

Advanced Design Concepts and Practice ADCP 2017 Workshop Special Track of ICMD 2017

<http://adcp2012.com>,

<http://www.chinamdi.org/ICMD/2017.htm>

Beijing

November 19th-21st, 2017



Organizers:

Tsinghua University

Mechanical Design Institution of
Chinese Mechanical Engineering Society

Beijing Institute of Technology

November 19-21st, 2017, Beijing



Advanced Design Concepts and Practice

ADCP2017 Workshop

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- Chairs** Prof. Ji Linhong, Tsinghua University
Prof. Michel van Tooren, University of South Carolina
- Organizers** Tsinghua University
Mechanical Design Institution of Chinese Mechanical Engineering Society
Beijing Institute of Technology
- Sponsor** MOE International Joint Laboratory of Innovative Design and Manufacturing of Advanced Mechanical systems
教育部高端装备创新设计制造国际合作联合实验室

Chair of Academic Committee:

Professor Xie You-bai, 谢友柏院士, Academician of Chinese Academy of Engineering

Academic Committee

Professor Chen Liping, Huanzhong University of Science and Technology, China

Professor Dieter Roller, University of Stuttgart, Germany

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Professor Ji Linhong, Tsinghua University, China

Professor Liu Guanzhong, Tsinghua University, China

Professor Liu Yusheng, Zhejiang University, China

Professor John Gero, University of North Carolina, USA

Professor Michel van Tooren, University of South Carolina, USA

Professor Ming Xinguo, Shanghai Jiaotong University, China

Professor Tetsuo Tomiyama, Cranfield University, UK

Professor Yongsheng Ma, University of Alberta, Canada

Keynote/Invited speakers

1. 特邀院士报告: 谢友柏院士, 中国工程院

Professor Xie You-bai, Academician of Chinese Academy of Engineering

Topic: Cognize Design Science, Study Design Science 认识设计科学 研究设计科学

2. 柳冠中教授, 清华大学美术学院

Professor Liu Guanzhong, The Academy of Arts & Design, Tsinghua University, China

Topic: Do you believe "Seeing is Believing?" 耳听为虚眼见为实吗?

3. Professor Michel van Tooren, University of South Carolina, USA

Topic: Non-conventional Materials for Advanced Structures :

Better structures by mixing, curving, printing, stirring and monitoring- Design and Manufacturing Aspects

4. 陈立平教授, 华中科技大学机械学院

Professor Chen Liping, Huazhong University of Science and Technology, China

Topic: Study on Knowledge automation, nonlinear control and parameter self-sensin 知识自动化、非线性控制与参数自感知研究初步

5. Professor Yong Zeng, Concordia University, Canada

Topic: A science of design for studying design activities: object of study, axioms, and research methodologies

6. 倪小军博士,中国科学院合肥物质科学研究院(等离子体物理研究所)

Dr. Ni Xiaojun, Institute of Plasma Physics, Chinese Academy of Sciences

Topic: Multidisciplinary design and simulation of a magnetic confinement fusion device-Tokamak

Panel discussion “Design for future inspired by biology/nature/X”

Chair: Professor Yong Zeng, Concordia University, Canada

Invited panelists

1. Professor Xie Youbai, Shanghai Jiaotong University
2. Professor Liu Guanzhong, Tsinghua University
3. Professor Li Yan, Sichuan University
4. Professor Chen Liping, Huazhong University of Science and Technology
5. Professor Yong Zeng, Concordia University, Canada
6. Professor Ji Linhong, Tsinghua University
7. Professor Chen Yong, Shanghai Jiaotong University
8. Dr. Dai Xudong, Auye Design Knowledge Service Net
9. Dr. Zhang Zhinan, Shanghai Jiaotong University
10. Dr. Li Xiang, SysGraph Lab

Introduction to the workshop

ADCP workshop series offers a forum for presentation and discussion to bring advanced theories and technologies to the design and simulation of complex equipment and products, with a focus on computational design and evaluation methods and tools. ADCP2017 will be held as a special track of the 2017 International Conference of Mechanical Design & the 19th Mechanical Design Annual Conference (ICMD 2017). *The theme of ADCP2017 is Design Inspired by Biology and Nature.*

Topics: include but not limited to:

- Design process and algorithms inspired by biology and nature
- Design for programmable behaviors and structures and DNA origami
- Knowledge based engineering (KBE)
- Design agents
- Design grammar and design language
- Design of intelligent systems
- Design modeling of cyber physical systems
- New generation design systems

Previous ADCP workshops:

ADCP2011, Beijing, July 6-8 th, 2011

ADCP2012, Karlsruhe, Germany, May 8 th, 2012

ADCP2013, Beijing, August 16 th, 2013

ADCP 2014, Stuttgart, Germany, 26 th September 2014

ADCP2015, Hangzhou, September 18-20 th, 2015

ADCP2016, Columbia, SC USA, August 24-25th, SC, USA

Season workshops:

ADCP2012 Summer Workshop at TU Delft on August 17th, 2012

ADCP2012 Fall Workshop in Beijing on November 8th, 2012

ADCP2014 Spring Workshop in Beijing, March 28th, 2014

ADCP2014 Summer Workshop in Beijing on June 24th, 2014

ADCP2015 Winter Workshop in Beijing on December 3rd. 2015

ADCP2016 Spring Workshop in Aix-Provence on May 9, 2016

Seminars: <http://adcp2012.com>

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Introduction to keynote speakers/invited speakers

1. 特邀院士报告: Professor: Xie You-bai, 谢友柏院士, Academician of Chinese Academy of Engineering



谢友柏院士

Professor Xie You-bai

Academician of Chinese Academy of Engineering

谢友柏院士, 1933 年生于上海, 1955 年毕业于交通大学内燃机制造专业并留校任教, 现任上海交通大学及西安交通大学教授, 是机械学、摩擦学专家, 1994 年被选聘为中国工程院院士。他提出了摩擦学三个公理和设计科学四个基本定律, 研究了摩擦学系统系统工程及设计中知识的流动、集成、竞争和进化, 并在大型机组转子轴承系统动力学设计、内燃机低摩擦设计和基于互联网的设计知识服务相关技术研发等中得到应用。近年专注于设计科学的研究, 在定义设计是人类一切有目的活动的起始后, 在设计需要同时考虑物质需求、精神需求和社会需求, 创新三要素(采用此前未曾用过的知识、满足现在不能满足的需求和竞争取胜), 创意引领设计, 创意的实践性和随机性, 设计中数据、信息、知识之间关系, 人和计算机之间关系, 知识流动的驱动力和阻力, 设计师的培养等理论和技术的研究上做了许多工作。开设过的课程有机械原理、机械零件、振动理论、流体动力润滑理论、轴承技术、弹性流体动力润滑理论、摩擦学、现代设计理论和方法、创新思维与现代设计、全生命周期性能数字样机等。

Professor Xie, You-Bai, 1933 born in Shanghai, graduated from Jiao Tong University (Shanghai) in 1955 with a speciality of IC engine manufacturing and stayed for teaching. He is now the professor of Shanghai Jiao Tong University and Xi'an Jiaotong University, a specialist in the areas of machinery science and tribology, and has been elected to the Chinese Academy of Engineering as a member in May 1994. He has put forward his Three Axioms of Tribology and Four Basic Laws in Design Science and presented many research results concerning with the systems engineering of tribo-systems, the flowing, integrating, competing and evolving of knowledge in design and all of them have been applied to the dynamic design of rotor-bearing systems of large turbine-generator sets, the low friction design of IC engines and the development of technique related to the internet-based design knowledge services. Recent decades he has focused on the study of Design Science. After defining that design is the beginning of all purposeful activities of human, the necessity of considering physical, mental and

social requirements simultaneously in design, three elements of innovation (meeting the requirements which cannot be met yet, using the knowledge which has not been used and winning the competition), the principle of creativity leading design, the practicality and randomness of creativity, the relationship between data, information and knowledge, the relationship between human and computers in design, the driving force and resistance of knowledge flow in design and the education of design engineers were investigated. The courses which he has taught included Theory of Mechanism, Design of Machine Elements, Theory of Vibration, Theory of Hydrodynamic Lubrication, Bearing Technique, Elasto-hydrodynamic Lubrication, Tribology, Theory and Methodology of Modern Design, Innovation Thinking and Modern Design, Life-cycle Performance Digital Prototype, etc.

Topic: Cognize Design Science, Study Design Science

Abstract: Design is a first step of all human's purposeful activities. The study of design is never absent from the studies of any special area. The study of design in a special area must be conducted from and limited by the vision of the area. A lot of controversies in the world related to the cognition of design, the existence of Design Science and the necessary of studying Design Science is then inevitable.

One does design, it is conducted from his/her subjectivity. When design is a human's activity, design will be an objectivity and with its own laws independent of any one's will. The laws of design in human's activity are different with the laws of design in a special area, a special discipline, a special profession or a special product and are a part of the basic and common laws of human's activity.

Richard Fuller (1895 ~ 1983) put forward his idea of design science that is the effective application of the principles of science to the conscious design of our environment in order to help make the Earth's finite resources meet the needs of all humanity without disrupting the ecological processes of the planet. The idea was an introspection to the waste of natural resources and violation of social needs in design. Walter Gropius (1883~1969) strived to find a common denominator for design, to develop a design science to create a unity of the arts and weave it with technology. His idea can be understood as to meet mental needs and physical needs simultaneously in design. These contained their ardent wishes on cognizing and studying the basic and common laws of design. It is sorry that their expectations have not been cognized and carried out enough yet. The gray sky becomes people's nightmare and that some problems more serious than the gray sky may happen in the future is not stretch the truth.

Into 21 century the urgency of study of Design Science which including but transcending the study of design in any special area becomes more and more clear. For example, the tourism becoming so big a market shows that the mental needs have been a daily demand of the publics. As so quick the development of information technique, logistics technique and global economic integration the society becomes more complex and interdependence of one another. The tidal wave of seeking "new" pushes competitive innovation, but it is not permitted that a "new" harms common brilliant life. The needs for society coordination will continuously grows. For example, problems with sharing bikes' appearing cannot be overlooked by the urban management. The common brilliant life requests new financial products, service products, etc. All of them are social products. Such a situation shows strongly that for any product physical needs, mental needs and social needs should be considered simultaneously in design and the problems of design knowledge supply for such consideration must be solved, otherwise the design will be shifted out in competition. Looking at now and future, the study of Design Science should be paid more attention than what expected by Fuller and Grupius in their era.

Study of Design Science in China is just starting. How to organize the study of Design Science including but transcending the study of design in special areas is a big problem to be solved.

认识设计科学 研究设计科学

设计是人类一切有目的活动的第一步，无论哪一个专业研究领域都不可能不研究设计。不过专业领域研究设计，是从领域的视角出发和受到领域视野的限制。世界上存在关于设计的不同认知、是否有设计科学以及是否需要研究设计科学的种种争论就是很容易理解的了。

当设计是某个人的行为时。设计是该人的主观，当设计是全人类行为时，设计就是一个客观，具有不依人的意志转移的规律。这种规律不同于专业领域、学科、行业、产品设计的规律，是人类有目的活动的基本、共同规律的组成部分。

理查德·福乐（Richard Fuller 1895~1983）提出他对设计科学深谋远虑的预见：设计要有效地利用科学原理使得地球上的有限资源能够满足全人类需求而不破坏植物的生态过程。这是对浪费自然资源行为的反思，是对设计要满足社会需求的领悟。沃尔特·格罗佩斯（Walter Gropius 1883~1969）则力图为设计寻求一个技术和艺术的公分母，实现技术和艺术的统一，并将这个追求表达为设计科学。他的主张可以理解为设计要追求精神需求和物质需求的共同满足。这些关于设计科学认识，蕴含着对于认识和研究设计基本、共同规律的期望。遗憾的是这些期望现在仍旧没有被所有做设计的人认识和执行，也没有被各个专业领域、学科、行业、产品设计的研究者所重视。因此，雾霾成为人类的梦魇以及今后可能发生比雾霾更严重的灾难也不是言过其辞。

到了 21 世纪，包括但是超越各专业领域、学科、行业、产品的设计科学研究迫切性越来越明显。如旅游居然能够形成这样大的市场，说明精神需求已经成为普通人群追逐的目标。信息技术、物流技术高度发展和全球经济一体化，使得社会变得越来越相互依赖，越来越复杂。人们对“新颖”的追求推动创新竞争，但是“新”不能破坏共同美好生活，这就不断产生新的治理社会的需求，也就是需要新的政策产品。就拿共享单车来说，它出来了，城管就不能不管。共同美好生活还要求新的金融产品、新的服务产品等等，这些都是社会需求。同时也强势地表明，不管哪一种产品，在设计中都不能不同时考虑满足物质需求、精神需求和社会需求以及解决满足这些需求的设计知识供给问题，否则就会在竞争中被淘汰。从现在形势和今后发展看，显然设计科学的重要性已经远远超过福乐和格罗佩斯当年的想象。

国内关于设计科学的研究还在起步阶段，如何能够组织力量在比一个产品的设计或者一个技术的开发更高层次上来认识设计科学、研究设计科学，是有待解决的命题。

2. Professor: Liu Guanzhong, 柳冠中教授, Tsinghua University, China



柳冠中教授，清华大学美术学院
Professor: Liu Guanzhong,

The Academy of Arts & Design, Tsinghua University, China

清华大学美术学院责任教授、博导；中国工业设计协会荣誉副会长，专家工作委员会主任，清华大学美术学院设计战略与原型创新研究所所长；山东工业设计研究院院长，南京艺术学院和广东工业大学博导。代表著述：工业设计学概论，事理学论纲，中国古代设计事理学系列研究（上、下卷），综合造型设计基础，设计方法论，象外集。

Professor Liu Guanzhong is professor of Academy of Design & Arts of Tsinghua University and Vice President and Director of Expert Committee of China Industrial Design Association. He is Director of Master's Degree of Engineering Group of National Instructive Committee in Industrial Design Education, President of Design Strategy and Prototype Innovation Institute and the Research Center of Arts and Science of Tsinghua University. He is also honorary president of the Design Arts and Media College of Nanjing University of Science and Technology and Honorary president of the Guangdong Industrial Design Training Institute. His main works include Outline of Matterology, Comprehensive Design foundation, Methodology of Design and Beyond the Form. From 1961 to 1966, he studied in Department of Architectural Designing, Central Academy of Art and Design. From 1974 to 1978, he served as an interior designer at Beijing Construction Design Institute, mainly responsible for lighting and lights design of public buildings. From 1978 to 1980, he took postgraduate program in Fine Arts Department of Central Academy of Art and Design. After graduating with a master's degree, he took a teaching post. From 1981 to 1984, he studied as a visiting scholar at National Stuttgart Academy of Design in Germany with a Western Germany DAAD scholarship. In 1984, he returned to China to teach at Central Academy of Art and Design and he became the first dean of industrial design department in China from Aug. 1984 to 1999, building up the industrial design education system in China. In 1999, he was awarded the Silver prize of the ninth National Fine Arts Exhibition for his "Cellphone Conceptual Design". In the same year, he was employed as professor and Ph.D supervisor by Tsinghua University after Central Academy of Art and Design was incorporated into Tsinghua University. In 2000, the article "Science of Human Things-----Design Methodology" was included in the book "Must Read for Designers" (SBN 3-89850-018-7) by German HOCHENHEIM publisher. He has received many national and university teaching and design awards. He has created theories such as "style design", "matterology" methodology, "design culture", and "symbiotic aesthetics". He is one of the most famous academic leaders, having great social influences in the area of industrial design.

Topic: Do you believe "Seeing is Believing?" 耳听为虚眼见为实吗？

3. Professor Michel van Tooren, University of South Carolina, USA



Professor Michel Van Tooren

Director of the SmartState(TM) Center for Multifunctional Materials and Structures (MFMS)
Director Ronald E. McNAIR Center for Aerospace Innovation and Research
Department of Mechanical Engineering, University of South Carolina, USA

Michel van Tooren is Professor Aerospace Systems Design and Structures at the College of Engineering and Computing (CEC) of the University of South Carolina, SmartState Endowed Chair in the Center for Multifunctional Materials and Structures and Director of the Ronald E. McNAIR Center for Aerospace Innovation and Research. Michel has a BSc, MSc and PhD in Aerospace Engineering and joined CEC in September 2013. Before joining USC he worked for Fokker Aerostructures in the Netherlands as Manager New Concept Development. He combined this position in industry with a part-time appointment at the Faculty of Aerospace Engineering of the Delft University of Technology. Prior to that he worked ten years as professor Systems Integration Aircraft at the same University, building a group specialized in Aircraft Design, Flight Mechanics and Multi-disciplinary Design Optimization. This group became well-known for its work in MDO, Aircraft Design, KBE and Truck Aerodynamics. He combined the research activities with a position in the management team of the faculty of Aerospace Engineering as vice dean. All this followed a previous ten years of research, education and innovation in design of composite structures. His research focus at CEC is on design and manufacture of composites structures, especially thermoplastics. In addition he serves as the Program Director Aerospace Engineering Studies for CEC.

Topic: Non-conventional Materials for Advanced Structures: Better structures by mixing, curving, printing, stirring and monitoring- Design and Manufacturing Aspects

Abstract: Recent developments in composite material and manufacturing technology have given us ‘full’ composite commercial aircraft in which the percentage of fiber reinforced polymer structure is at an all-time high. One could conclude that this will end an era of development and we can move on to a next challenge, for example achieving a similar goal in automotive or shipbuilding. Being an aerospace materials and structure engineer that doesn’t feel right and a next challenge in aerospace would be much preferred over a shift in application domain. The discussion will therefore be focused on improving the performance of the full composite aircraft by adopting and adapting many ideas that are available or under development that can help to improve key characteristics of aircraft structures such as acquisition cost, weight, in-service cost and lead time.

The developments that will be reviewed are related to mixing, curving, printing, stirring, joining and monitoring of composites and their constituents. The topics are discussed in general first and then the research done at the McNAIR Center and its partners will be highlighted as an example of what could be of interest and what it would improve for a next generation of aircraft structure. A short outlook to what the new technologies would require from design tools will complete the talk.

4. Professor Chen Liping 陈立平教授, Huazhong University of Science and Technology, China



Professor Chen Liping 陈立平教授
Director of CAD Center, Mechanical Engineering School
Huazhong University of Science and Technology, China

Dr. Chen Liping is a professor at school of mechanical science & engineering, Huazhong Univ. of Science and Technology. He is the director of the research center of national CAD support software engineering technology (Wuhan), and the academic committee member in civilian aircraft flight simulation state key laboratory. In recent twenty years, his research focuses on the geometric constraint solving, multi-body system dynamics, multidisciplinary modeling and simulation analysis of digital design support technology. Also, he has undertaken a number of related national natural science foundation projects, national 863 plan project and enterprise cooperation projects. Recently, his research interests are the physical system modeling and simulation method including theory research, tools development and engineering application. He has proposed the theory of multiple field constraint fusion and launched the consistent representation method in physical system with differential algebraic equation in time domain and partial differential equation in space domain, which can provide the fundamental support for the new generation of complex physical system modeling and simulation tool. Moreover, he has organized and developed the first unified modeling and simulation platform (MWorks) based on Modelica in the Asia-pacific region, the platform has been widely used in the domestic aviation, aerospace, automobile, engineering.

Topic: Study on Knowledge automation, nonlinear control and parameter self-sensing

知识自动化、非线性控制与参数自感知研究初步

信息物理融合是智能产品、装备及系统共性技术特征，支持信息物理融合是当前设计理论与技术面临的挑战。通过多领域统一建模形式化表达，采用符号动力学运算，实现了复杂多学科系统的动力学系统的自动获取，突破了模型驱动的软件自动生成等关键技术，建立了工程物理系统原理及应用的知识自动化体系。结合工业机器人控制存在的问题，介绍了该知识自动化流程在非线性动态逆控制中的应用，提出了一种参数自感知的机器学习方法。

5. Professor Yong Zeng, Concordia University, Canada



Professor Yong Zeng

Concordia Institute for Information Systems Engineering, Concordia University.

NSERC Chair in Aerospace Design Engineering

Dr. Yong Zeng is a Professor in the Concordia Institute for Information Systems Engineering at Concordia University. He is NSERC Chair in Aerospace Design Engineering (July 2015-June 2020) and was the Canada Research Chair (Tier II) in design science (April 2004 - August 2014). He is the Editor-in-Chief of Journal of Integrated Design and Process Science (published by IOS) and an editorial board member of Computers in Industry and Journal of Computational Design and Engineering. His research aims to understand and improve creative design activities, which crosses design, computer science, mathematics, linguistics, and neurocognitive science. He has proposed the Environment-Based Design theory.

Prior to joining in Concordia in August 2003, he was a research associate at National Research Council of Canada for about two years after he received his Ph.D. from Mechanical and Manufacturing Engineering at the University of Calgary in 2001. He obtained another PhD degree in Computational Mechanics from Dalian University of Technology in 1992, where he also received his Master's degree in 1989. Between his two PhD studies, he was a faculty member in the Department of Civil and Architectural Engineering at the Institute of Logistics Engineering, where he completed his B.Eng degree in Structural Engineering in 1986.

Topic: A science of design for studying design activities: object of study, axioms, and research methodologies

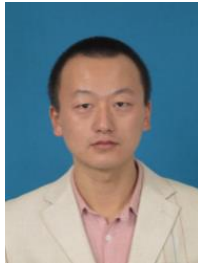
Abstract: Conceptual design is an early and critical phase of the engineering design process. Decisions made in the conceptual design phase can affect dominantly the final product cost. Therefore, having good concepts at the end of this phase is one of the important factors to successful actions. This requires effective and efficient methods and tools that can help designers deliver innovative and creative solutions. To build such methods and tools, it is indispensable to discover the knowledge about design activities such as the nature of design, factors affecting design activities and the designer's mental process. This work is a continuing effort to build a science of design which aims to discover knowledge about design activities through formal scientific process. In this talk, we will focus on a new design theory that has been developed based on two postulates:

- Postulate of recursive design reasoning: Design reasoning follows a recursive reasoning process.
- Postulate of designer's stress-creativity relation: Design creativity is related to designer's mental stress through an inverse U shaped curve.

Physiological experiments will be introduced to show the challenges in experiment design and analysis for such studies, and to illustrate our findings about the relationships between designer's mental effort and mental stress, which are quantified by electroencephalography (EEG) and heart rate variability (HRV), respectively. Future trends in this research will also be discussed.

Applications of this scientific theory will be presented, covering education design, organization behavior, and role of perception in creative design.

6. Dr. Ni Xiaojun, Chinese Academy of Sciences



Dr. Ni Xiaojun

Institute of Plasma Physics, Chinese Academy of Sciences

Dr. Ni Xiaojun obtained his PhD at University of Science and Technology of China on Engineering Mechanics in 2012. He has worked in the Institute of Plasma Physics, Chinese Academy of Sciences since 2012.6

Technical Activities:

Mechanical Analysis and optimal design for the Tokamak component:

- Mechanical and thermo-hydraulic analysis and optimal design for ITER TF-type HTSCL;
- Seismic analysis and optimal design for ITER PF4 Feeder;
- Mechanical and seismic analysis and optimal design for the EAST cryostat;
- Thermo-hydraulic analysis and optimal design for EAST diagnostic component;
- Electromagnetic, mechanical, thermo-hydraulic and seismic analysis and optimal design; for CFETR (China fusion Engineering Test Reactor) VV conceptual design model;
- Electromagnetic and mechanical analysis and optimal design for Busbar & HTSCL in GA Feeder;
- Electromagnetic and thermo-hydraulic analysis and optimal design for thermal shield in GA Feeder;
- Thermal analysis for cryogenic system and optimal design of GA Feeder;
- Mechanical and seismic analysis and optimal design for global model of GA Feeder system;
- Thermal analysis for thermal shield and optimal design of ITER Feeder;
- Thermal and mechanical analysis and optimal design for cold mass support of ITER Feeder;
- Electromagnetic analysis and optimal design for EAST divertor.

Topic: Multidisciplinary design and simulation of a magnetic confinement fusion device-Tokamak

Abstract: Nuclear energy is considered to be an inexhaustible resource in the long term. As one kind of nuclear energy, fusion energy has excellent growth prospects in the field of new energy due to its high security and less fuel consumption. At present, Tokamak is regarded as a very important device for the development of fusion energy, and the relevant facilities are developed and built in many countries. For construction of any Tokamak device, both physics and engineering designs must be performed. The primary function of physics design is definition of the system requirements, and the engineering design is carried out for meeting these system requirements. In view of the fact that the requirements of Tokamak system are involved in electromagnetism, structural mechanics, thermodynamics and hydrodynamics simultaneously, the Tokamak engineering design would have huge challenges. Therefore, it is very important to select a suitable tool for assessing the performance of engineering design. This paper will describe an efficient simulation technology for analysis, assessing and optimizing the engineering design of Tokamak device, which involves the use of computer and some special softwares. It has many advantages including the visualization of

systematic process and results, low costs, and multi-discipline adaptability, and can greatly improve the efficiency and reliability of the Tokamak engineering design. The relevant work has been performed for the evaluation and optimization of engineering designs of some Tokamak devices, such as, ITER, EAST, and CFETR, and the corresponding engineering application cases will be displayed.

磁约束聚变装置多学科设计和仿真

核能是一种无限、清洁的新能源。作为核能中一个大类的聚变能，因具有安全性高和燃料消耗低等特点，在新能源领域具有极好的增长前景。目前，托卡马克被认为是发展聚变能的一个十分重要的装置。它是一种磁约束聚变装置，已在许多国家被研究和建造。任何一个托卡马克装置的建造过程中，装置相关的物理设计和工程设计必须被执行，其中，物理设计的一个重要作用就是定义清楚整个装置的系统性能要求，而工程设计则是让装置能满足这些系统性能要求。系统性能要求涉及多个学科，诸如核物理、电磁学、结构力学、热力学、流体力学等学科，且这些性能要求在托卡马克装置设计中必须同时满足。这些要求给磁约束聚变装置工程设计带来了巨大的挑战。因此，评估工程设计的工具选择就显得十分重要。报告描述一个有效的仿真技术，被应用于评估和优化托卡马克工程设计，该仿真技术涉及计算机和特殊软件资源的综合运用，具有过程和结果可视化、低成本和多学科适用性等诸多优点，同时还可以极大的改善托卡马克工程设计的效率及可靠性。相关工作已经成功应用于托卡马克装置（诸如 ITER, EAST, CFETR 等）工程设计的评估和优化工作，相应典型案例也将被展示。

Invited panelists

1. Professor Xie Youbai, Shanghai Jiaotong University, see keynote/Invited speakers
2. Professor Liu Guanzhong, Tsinghua University, see keynote/Invited speakers
3. Professor Michel van Tooren, South Carolina University, USA, see keynote/Invited speakers
4. Professor Yong Zeng, Concordia University, Canada, see keynote/Invited speakers
5. Professor Li Yan, Sichuan University



Professor Li Yan 李彦教授
Sichuan University

李彦 博士，教授、博士生导师，四川省委省政府决策咨询委员会委员、四川省学术技术带头人、创新方法与创新设计四川省重点实验室主任、创新方法研究会技术创新方法专业委员会副理事长。在英国利物浦约翰摩尔斯大学取得博士学位，并在卡迪夫大学制造工程中心和剑桥大学工程设计中心从事了三年研究工作。主要研究方向为创新设计理论方法及计算机辅助工具、智能制造及工业互联网。已完成和在研包括国家自然科学基金重点项目、“863”计划、科技部专项、四川省重点攻关等省部级科研项目等多项。在国际国内学术刊物上发表170多篇论文，科学出版社专著一部，主编普通高等教育“十二五”规划教材一部。获“‘十一五’国家科技计划执行优秀团队奖”，获2012年度高等学校科学研究优秀成果奖(科学技术)科技进步奖一等奖。

6. Professor Ji Linhong, Tsinghua University



Professor Ji Linhong 季林红教授
Tsinghua University

季林红教授1985、88年先后毕业于清华大学精密仪器与机械学系分获本科及硕士学位，96年毕业于日本东京大学获工学博士学位，曾任东京大学助理教授，98年回清华任教、03年晋升教授，曾任设计工程研究所所长、精仪系副主任、机械系副主任、摩擦学国家重点实验室副主任、清华国家工科机械基础教学基地主任、清华国家机械工程教学示范中心主任等，是生物机械学科带头人。

季林红教授长期从事机械系统设计理论、智能及生物机械领域的教学、研究工作。近20

年来，负责并承担了包括国家973、863、国家专项、国家自然科学基金重点基金、国家支撑计划课题、奥运攻关课题等二十余项国家级课题，其多项研究填补了国家技术空白，如自走式玉米收获机、远洋船舶压舱水处理技术及系统、病菌及水生微生物快速检测技术及检测系统、IC（大规模集成电路）装备工艺优化及多场耦合设计支撑系统，神经康复机器人、截瘫外骨骼机器人、竞技体育能力训练技术及技能训练装备等。在国内外杂志上发表学术论文200余篇，其中SCI收录50余篇，EI收录90余篇；申请国家发明专利80余项，美国专利2项，已获授权国家发明专利62项、国防专利4项，授权实用新型专利15项，授权软件著作权12项。曾获宝钢教育基金优秀教师奖，北京市高等学校教学名师奖，清华大学第十五届“良师益友”奖等。

学术兼职：中央军事委员会科技委员会创新特区人体效能增强技术主题首席科学家，中国体育科学学会副理事长，国家康复辅具研究中心董事，中国机械工程学会生物制造工程分会副主任委员，中国康复医学会常务理事、康复医学工程专业委员会主任委员，中国残疾人康复协会常务理事、康复工程专业委员会副主任委员，中国康复辅具协会常务理事、康复工程专业委员会后任主任委员，生物医学工程学会（BME）康复工程分会常务理事、后任主任委员；生物医学工程学会（BME）机器人临床技术与应用分会常务理事；清华大学“无障碍发展研究院”（与中国残疾联合会联合）副院长，“脑可塑性与功能重建卓越实验室”（与天坛医院联合）北京市重点实验室副主任等。

7. Dr. Dai Xudong, Auye Design Knowledge Service Net



Dr. Dai Xudong 戴旭东博士
Auye Design Knowledge Service Net

戴旭东 博士 教育部现代设计与制造网上合作研究（上海）中心 主任，奥依知识服务网创始人、董事长，中国工程院“提高我国产品自主设计能力发展战略研究”咨询专家，“产品现代设计与技术创新”论坛发起人。上海交通大学从事教学科研十多年，曾任上海交通大学现代设计研究所 FIPER 技术中心主任，美国南加州大学 IMPACT 中心访问学者。十多年来一直致力于产品创新与设计理论方法应用研究，担任上海交通大学“工程（产品）设计”、“创新思维与现代设计”及“产品现代设计理论方法与工具”等课程主讲老师。先后构建了产品现代设计平台、设计知识服务模型与基于分布计算模型条件下的数字样机系统等。先后主持完成国家自然科学基金项目、中国工程院咨询项目、教育部重点科学技术项目及企业委托的研究开发项目二十多项，发表学术论文二十多篇。致力于产品创新与设计知识服务推广工作，主持设计开发的多款新产品成功推向市场并获得好评。

8. Professor Chen Yong, Shanghai Jiaotong University



Dr. Yong Chen 陈泳博士
Shanghai Jiao Tong University.

Dr. Yong Chen, PhD, Associate Professor, Institute of Modern Design, School of Mechanical Engineering, Shanghai Jiao Tong University. Research Interests: Conceptual Design, Knowledge-based Design, Functional Modeling, Systems Engineering, Requirements Engineering, Design Theory & Methodology, Design Philosophy.

Academic Experience

Sep, 2006 – present, Shanghai Jiao Tong University, Shanghai, China, Associate Professor, School of Mechanical Engineering

Jul, 2011 – Jul 2012, University of Southern California, Los Angeles, USA, Visiting Professor, Department of Mechanical and Aerospace Engineering

Jul, 2004 – Jun, 2006, Shanghai Jiao Tong University, Shanghai, China, Postdoctor, School of Mechanical Engineering

Sep, 1998 – Jun, 2004, Zhejiang University, Hangzhou, China, PhD Student, Department of Mechanical Engineering

Sep, 1993 – Jun, 1997, Zhejiang University, Hangzhou, China, Undergraduate, Department of Mechanical Engineering

9. Dr. Zhang Zhinan, Shanghai Jiaotong University



Dr. Zhang Zhinan 张执南博士
Shanghai Jiaotong University

张执南，工学博士，上海交通大学机械与动力工程学院副教授、博士生导师。主要研究方向为创新设计方法、摩擦学系统建模与设计。兼任中国机械工业教育协会理事，中国机械工程学会摩擦学设计专业委员会和青年工作委员会委员。主讲研究生复杂机电系统的设计与实践，本科生毕业设计、工程学导论、创新思维与现代设计等课程。主持国家自然科学基金面上项目、青年项目、国家自然科学基金航天先进制造联合基金重点项目子课题共计 3 项，

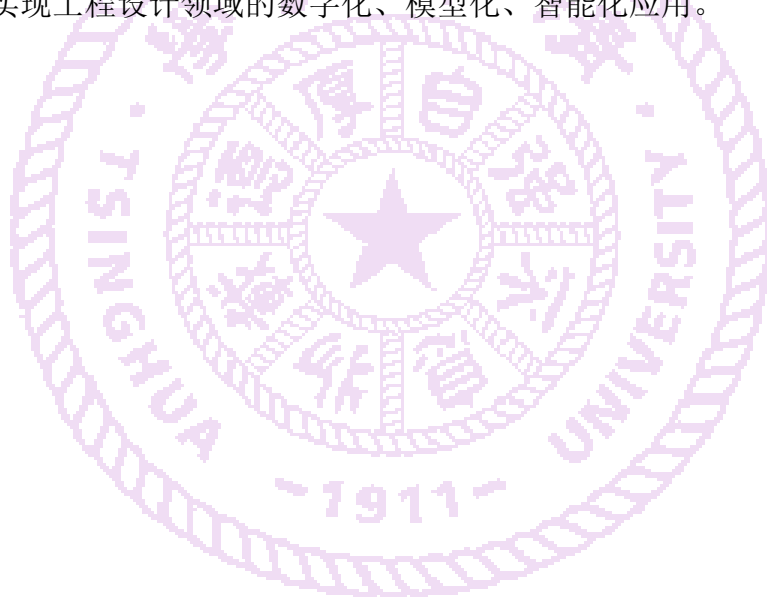
多项企业合作课题。发表论文 50 余篇，申请国家发明专利 20 余项（已授权 2 项），软件著作权 2 项，外文图书 2 章，翻译图书 1 本。

10. Dr. Li Xiang, SysGraph Lab



Dr. Li Xiang 李响博士
SysGraph Lab

毕业于上海交通大学，具有计算机科学与技术、机械工程跨学科专业背景，研究方向：设计方法学、智能设计、基于模型的知识图谱。2017 年于上海成立 SysGraph Lab，致力于打造工程设计领域的创新设计实验室，探索新一代人工智能技术，并与工程设计相结合（AI + Engineering），实现工程设计领域的数字化、模型化、智能化应用。



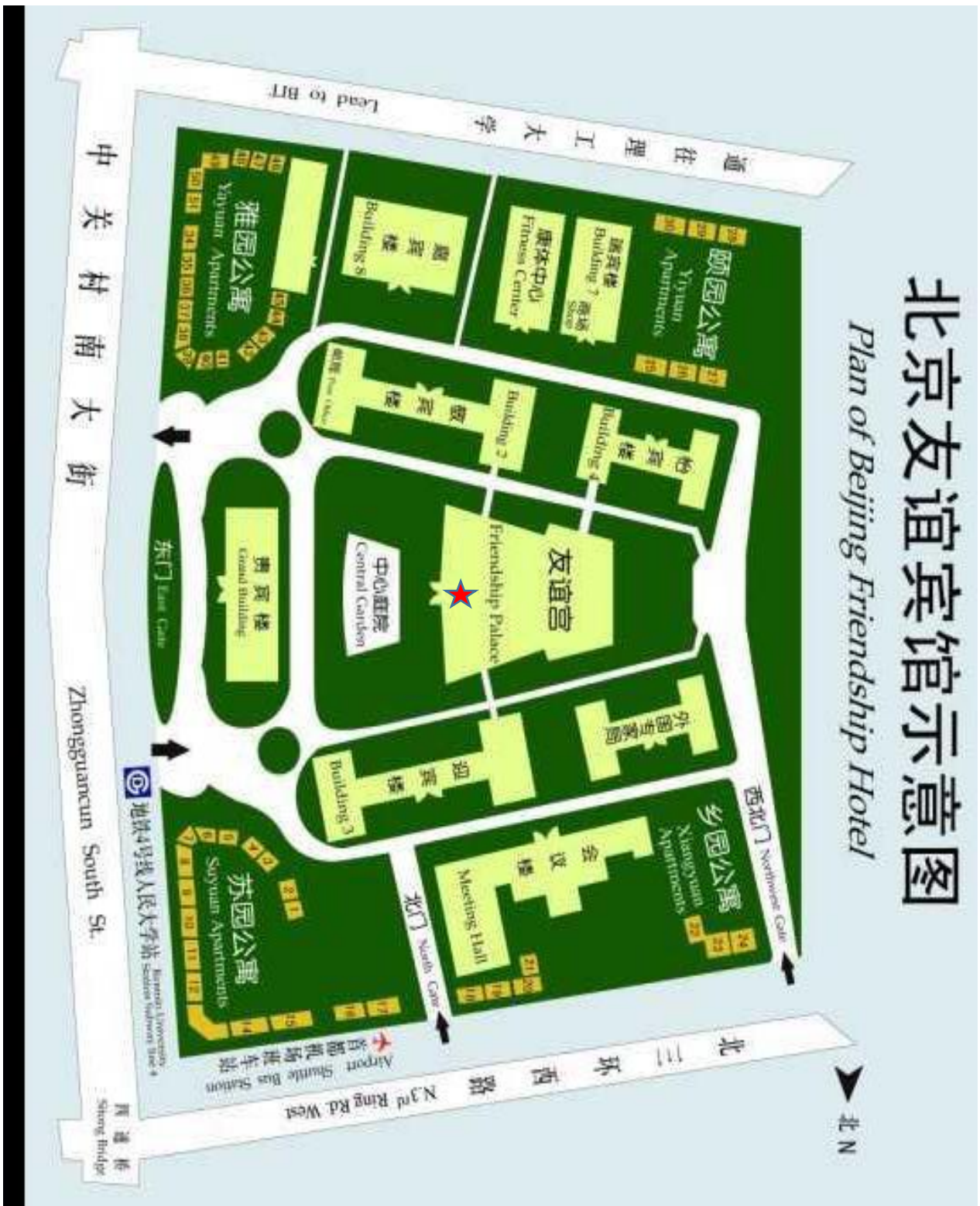
Program (language: English/Chinese)

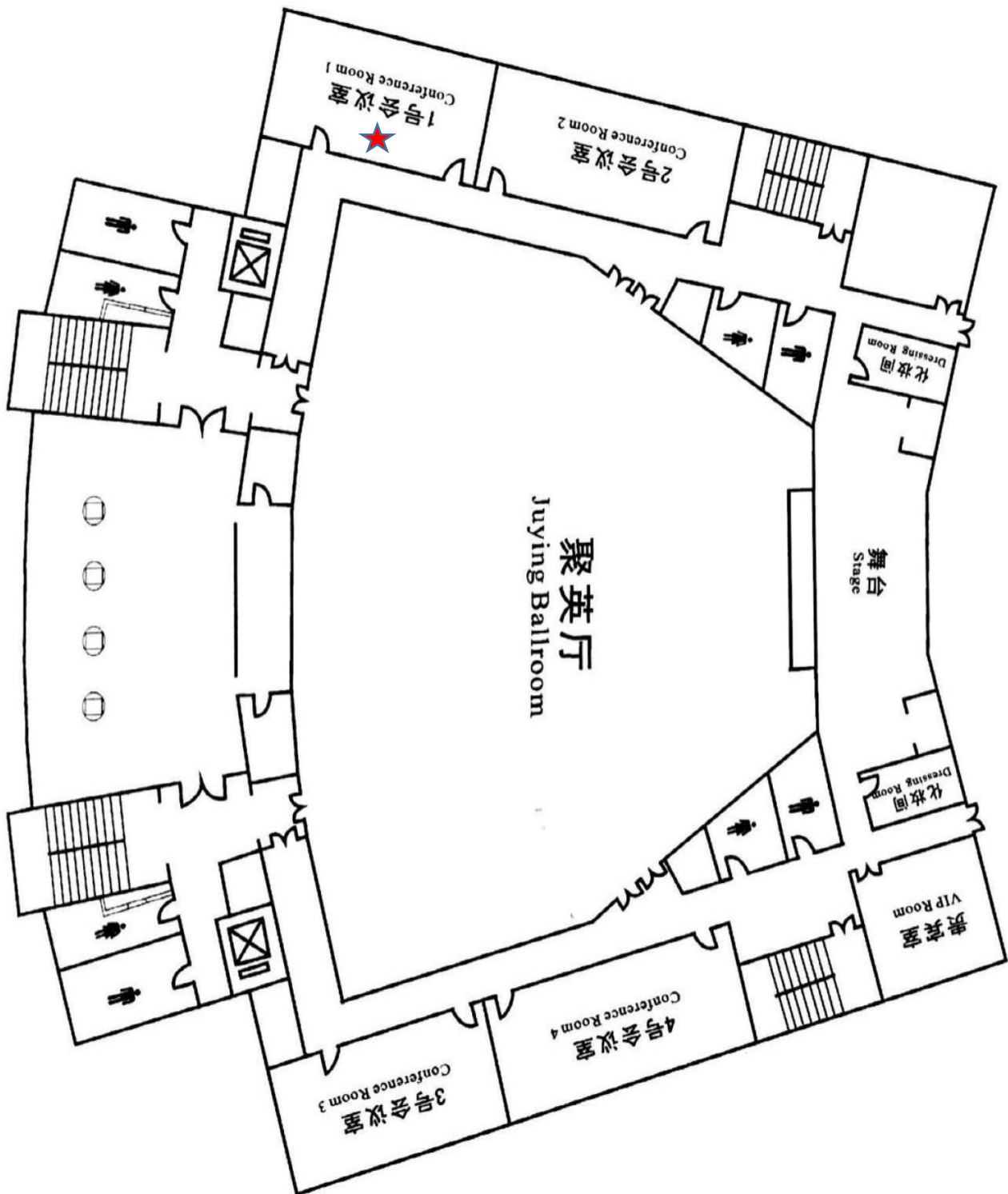
Sunday 19th, 2017 2.00 -6.00pm Venue: No. 1 Meeting room, Friendship Palace		
Time	Topics	Speakers
2.00-2.30 pm	Registration/ venue: Friendship Palace	
2.30-2.45	Welcome and Introduction	Prof. Ji Linhong, Tsinghua University
	Session 1:	Chair: Prof. Ji Linhong, Tsinghua University
2.45-3.30pm	Do you believe "Seeing is Believing?" 耳听为虚，眼见为实吗？	Keynote speaker Prof. Liu Guanzhong The Academy of Arts & Design, Tsinghua University
3.30-4.00pm	Study on knowledge automation, nonlinear control and parameter self-sensing 知识自动化、非线性控制与参数自感知研究初步	Invited speaker Prof. Chen Liping, Huazhong University of S&T
4.00-4.15pm	Registration/Coffee & Tea Break	
	Session 2:	Prof. Ji Linhong, Tsinghua University
4.15-4.45pm	A science of design for studying design activities: object of study, axioms, and research methodologies	Invited speaker Prof. Yong Zeng Concordia University, Canada
4.45-5.15 pm	Multidisciplinary design and simulation of a magnetic confinement fusion device-Tokamak	Invited speaker Dr. Ni Xiaojun, Chinese Academy of Sciences
5.15-5.20pm	Break	
	Session 3: Panel discussion: Design for future inspired by biology/nature/X	
5.20-6.00pm	Panelists: 1. Professor Xie Youbai, Shanghai Jiaotong University 2. Professor Liu Guanzhong, Tsinghua University 3. Professor Li Yan, Sichuan University 4. Professor Chen Liping, Huazhong Science and Technology University 5. Professor Yong Zeng, Concordia University, Canada 6. Professor Ji Linhong, Tsinghua University 7. Professor Chen Yong, Shanghai Jiaotong University	Chair Prof. Yong Zeng Concordia University, Canada

	8. Dr. Dai Xudong, Auye Design Knowledge Service Net 9. Dr. Zhang Zhinan, Shanghai Jiaotong University 10. Dr. Li Xiang, SysGraph Lab 11. Dr. Hou Yuemin	
6.00-7.30pm	Dinner	
Monday 20th, 2017 9.00am-6.00pm		
9.00-9.20am	ICMD Opening Ceremony Venue: Juying Ballroom, Friendship Palace	Chair: Jianrong Tan Zhejiang University
9.20-10.00am	The value and future of the design	Professor Yongxiang Lu, Academician of Chinese Academy of Sciences
10.00-10.20am	Coffee & Tea Break	
	Plenary Speech Venue: Juying Ballroom, Friendship Palace	Chair: Feng Gao Shanghai Jiao Tong University
10.20-10.50am	Novel Robotic Designs for Training of Human Gait, Posture, and Balance	Sunil Agrawl, Columbia University, USA
10.50-11.20am	认识设计科学 研究设计科学 Cognize Design Science, Study Design Science	Professor You-bai Xie Academician of Chinese Academy of Engineering
11.20-11.50am	From imitation design to innovative design	Professor Jianrong Tan, Zhejiang University
12.00am-2.00pm	Lunch (First floor of Friendship Palace)	
2.00-4.00 pm	Session 4: Venue: No. 1 Meeting Room, Friendship Palace	Chair Prof. Chen Liping, Huazhong University of Science and Technology
2.00-2.30pm	2KM Journey of innovation: cognition and Practice 创新的 2 个一公里: 认知与实践	Dr. Zhang Zhinan, Shanghai Jiaotong University
2.30-3.00pm	The Structure-Property Theory: Constructing the Design 构性理论对设计的建构	XU Qian, Professor LI Yan, LI Song, Sichuan University
3.00-3.30pm	4D Design towards a descriptive design model	Dr Hou Yuemin, Prof. JI Linhong, Tsinghua University, prof. Michel van Tooren, University of South Carolina
3.30-4.00pm	Reflect on Design Science from Two Perspective of Academia and Industry 从学术界和工业界两个的视角来看设计科学	Dr. Li Xiang SysGraph Lab
4.00-4.15pm	Coffee/Tea break	

4.15-6.00pm	Session 5	Chair Professor Ji Linhong
4.15-4.45pm	Design Knowledge Service Model Based On Distributed Resource Environment 基于分布式知识资源环境的设计知识服务模型	Dr. Dai Xudong, Auye Design Knowledge Service Net , China
4.45-5.05pm	Development and optimization of unpowered energy-stored exoskeleton	Dr. Guan Xinyu, Tsinghua University
5.05-5.25pm	Implementation and validation of engagement monitoring in an engagement enhancing rehabilitation system	Dr. Li Chong, Tsinghua University
5.25-5.55pm	Non-conventional Materials for Advanced Structures: Better structures by mixing, curving, printing, stirring and monitoring- Design and Manufacturing Aspects	Professor Michel Van Tooren, University of South Carolina, USA
5.55-6.00pm	Closing Remarks	
6.30-8.00pm	Dinner (Juying Ballroom, Friendship Palace)	
Tuesday 21st, 2017 (ICMD)		
8.30-12.00am	Plenary Speech	Chair: Peihua Gu, Shantou University
8.30-9.10am	The technology of deep space exploration and large radio telescope	Baoyan Duan, Xidian University
9.10-9.50am	Designing Smart X	Tetsuo Tomiyama, Cranfield University
9.50-10.10	Coffee & Tea Break	
10.10-12.10	Plenary Speech	Chair: Baoyan Duan Xidian University
10.10-10.50	Digital Transformation of traditional products manufactured by Small-Medium Enterprises: Designing profitable user experiences!	Humayun Rashid, American Chamber of Commerce
10.50-11.30am	Intelligent design and manufacturing	Detlev Reicheneder, Autodesk
11.30-12.10am	The development prospect of civil aircraft	Guanghui Wu, Commercial Aircraft Corporation of China
12.00am-1.30pm	Lunch (First floor of Friendship Palace)	
2.00-6.00pm	Session presentation, see ICMD program	
6.00-7.30pm	Dinner (First floor of Friendship Palace)	

Map





The End