

# UM-SJTU Joint Institute

<http://umji.sjtu.edu.cn/>

## I . Introduction to Disciplines and Main Research Fields

University of Michigan-Shanghai Jiao Tong University Joint Institute (JI) was founded in 2006 as the partnership between Shanghai Jiao Tong University (SJTU) and the University of Michigan (UM), which is known as “the best public university” in the U. S. ranking 12<sup>th</sup> in the world, and is the higher education reform district set up by Chinese Ministry of Education. During the past nine years, JI has developed tremendously and achieved extraordinary accomplishments, such as being recognized as a “Model for International Education in Shanghai”, a recipient of the “First-Class Award for National Education Reform”, and, most significantly, a “Model of Chinese Higher Education Reform” by Chinese Ministry of Education. JI has made major breakthroughs in building a high-caliber faculty team and creating an innovative education model. In a short time, JI has set an excellent example for Sino-American education collaborations in China by demonstrating how to establish a world-class university in China, which has made a great impact on other universities. In 2014, JI won the prestigious Andrew Heiskell Awards for Innovation in International Education—one of the highest honors in international higher education, having been the first institute that wins the award for over ten years since China initiated international education collaboration.

JI consists of six majors, namely Mechanics, Mechanical Engineering, Power Engineering and Engineering Thermophysics, Electronics Science and Technology, Information and Communication Engineering, and Control Science and Engineering. Among them, Mechanics, Mechanical Engineering, Power Engineering and Engineering Thermophysics, and Control Science and Engineering are State Key Academic Programs at Primary Discipline Level.

Majors	Research Fields
Mechanics	Dynamics and Vibrations
	Thermodynamics and Fluid Mechanics

(continued)

Majors	Research Fields
Mechanical Engineering	Biomedical Technology
	Design and Manufacturing
	Dynamics and Vibrations
	Energy and Power Systems
	Mechatronics and Control
	Micro/Nanotechnology
	Structure and Materials
	Thermodynamics and Fluid Mechanics
Power Engineering and Engineering Thermophysics	Dynamics and Vibrations
	Energy and Power Systems
	Thermodynamics and Fluid Mechanics
Electronics Science and Technology	Biomedical Technology
	Circuits and Devices
	Electromagnetic, Photonics and Electrophysics
	Mechatronics and Control
	Micro/Nanotechnology
	Solid State Physics
Information and Communication Engineering	Communication, Networking and Control
Control Science and Engineering	Communication, Networking and Control
	Mechatronics and Control

## II . Faculty

### 1. Overview of Faculty

JJ adopts the tenure system and its faculty appointment, assessment, and promotion are all conducted with reference to the requirements of the first-class university in the U. S. During the past nine years, a large number of professors, doctors, and post-doctors, coming from the top universities and research institutes of the world, came to apply for a job in JJ every year. More than 30 full-time incumbent professors have their doctor's degree of world-class universities.

## 2. Renowned Professors

No.	Name	Education Background	Research Interests
1	HUANG Peisen	<ul style="list-style-type: none"> <li>• PhD, University of Michigan</li> <li>• tenured professor at Stony Brook University</li> <li>• dean of the Joint Institute</li> <li>• professor, doctoral supervisor of the Joint Institute</li> <li>• scholar of the Thousand Talents Plan</li> <li>• selected by Pujiang Talent Program of Shanghai</li> </ul>	<ol style="list-style-type: none"> <li>1) Optical metrology: Laser based dimensional metrology ( surface roughness, shape, and flatness, length, angle, etc.); 3-D surface shape measurement</li> <li>2) Machine vision: Surface defect inspection; Face recognition</li> <li>3) Precision motion sensing and control; optical encoders for nanopositioning</li> </ol>
2	NI Jun	<ul style="list-style-type: none"> <li>• PhD, University of Wisconsin-Madison</li> <li>• honored dean of the Joint Institute</li> <li>• professor, doctoral supervisor of the Joint Institute</li> <li>• winner of Presidential Faculty Fellows Award</li> <li>• meritorious professor of University of Michigan</li> <li>• winner of Presidential Young Scientist Award</li> <li>• scholar of the Thousand Talents Plan</li> <li>• distinguished professor of Chang Jiang Scholar</li> <li>• winner of the first prize of state-level teaching award in 2009</li> <li>• winner of Shanghai Magnolia Award in 2010</li> </ul>	Professor Ni's research and teaching interests are in the area manufacturing science and engineering, with special focuses on precision machining, manufacturing process modeling and control, statistical quality design and improvement, micro/meso systems and manufacturing processes, and intelligent monitoring and maintenance systems.
3	Chien-Pin Chen	<ul style="list-style-type: none"> <li>• PhD, Michigan State University</li> <li>• director and tenured professor of Department of Chemical and Materials Engineering, University of Alabama in Huntsville, USA</li> <li>• assistant dean of the Joint Institute</li> <li>• professor, doctoral supervisor of the Joint Institute</li> <li>• Fellow of Society of Mechanical Engineers (ASME),</li> </ul>	<ol style="list-style-type: none"> <li>1) Spray combustion; atomization/spray</li> <li>2) CFD/Multi-scale computing</li> <li>3) Large Eddy Simulation; turbulent and reacting flows</li> <li>4) Multiphase flows</li> </ol>
4	Sung-Liang Chen	<ul style="list-style-type: none"> <li>• PhD, University of Michigan</li> <li>• assistant Professor, doctoral supervisor of University of Michigan</li> <li>• doctoral research fellow, Medical School, UM-SJTU Joint Institute, SJTU</li> <li>• the Thousand Talents Plan (youth)</li> <li>• selected by Pujiang Talent Program of Shanghai</li> </ul>	<ol style="list-style-type: none"> <li>1) Optical detection of ultrasound</li> <li>2) Photoacoustic microscopic and tomographic systems</li> <li>3) Biomedical optical imaging</li> </ol>

(continued)

No.	Name	Education Background	Research Interests
5	DAN Yaping	<ul style="list-style-type: none"> <li>• PhD, University of Pennsylvania</li> <li>• Bachelor's degree of Xi'an Jiao Tong University, Master's degree of Tsinghua University</li> <li>• post-doctor, research associate of Harvard University</li> <li>• associate Professor, doctoral supervisor of the Joint Institute, SJTU</li> <li>• the Thousand Talents Plan (youth)</li> </ul>	<ol style="list-style-type: none"> <li>1) Nano-electronics for integrated circuits and devices</li> <li>2) Nano-optoelectronics for hybrid electronic and photonic integrated circuits and devices</li> </ol>
6	Morteza Eslamian	<ul style="list-style-type: none"> <li>• PhD, University of Toronto</li> <li>• Assistant Professor, Texas A&amp;M University-Corpus Christi</li> <li>• Associate professor, doctoral supervisor of the Joint Institute, SJTU</li> </ul>	<ol style="list-style-type: none"> <li>1) Fabrication of solution-processed solar cells, such as polymer and perovskite solar cells</li> <li>2) Fundamentals and applications of thin films, and spray coating</li> </ol>
7	GUO Yunlong	<ul style="list-style-type: none"> <li>• PhD of University of Louisville, Master's degree &amp; Bachelor's degree of Tsinghua University</li> <li>• associate Professor, doctoral supervisor of the Joint Institute</li> <li>• research fellow of SJTU, associate professor of school of Materials Science and Engineering, member of national key laboratory of metal matrix composite</li> <li>• associate research fellow, post-doctor of Princeton University</li> <li>• visiting scholar to Northwest University</li> <li>• the Thousand Talents Plan (youth)</li> </ul>	<ol style="list-style-type: none"> <li>1) Physical properties of polymeric glasses</li> <li>2) Dynamics of nanoscopically confined polymers</li> <li>3) Structural and responsive materials</li> </ol>
8	David Hung	<ul style="list-style-type: none"> <li>• PhD, Carnegie Mellon University</li> <li>• associate professor, Mechanical Engineering, the former Michigan State University</li> <li>• associate professor, doctoral supervisor of the Joint Institute, SJTU</li> <li>• fellow of International Society of Automotive Engineers</li> <li>• distinguished visiting fellow, Royal Academy of Engineering, United Kingdom</li> <li>• Shanghai distinguished expert, the Thousand Talents Plan</li> <li>• New Century Talents Program by Chinese Ministry of Education</li> </ul>	<ol style="list-style-type: none"> <li>1) Clean Vehicle Engine Technology and Sustainable Transportation Infrastructure</li> <li>2) Fuel Injection for Internal Combustion Engines and Aircraft Engines</li> <li>3) Multi-disciplinary Research in Spray &amp; Atomization</li> <li>4) Alternative and Bio-renewable Fuels</li> <li>5) Optical Diagnostics, Flow Sensing, and Measurement Techniques</li> </ol>

(continued)

No.	Name	Education Background	Research Interests
9	SHEN Yongxing	<ul style="list-style-type: none"> <li>• PhD of Stanford University, Bachelor's degree of Tsinghua University</li> <li>• tenured lecturer of the former Polytechnic University of Catalonia, Spain</li> <li>• associate professor, doctoral supervisor of the Joint Institute, SJTU</li> <li>• the Thousand Talents Plan (youth)</li> </ul>	<ol style="list-style-type: none"> <li>1) Efficient numerical methods for hydraulic fracturing</li> <li>2) Phase-field methods for crack propagation</li> <li>3) Fracture of thin shells</li> <li>4) Discontinuous Galerkin methods</li> <li>5) Simulation methods to study mechanical properties of materials</li> </ol>
10	WAN Wenjie	<ul style="list-style-type: none"> <li>• PhD of Princeton University, post-doctor of Yale University</li> <li>• Assistant professor, doctoral supervisor of the Joint Institute, SJTU</li> <li>• research fellow, Department of Physics, SJTU</li> <li>• winner of National Scholarship for Excellent Overseas Students</li> <li>• the Thousand Talents Plan (youth)</li> </ul>	<ol style="list-style-type: none"> <li>1) Nonlinear Optics</li> <li>2) Nanophotonics</li> <li>3) Plasmonics</li> <li>4) Super-resolution Microscopy</li> </ol>
11	WANG Xudong	<ul style="list-style-type: none"> <li>• PhD of Georgia Institute of Technology and SJTU, Bachelor's degree of SJTU</li> <li>• distinguished expert, the Thousand Talents Plan, Shanghai</li> <li>• distinguished professor of universities in Shanghai (Orientalist)</li> <li>• associate professor, doctoral supervisor of the Joint Institute, SJTU</li> <li>• selected by New Century Talents Program by Chinese Ministry of Education</li> <li>• selected by Pujiang Talents Program of Shanghai</li> <li>• selected twice by Marquis Who's Who, USA</li> </ul>	<ol style="list-style-type: none"> <li>1) Wireless Communications Networks</li> <li>2) Smart Grid</li> <li>3) Cyber-Physical Systems</li> </ol>
12	ZHANG Jun	<ul style="list-style-type: none"> <li>• PhD, University of California, Berkeley</li> <li>• PhD, double bachelor's degree, Shanghai Jiao Tong University</li> <li>• associate professor, doctoral supervisor of the Joint Institute, SJTU</li> <li>• research fellow, Department of Automation, SJTU</li> <li>• selected by Pujiang Talents Program of Shanghai</li> </ul>	<ol style="list-style-type: none"> <li>1) Control and optimization of quantum systems</li> <li>2) Complex system analysis and control</li> </ol>

### III. Achievements

#### Papers on Quantum Identification Published in Physical Review Letters

—Boosting Basic Theory and Frontier Research

Associate Prof. Jun Zhang has made big progress in the research on quantum identification. A recent paper of his titled “Quantum Hamiltonian identification from measurement time traces” coauthored with Dr. Mohan Sarovar of Sandia National Laboratories, U. S. A. , has been published by the famous international journal, Physical Review Letters.

Precise identification of parameters governing quantum processes is a critical task for quantum information and communication technologies. Zhang and Sarovar propose a completely different approach from process tomography. They measured the observed quantities provided by the system at multiple time points, resulting in a continuous time series. On this basis, by using the controllability and identification algorithm of the classical control theory, the system can derive the unknown parameters to satisfy the algebraic equations. These can be obtained by solving algebraic equations of the system parameters to be identified. This method can effectively utilize priori knowledge of the system and can be applied to limited resources, thereby, very helpful for experiments.

#### An Underactuated Prosthetic Hand Based on Postural Synergies

—Grabs Attention from Media and Mass

During the *Daily Planet* program of the Discovery Channel Canada aired on February 18, a robotic hand dexterously rotating two meditation balls caught a lot of viewers’ attention. The amazing innovation is “an underactuated prosthetic hand based on postural synergies” developed by the Rii? Lab (the Research Laboratory of Robotics Innovation and Intervention) at the UM-SJTU Joint Institute.

Prof. Kai Xu, Director of the Rii? Lab, explained that, based on bionic ideas, he designed his prosthetic hand to be a simple and flexible continuum, translating input from two motors globally into 16 joint motions, giving the prosthetic hand the ability to effectively grasp a variety of objects. At the same time, this simple continuum also greatly simplifies the prosthetic design and processing, thereby, reducing costs. Coupled with the use of 3D printing technology, it is possible in the future to produce customized, powerful, and cheap prostheses.

#### The Variations of Fuel-Air Mixture Preparation and Combustion Process in Engines

—Undertaking International Cooperation with World-Class University

Cycle-by-cycle variations in engine combustion—brought about by cycle-by-cycle

variations in fuel atomization and evaporation, in-cylinder airflow, temperature distribution, pressure, and residual gas content—represent a particular challenge to the advancement of the internal combustion engine. Professor David Hung and his collaborator, Professor Martin Davy, of the University of Oxford will be working together to address the fundamental research related to the variations of fuel-air mixture preparation and combustion process in engines. Professor David Hung has been selected by the United Kingdom’s Royal Academy of Engineering to receive a 2014-2015 Distinguished Visiting Fellowship. The fellowship provides full funding and local support for Professor Hung to travel to the UK to work with Professor Martin Davy.

### **OCT-Photoacoustic imaging dual-modality endoscopy for diagnosis of atherosclerosis**

—“863” Program Young Scientist Special Subject

According to the World Health Organization (WHO), cardiovascular diseases, mainly caused by atherosclerosis, contributes to almost 50% of non-communicable disease deaths. In recent years, imaging techniques, especially minimally invasive endoscopies technique has been applied to diagnose atherosclerosis. However, none of any single imaging modality can be applied to simultaneously observe the three main features of vulnerable atherosclerosis plaque, i. e. , thin fibrous cap, the lipid core, and the macrophage activity. So multi-modality imaging has to be used for comprehensive diagnosis. Professor Jigang Wu of UM-SJTU Joint Institute is leading a project focusing on developing novel endoscopic technique combining optical coherence tomography (OCT) and photoacoustic imaging, aiming for comprehensive diagnosis of atherosclerosis. This research is the first major effort of the planned SJTU-UM Joint Lab of “multimodal biomedical imaging and sensing”. Other endoscopic imaging technique for atherosclerosis diagnosis, including ultrasound imaging and Raman spectroscopy, will also be developed based on this project. This project has been granted the fund from the Young Scientist Projects of National High Technology Research and Development Program (863).

### **An Active Optical Encoder Based on Flat Panel Display Technology**

—International Leading Precise Measurement Technology

Precision planar motion control is highly important for such applications as semiconductor manufacturing, precision machining, precision measurement, biomedical engineering, and nano-manufacturing. To realize high-precision planar motion control, high-precision displacement measurement technology is indispensable. This project, led by Professor Peisen Huang, takes advantage of the rapidly progressing digital flat-panel display technologies and proposes to develop a novel active optical encoder technology for precision position measurement. In this technology, a camera is used to capture the image of the pixels

of a display panel, which are actively encoded. Through image and signal processing, the absolute position of the camera relative to the display panel can be measured at nanometer accuracy. This new technology is then integrated in an air bearing planar motor to enable feedback control for precision positioning. Compared with traditional technology, this technology has advantages of high-precision, large scope measurement, simple structure, and low price. Through this project, we hope to achieve breakthroughs in the area of high-precision optical encoders and thus contribute to the progress of nano position measurement and control technologies.

## **Methods and Applications of Multidisciplinary Design Optimization for Near Space Vehicles**

—Providing Technical Support for Space Industry

Space vehicles are typical modern complex engineering systems. The system design for space vehicles involves multiple modern engineering disciplines. Since these systems are complex and special, their system performance will inevitably be restricted by the analysis and design ability of the corresponding disciplines. Nowadays, the optimization design of this kind of complex systems can hardly rely on designers' experience or traditional optimization design methods any more. This project, led by Prof. Mian Li, an associate professor of University of Michigan - Shanghai Jiao Tong University Joint Institute, aims to solve the problems of multidisciplinary optimization and decision making for complex nonlinear systems by developing and applying state-of-art multi-objective multidisciplinary collaborative optimization methods. This project is cooperated with Beijing Near-Space Vehicle System Engineering Research Institute of China Academy of Launch Vehicle Technology (CALT). Taking near-space vehicles as the main applications, this project focuses mainly on applying efficient multidisciplinary design optimization methods, building multidisciplinary design optimization framework and system based on the application objectives, and performing multidisciplinary system design for near-space vehicles. This research will systematically solve the design optimization problems for multidisciplinary nonlinear complex systems represented by near space vehicles and provide theoretical basis for optimization design of a new generation of complex electromechanical systems.

### **IV. International Collaboration**

#### **1. Student Exchange Programs**

Winter Study Abroad Programs

- University of Michigan program
- Technical University of Berlin Program
- University of Navarra, Spain Program

## 2. Joint Education Programs

- JI-KTH 3+2 Program
- The Michigan Ross Master of Management - Shanghai Cohort Program

## V. Platforms for Scientific Innovation

### 1. Research Centers

- (1) Center of Optics and Optoelectronics (COO)
- (2) The Center of Advanced Computational Engineering and Science (CACES)

### 2. Experiment Center

The JI's teaching laboratory takes full advantage of resources of SJTU and the University of Michigan, referring to the UM's experimental course requirements, sharing existing SJTU laboratory resources, actively developing and building new laboratories, and progressively realizing the synchronization of experimental teaching and laboratory facilities with the UM. Currently, the teaching laboratory of the institute has a total area of 880 square meters, including mechanical basic laboratory, Circuits and Systems Laboratory, electromagnetics and microwave circuit laboratories, laser optics laboratories, and engineering Introduction laboratories. Besides, we have a machining center with a total area of 140 square meters.

The main laboratory equipment includes wind tunnel, computer-controlled electronic universal testing machine, inverted microscope, optical lab kit, hydrogen fuel cell kits, etc. The machining center has CNC milling machines and CNC micro-lathes with Siemens and MACH3 systems, 3D printer (rapid prototype machine), laser cutting machines, and other major mechanical processing equipment.

## VI. Distinguished Alumni

MAO Wenguang, Ph.D of University of Texas, Austin, Full scholarship;  
 SHI Chengzhi, Ph.D of UC Berkeley, Full scholarship;  
 MA Chu, Ph.D of MIT, Full scholarship;  
 CHENG Shuo, Associate Consultant of Siemens Management Consulting;  
 LIU Li, Servior Engineering of Schlumberger.