scientist at the DLR in Göttingen, Germany. After a brief sojourn at the DLR Division of Space Utilization in Cologne, he worked as a lecturer in the Department of Mechanical Engineering of the Australian Defense Force Academy (ADFA), Canberra, Australia. Resigned in 1989. Already in 1988, he had been appointed head of the High Enthalpy Tunnel Project in DLR Göttingen. He followed with appointments as Head of the Aerothermodynamics Branch and Head of the Wind Tunnels Division in the DLR. He appointed (managing) Director of the DNW (German-Dutch Wind Tunnels - a joint entity founded by the national aerospace laboratories of Germany and The Netherlands) in 1998. He appointed a (part time) Full Professor at the TU Delft Faculty of Aerospace Engineering in 2009 to complement the task of being the Director of DNW.

In order to reduce fuel consumption, novel propulsion concepts are evaluated alongside with refinements of the existing propulsive techniques. In a systematic approach, the generation of noise is evaluated alongside with the propulsive performance. This combination is the driver for most of our current testing at DNW and at TUD. The acoustic testing falls into three somewhat overlapping main categories: 1) Localization of noise sources; 2) Directivity of the sources; 3) Interaction of acoustic sources with the aircraft. In recent two decades, the acoustic array has been the main tool for noise source localization. The capabilities and limitations will be discussed with the help of a few characteristic examples. For source directivity, tests in DNW are performed in the free jet tunnel configuration in order to obtain far-field data. The directivity testing of installed propulsion noise relies on the test providing appropriate similarity with the free flight conditions. A test on engine noise shielding funded by the EU Commission in the framework of CleanSky serves as an example of a well-planned test. The interaction of the rotor with static structures (pylons, wings and swirl recovery vanes) forms a challenge both in terms of conventional noise as well as in terms of the acoustic waves interacting with solid surfaces and possibly exciting structure-borne noise. Examples of experimental work performed at TUD, determining the interaction noise and verifying the possibilities to reduce it, will be discussed.

Prof John EKATERINARIS

Lecture Title: On the use of centered, upwind, and high order shock capturing numerical schemes for aeroacoustics

Prof. John Ekaterinaris received his M.Sc. in Mechanical Engineering in 1983 and his Ph.D. from the School of Aerospace Engineering in 1987, both at the Georgia Institute of Technology. Between 1987 and 1995, he worked at NASA–Ames Research Center and at the same time was faculty at the Naval Postgraduate Scholl at Monterey, CA. In 2000 returned to Greece and took the Research Director position of the Institute of Applied and Computational Mathematics at FORTH, where he remained until 2005. In Sept. 2005 he joined the faculty of Mechanical and Aerospace Engineering at the University of Patras. While he was in Greece carried out funded research and basic research funded by the London offices of AFOSR and ARO with the help PhD students and postdoctoral fellows. He joined the faculty of Aerospace Engineering of Embry-Riddle Aeronautical University in August 2012. His interests are computational mechanics, multi-scale phenomena, stochastic PDE' s, and biomechanics.

Developments of high order accurate schemes for the numerical solution of the linearized Euler equations that describe adequately sound propagation have been pursued for many years. These were primarily finite difference methods suitable for domains with moderate complexity. Recently, the discontinuous Galerkin finite method, which is a low dissipative upwind method for sufficiently high order of accuracy, has been also employed to make possible aeroacustic predictions in complex domains. The linearized Euler equations describe however only propagation of aeroacoustic disturbances and for sound generation, jet or vortex noise for example, the full nonlinear problem must be considered. As a result, a number of high order upwind schemes and centered schemes with minimal amount of added dissipation in the form of characteristic based filters or spectral filters have been employed for the numerical solution of the Navier-Stokes equations in direct and large eddy simulation of sound generation and propagation. For high speed flows, such as supersonic jets, discontinuities may develop and use of shock capturing schemes is necessary. For these class of aeroacoustic problems, weighted essentially non-oscillatory (WENO) schemes, discontinuous Galerkin discretization especially those providing high order shock capturing capability and even classical second order finite volume methods combined with high resolution meshes can be employed. In this presentation the essential features of these methods are outlined and examples from their application are presented.

Prof Song FU 符松

Prof Zhixiang XIAO 肖志祥

Lecture Title: Studies of unsteady flows and airframe noise past landing gear-like geometries

Dr. Zhixiang Xiao received his Ph. D degree at NWPU in 2003. Since 2003, he works in Tsinghua University. He promoted as an associate professor from Jan. 2008. After the reform of personnel system, he serves as a special professor since Jan. 2017. He is a senior member of AIAA, the committee member of aerodynamics at hypersonic, CSTAM, the committee member of aerodynamics for low, transonic and supersonic speed, CARS, the committee member of aerodynamic loading, CSA, and the guest professor of STEC. His research interests are simulations of transition/unsteady turbulence, aeroacoustics, aerothermodynamics, flow or noise control methodologies, and so on. As a PI, he took charge of over 50 projects in the recent 10 years. He developed and improved the in-house CFD solver, UNITs, which was widely applied in industries of aeronautics and astronautics. Now he has published over 100 papers, including over 30 peer reviewed journal papers. He has annually hosted and organized the Summer Course of Turbulence Modelling in THU since 2012, over 900 participants.

Airframe noise is very important when the civil airplane approaches, where the landing gear is the main contributor. It is very difficult to accurately simulate the unsteady flows and noise from the landing gear with very complex geometries. The landing gear is always simplified as cylinder, tandem cylinders or simplified landing gear. Advanced RANS-LES hybrid methods, such as DDES and IDDES models, were applied to predict the near-fields unsteady flows past the landing gear-like configurations, such as tandem cylinders, triple cylinders, and rudimentary landing gear. The interactions of vortices and components were investigated and the generation of high sound pressure level region were explored. At the same time, far-fields acoustics past the tandem cylinders was calculated using the FW-H methods. The noise reduction methodologies around the landing gear-like geometries will be briefly introduced in the on-going EU-China corporation project.

Prof Xiangyu HU 胡湘渝

TECHNISCHE UNIVERSITÄT

Lecture Title: A high-order targeted ENO scheme for large-eddy simulation of incompressible and compressible turbulence

Dr. Xiangyu Hu obtained his PhD degree from Beijing Institute of Technology in 1999. After the post-doctoral researches Beijing, Singapore, and Dresden. He joined Technical University of Munich as Scientific Assistant in 2006. He is now serving the Institute of Aerodynamics and Fluid Mechanics as Adjunct Teaching Professor. He is also serving the international SPHERIC steering committee from 2008. Dr. Hu have been engaged in researches on computational fluid dynamics (CFD). His main research fields are multi-resolution and multi-scale modeling of multiphase flow, smoothed particle hydrodynamics (SPH) method, high-order numerical schemes and others. He has authored or co-authored more than 60 papers in scientific journals and more than 100 presentations in international conferences.

Even for state-of-the-art implicit LES (ILES) methods, where the truncation error acts as physically-motivated subgrid-scale model, simultaneously resolving turbulence and non-turbulence subgrid scales is an open challenge. For the purpose of dealing with these scales, such as shocks, extra shock sensors, which are case-dependent and may not maintain the monotonicity, are generally employed. The problem originates in the lack of scale-separation between low-wavenumber smooth regions, high-wavenumber fluctuations, and discontinuities, and in inadequate scale-dependent numerical dissipation. The targeted ENO (TENO) approach allows for separately designing the dispersive and dissipative truncation error components. Thus it provides the suitable environment to develop an implicit LES model. A new 8-point 6th-order TENO8-A scheme is presented. Locally this scheme separates resolved and non-resolved scales. Low-wavenumber smooth scales are handled by an optimized linear scheme while high-wavenumber components, that involve non-resolved fluctuations and discontinuities, are subjected to adaptive nonlinear dissipation. The new scheme is Galilean invariant and does not involve separate sensors to detect flow structures, such as shocks. Benchmark simulations demonstrate that the TENO8-A scheme exhibits robust shock-capturing and high wave-resolution properties, and at the same time it reproduces the kinetic energy evolution for turbulence. Moreover, vorticity, entropy and acoustic modes of compressible turbulence are handled at least as accurately as explicit or other state-of-the-art ILES models.

Prof Xiaodong LI 李晓东

Lecture Title: High Order Numerical Simulation of Noise Generation from Complex Flows

Dr. Xiaodong Li is a professor in the School of Energy and Power Engineering at the Beihang University (BUAA). He graduated from BUAA with Bachelor' s, Master' s and Ph.D.' s degrees in 1989, 1992 and 1995, respectively. He has been a guest scientist at German Aerospace Research Center (DLR) in 1997 and subsequently at Technical University of Berlin. He established wide international collaboration network during the past 20 years. Dr. Li' s research interests are in the development of new theoretical and numerical methods for aeroacoustics, especially for jet noise, duct acoustics, turbomachinery noise and airframe noise. Currently he is an Associate Fellow of AIAA and serves as an international member of the AIAA technical committee of aeroacoustics. Dr. Li also serves on the Editorial Board of the International Journal of Aeroacoustics.

Computational Aero-Acoustics (CAA) methods are designed to simulate noise generation from complex flows. However, unsteady CAA computations are very time demanding and most high order spatial discretization schemes are rather difficult to handle complex geometries. This lecture will first introduce two non-uniform time integration methods for efficient CAA computations. Then an optimized spectral difference scheme and a flux reconstruction method will be described for the treatment of complex geometries. Finally, different aeroacoustic problems including jet, slat and acoustic liner will be presented to demonstrate the capability of the developed high order CAA methods.

Prof Peiqing LIU 刘沛清

Prof Hao GUO 郭昊

Lecture Title: Aeroacoustic experimental study on landing gears and high lift devices in D5 wind tunnel

Prof. Liu is the director of Key Laboratory of Aero-Acoustics (Beihang University), Ministry of Industry and Information Technology. He graduated from Tsinghua University and obtained his Ph.D degree in 1995 and worked in Beihang University from 1997 to present time. The main research interests of Dr. Liu include applied aerodynamics, propeller design complex flow control and Aeroacoustics. He has published more than 100 journal papers.

Dr. Guo is currently an Associate Professor at Beihang University in China. He obtained his B.Eng. in Structural Engineering in 1997 from Peking University, China; and earned his Ph.D degree in Physics from the Chinese University of Hong Kong in 2007, Hong Kong. He joined the Institute of Fluid Mechanics at Beihang University in 2008 as an Assistant Professor. Dr. Guo’ s research interests include turbulent thermal convection, wall turbulent flows, flow control, aeroacoustics, etc. He has published more than 20 SCI journal papers.

The aerodynamic noise is a problem of modern large aircrafts, especially during takeoff, approach and landing stages. The airframe noise can be generally categorized into two components, namely the high-lift device noise and the landing gear noise. The noise generation mechanisms and the radiation characteristics are different from each other, such that the corresponding noise reduction methods are different. Recently, the 30P30N high-lift airfoil and the LAGOON simplified nose landing gear are experimental tested in D5 aeroacoustic wind tunnel at Beihang University, aiming at revealing the noise generation mechanisms and far-field noise features of these airframe components. Furthermore, some noise reduction treatments and fundamental cavity noise are also presented.

Prof Fulvio SCARANO

Lecture Title: Aeroacoustic noise generation mechanisms: hearing or seeing?

Prof Fulvio Scarano is the full professor of TU Delft and the chair of Aerodynamics (TUD). He graduated from the University of Naples Institute of Aeronautics and Astronautics in 1996 and obtained his Ph.D. from the Von Karman Institute in 2000. In the same year, Prof Fulvio Scarano joined the Aerospace Engineering Institute of Delft University of Technology, Netherlands. Fulvio Scarano's research field is about particle imaging technology (PIV technology) and its applications in the supersonic and hypersonic conditions and development.

He has been the project leader of "Flow Visualization Based Pressure-FLOVISP", "Adaptive computation of turbulent flows with separation", "PIV-based non-intrusive determination of unsteady aerodynamic loads" and so on.

The increasingly stringent requirements on noise emission from the aviation sector have stimulated the development of accurate methods to estimate the sound emission from an aircraft through wind tunnel tests.

The improved capabilities of microphone based techniques allow nowadays identifying the noise source regions with acceptable spatial resolution and good spectral accuracy. Nevertheless, to fully identify the physical mechanisms behind the generation of aeroacoustic noise, specific aerodynamic experiments and numerical simulations are performed yield complementary information to the microphone data.

The advancements of time resolved tomographic PIV have paved the way to the measurement of the instantaneous velocity and the estimation of the instantaneous pressure field, of paramount importance for noise source detection.

The talk presents the fundamental principles to obtain acoustic information from PIV measurements, followed by a survey of applications, namely: rod-airfoil interaction; jet noise; trailing edge noise and the effects of trailing edge manipulation by different types of serrations.

Further developments in this field are still needed before these techniques can be used in industrial facilities.

Most recently, with the introduction of large scale PIV hardware and techniques, some applications at industrial scale are becoming feasible.

Prof Zhensu SHE 佘振苏

Lecture Title: Theory of turbulent boundary layer and its derived turbulence model: progress and perspective.

Zhen-Su She is a Zhou Peiyuan Professor of Mechanics at the Peking University. He was the former director of the State Key Laboratory for Turbulence and Complex System. He is the author of the widely known "She-Leveque" scaling model of turbulence, and has pioneered a new theory of wall turbulence called "structural ensemble dynamics (SED)" aiming at accomplishing a complete analytic description of turbulent boundary layers beyond the log law of Prandtl and von Karman. He is a Sloan fellow, and an American Physical Society fellow. He was awarded a Yangtze River Scholar in 1999, and a Chinese Young Scientist model in 2003, and a title of National distinguished Professor in 2009.

A new theory of turbulent boundary layer and its derived algebraic model based on a structural ensemble dynamics (SED) theory of wall turbulence are reported. The theory describes a multi-layer structure of eddy lengths in both the streamwise and wall-normal directions, which presents a remarkably universal character for a variety of wall flows. Comparisons to experimental and numerical data with widely used turbulence models such as SA, SST etc, in a variety of flows ranging from incompressible to hypersonic, with varying incoming turbulence intensities/scales inducing transition, and with a variety of attack angles for airfoil flows, show that the newly derived model yields superior predictions, demonstrating that the multi-layer description of the SED theory is reliable, and its derived turbulence model is promising. This study has an interesting outcome of fundamental interest, namely, identifying physical parameters of turbulent boundary layer, so as to differentiate different wall flows. Future study using the new model to study a variety of wall flows of aeronautic applications is discussed.

Prof Xiaofeng SUN 孙晓峰

Prof Lin DU 杜林

Lecture Title: Sound generation from moving boundaries

Lin Du is associated Professor of Fluid and Acoustic Engineering Laboratory, School of Energy and Power Engineering, Beihang University. Dr. Du' s research interests include the rotor/stator interaction, fluid-structure interaction and aeroacoustics in turbomachinery. A computational platform is established to solve the unsteady flow associated with moving boundary problems on the basis of immersed boundary method. The numerical method is developed to simulate laminar/turbulent flow, incompressible/compressible flow. The code is parallelized to reduce the computational time. In the frame of the present method, the unsteady flow passing through blade rows in turbomachinery can be studied on fixed simple orthogonal meshes. The data transfer at the interface between moving and stationary grids which slip against each other in traditional numerical methods is avoided. This is significant to elaborate the effect of rotor/stator interaction by numerical simulations. This method is also applied to study fluid-structure interaction and sound generation of complex moving boundaries.

A high-order computational model is developed to simulate the flow-induced sound problems with arbitrarily moving boundaries, on the basis of a discretized forcing immersed boundary method. The "2H2U" optimal criteria are proposed to illustrate the importance of a suitable body force model for developing high-order methods to simulate this kind of problems without bringing parasite waves near wall boundaries. A model equation is introduced to analyze the convergence and stability qualities of the present immersed boundary method, thus to obtain the optimal grid size ratio. To demonstrate the capability of the computational model and the reasonability of the proposed "2H2U" criteria, three kinds of flow-induced sound benchmark problems are simulated by utilizing the developed in-house compressible solver. Excellent agreements are obtained with the previous results both for the near-field flow structures and sound fields for the first kind of benchmark problem. In particular, it is proved that the developed computational model allows a larger CFL number than the penalization method and ghost-cell method for the flow-induced sound problems.

Prof Zhigang YANG 杨志刚

Lecture Title: Vehicle aero-acoustic design

Co-authors: Dr. Yigang Wang, Dr. Qiliang Li

Prof. YANG Zhigang received his PhD from Cornell University. He worked in NASA Lewis Research Centre and GM respectively before joining the faculty of Tongji University in 2005 to manage the Shanghai Automotive Wind Tunnel project. He holds a Yangtze River Professorship from Ministry of Education, and a National 1000 Plan Professorship from the Central Government of China. Since June 2017, He has assumed the additional responsibility as the Chief Engineer of Beijing Aeronautical Science & Technology Research Institute (BASTRI), the R&D Center for Commercial Aircraft Corporation of China (COMAC). His technical specialties include flow stability, turbulence modelling, computational fluid dynamics method; vehicle aerodynamics, aero-acoustics, thermal management; and wind tunnel design, vehicle design and energy research.

Wind noise performance is important for ground vehicle. Prediction and reduction of wind noise are important for vehicle makers. Wind tunnel test and numerical simulation are the main research methods of wind noise. Aerodynamic and aero-acoustic Wind Tunnel at Tongji University is the first full scale vehicle wind tunnel in China with low background noise. It can be used for wind noise measurement of vehicles and high-speed trains, et al. It has become a major research platform for wind noise of domestic automobile companies. On the simulation side, a high performance computing platform with 1352 cores was built and Acoustic Perturbation Equations (APE) method was developed and successfully applied in the prediction of aerodynamic noise of high-speed trains and vehicles. The flow field and acoustic field outside the vehicle were simulated by CFD and APE, while SEA was then applied to calculate the wind noise transmission into the cabin. The characteristics of exterior wind noise source was revealed and the transmission paths were identified. On the basis of wind noise prediction method, a parametric model was built to allow the mathematical description and fast reshaping of the model geometry to facilitate the reduction of the sound pressure level in the passenger cabin.

217-11-28		Time	217-11-29			217-11-30
Registration whole day Since 8:00am in the Vision Hotel	Session 1 Chair: Ramesh K. AGARWAL	8:30am-9:20am	Opening ceremony Starting Speech from the Chairman of AAAW Welcome Speech from the President of Beihang University	Session 3 Chair: Georg EITELBERG	8:30am - 9:20am	**John EKATERINARIS (Embry-Riddle Aeronautical University)** On the use of centered, upwind, and high order shock capturing numerical schemes for aeroacoustics
		9:20am-9:40am	Group Photo In front of the New Main Building		9:20am -10:10am	**Zhigang YANG (Tongji Univerity)** Vehicle aero-acoustic design
		9:40am-10:30am	**Jan Werner DELFS (DLR)** Airframe related aeroacoustics - Research at DLR		10:10am -10:30am	Tea Break
		10:30am - 10:50am	Tea Break		10:30am - 11:20am	**Fulvio SCARANO （TU Delft）** Aeroacoustic noise generation mechanisms: hearing or seeing?
		10:50am - 11:40am	**Cyrille BREARD (COMAC)** Aircraft noise during aircraft development from design to entry of service: achievements and needs		11:20am - 12:10pm	**Peng CHEN (CARDC)** Aeroacoutic Experiment on Main Rotor of Helicoptor in Anechoic Wind Tunnel
		11:40am - 12:30pm	**Zhensu SHE (Peking University)** Theory of turbulent boundary layer and its derived turbulence model: progress and perspective		12:10pm - 12:40pm	**Xiaofeng SUN / Lin DU (Beihang University)** Sound generation from moving boundaries
		12:30pm - 13:30pm	Lunch break At Beihang Traning Center Canteen		12:40pm - 13:40pm	Lunch break At Beihang Traning Center Canteen
	Session 2 Chair: Jan Werner DELFS	13:30pm - 14:20pm	**Georg EITELBERG (DNW)** Current trends in aeroacoustic testing in DNW and in TU Delf	Session 4 Chair: John EKATERINARIS	13:40pm - 14:30pm	**Damiano CASALINO （TU Delft）** On the usage of the Lattice-Boltzmann method for aircraft and rotorcraft aeroacoustics: from fundamental research to engineering deployment
		14:20pm - 15:10pm	**Ramesh K. AGARWAL (Washington University in St. Louis)** A Unified Time-Domain/Frequency-Domain Methodology for Computational Acoustics		14:30pm - 15:20pm	**Xiangyu HU (TU Munich)** A high-order targeted ENO scheme for large-eddy simulation of incompressible and compressible turbulence
		15:10pm -15:30pm	Tea Break		15:20pm - 15:40pm	Tea Break
		15:30pm -16:00pm	**Song FU / Zhixiang XIAO (Tsinghua University)** Studies of unsteady flows and airframe noise past landing gear-like geometries		15:40pm - 16:30pm	**Peter BRANDSTÄTT (Fraunhofer IBP)** Noise Reduction technology in large acoustic infrastructure
		16:00pm - 16:30pm	**Peiqing LIU/Hao GUO (Beihang University)** Aeroacoustic experimental study on landing gears and high lift devices in D5 wind tunnel		16:30pm - 17:20pm	**Xiaodong LI (Beihang University)** High Order Numerical Simulation of Noise Generation from Complex Flows
		16:30pm -18:00 pm	Visiting Beihang D5 Aeroacoustic Windtunnel in Shahe Campus （by coach）		17:20pm - 18:10pm	**Rinie AKKERMANS (TU Braunschweig)** CROR noise radiation and its mitigation
18:00 pm - 20:00pm Welcome dinner in the Vision Hotel		18:00 pm - 20:00 pm	Dinner in Yangfang Hotpot Restaurant		18:10pm - 20:00pm	Red Oriental Restaurant

AAAW
International Advanced Aero-Acoustics Workshop

2017年11月28日		时间		2017年11月29日		时间		2017年11月30日
全天注册 自 早8:00 与唯实酒店大堂	场次 1 主持: Ramesh K. AGARWAL	上午	8:30 - 9:20	开幕式 李家春院士发言 徐惠彬校长致辞	场次 3 主持: Georg EITELBERG	上午	8:30 - 9:20	**John EKATERINARIS (美国安柏瑞德航空航天大学)** On the use of centered, upwind, and high order shock capturing numerical schemes for aeroacoustics
			9:20 - 9:40	集体合影 于 新主楼前			9:20 - 10:10	**杨志刚 (同济大学)** Vehicle aero-acoustic design
			9:40 - 10:30	**Jan Werner DELFS (德宇航 DLR)** Airframe related aeroacoustics - Research at DLR			10:10 - 10:30	茶歇
			10:30 - 10:50	茶歇			10:30 - 11:20	**Fulvio SCARANO （代尔夫特理工大学）** Aeroacoustic noise generation mechanisms: hearing or seeing?
			10:50 - 11:40	**Cyrille BREARD (中国商飞 COMAC)** Aircraft noise during aircraft development from design to entry of service: achievements and needs			11:20 - 12:10	**陈鹏 (中国空气动力研究与发展中心 CARDC)** Aeroacoutic Experiment on Main Rotor of Helicoptor in Anechoic Wind Tunnel
			11:40 - 12:30	**余振苏 (北京大学)** Theory of turbulent boundary layer and its derived turbulence model: progress and perspective			12:10 - 12:40	**孙晓峰 / 杜林 (北京航空航天大学)** Sound generation from moving boundaries
			12:30 - 13:30	午餐 于 北航培训餐厅			12:40 - 13:40	午餐 于 北航培训餐厅
	场次 2 主持: Jan Werner DELFS	下午	13:30 - 14:20	**Georg EITELBERG (DNW)** Current trends in aeroacoustic testing in DNW and in TU Delf	场次 4 主持: John EKATERINARIS	下午	13:40 - 14:30	**Damiano CASALINO （代尔夫特理工大学）** On the usage of the Lattice-Boltzmann method for aircraft and rotorcraft aeroacoustics: from fundamental research to engineering deployment
			14:20 - 15:10	**Ramesh K. AGARWAL (圣路易斯华盛顿大学)** A Unified Time-Domain/Frequency-Domain Methodology for Computational Acoustics			14:30 - 15:20	**Xiangyu HU (慕尼黑工业大学)** A high-order targeted ENO scheme for large-eddy simulation of incompressible and compressible turbulence
			15:10 - 15:30	茶歇			15:20 - 15:40	茶歇
			15:30 - 16:00	**符松 / 肖志祥 (清华大学)** Studies of unsteady flows and airframe noise past landing gear-like geometries			15:40 - 16:30	**Peter BRANDSTÄTT (弗劳恩霍夫建筑物理研究所)** Noise Reduction technology in large acoustic infrastructure
			16:00 - 16:30	**刘沛清/郭昊 (北京航空航天大学)** Aeroacoustic experimental study on landing gears and high lift devices in D5 wind tunnel			16:30 - 17:20	**李晓东 (北京航空航天大学)** High Order Numerical Simulation of Noise Generation from Complex Flows
			16:30 - 18:00	参观北航陆士嘉实验室D5气动声学风洞 （北航沙河校区，乘坐大巴前往）			17:20 - 18:10	**Rinie AKKERMANS (布伦瑞克工大)** CROR noise radiation and its mitigation
晚上18:00 - 20:00 晚餐 于 唯实餐厅			18:00 - 20:00	晚餐 于 阳坊大都火锅饭店			18:10 - 20:00	晚餐 于 东方红饭店