2014

ZHEJIANG UNIVERSITY ACADEMIC ANNUAL REPORT

PREFACE

Zhejiang University, situated in Hangzhou, a popular tourist destination full of history and culture, is an institution of higher learning with an enduring history of 117 years and a high reputation. During the course of its development, an excellent tradition with the motto of "seeking truth and innovation" came into being, supporting the mission of cultivating elites, promoting technological advances, engendering social development and spreading advanced culture. This comprehensive, research-oriented university has 7 faculties, 37 schools (departments) in 12 disciplines: sciences, engineering, agriculture, medicine, management, philosophy, economics, law, education, literature, history and art, as well as 7 affiliated hospitals of the highest standard. It is endowed with five campuses (Zijingang, Yuquan, Xixi, Huajiachi and Zhijiang), covering an area of 4,503,741m^2 in total, university buildings themselves having an area of over 2,040,000 m^2, with floor space of 260,000 m^2 still under construction. Currently, ZhejiangUniversity houses over 6.71 million books and owns 46,666 full time students, among whom are 23,633 undergraduates, 13,949 master candidates and 9,084 doctoral candidates. In addition, 4,221 foreign students are enrolled as well.

Academic studies are the soul, source and foundation of a university, so academic advances constitute its wisdom, progress and reputation. Zhejiang University, upholding its academic and disciplinary development, has progressed a lot in disciplinary development, talent cultivation, research, academic exchanges and cooperation, and academic systems.

Embodying the creation, inheritance and accumulation of knowledge, the university aims to increase understanding and exploration of the objective world and its reality, to nurture an atmosphere of pursuing truth, impartiality, democracy and tolerance on the campus and to cultivate the culture of respecting, following, understanding and approaching academic studies, all of which serve as the ultimate source of the endless pursuit of students and faculty towards academic studies.

The compilation of the *Academic Annual Report* is targeted at arousing the attention and interest of students, teachers, researchers and the public towards the academic development of Zhejiang University, creating a strong academic atmosphere and enhancing academic exchanges.

By summing up university's academic achievements in 2013, which the online campus community has voted as the most noteworthy, the *Academic Annual Report* introduces and lists them. The Report serves as a compilation of the academic contributions of Zhejiang University members for the past year and serves as a record of Zhejiang University's march forward as a first-class university.

It is evident in this report that, by cherishing the philosophy of "seeking truth," innovation and exploration, Zhejiang University members will be better able to conduct academic studies and better serve the nation and the society with their professional knowledge, deliberation and discrimination.

Gratitude is extended to all who have supported and encouraged the compilation and publication of this year's *Academic Annual Report*.

Academic Committee, Zhejiang University

ZHEJIANG UNIVERSITY ACADEMIC ANNUAL REPORT 2014

The Academic Annual Report 2014,
Zhejiang University

Sponsor:
The Academic Committee of Zhejiang University

Co-Sponsor:
Zhejiang University Young Professor Association

Chief Editor: Z. Zhang

Editor: HR. Li MJ.Zhu

Acknowledgements:
The Sci-Tech Academy of Zhejiang University
The Social Sciences Academy of Zhejiang University

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Zhao Jianghui design office

ACZJU THE ACADEMIC COMMITTEE OF ZHEJIANG UNIVERSITY

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Academic Development of Zhejiang University in 2014

With the vision of building itself into a first-class global university, Zhejiang University (ZJU) has created a new situation in disciplinary development, academic research and the cultivation of talent, meeting the needs of the disciplines most urgently needed in state and academic frontiers, while being based on regional entrepreneurship and innovation, emancipation of the mind and grasping opportunities.

I. Disciplinary Development

Implementing the Project of "Discipline and Talent Team Development". Based on a well-established framework of 14 first-level national key disciplines, 21 second-level national key disciplines and 10 national key (cultivated) disciplines, ZJU conducted the Project with the reforms of "highlighting the strategic positions of human resource development, boosting disciplinary development, exercising the principal roles of schools and departments, invigorating grassroots units, promoting disciplinary adjustment and integration, advancing frontier and interdisciplinary development" with an investment of 1.85 billion yuan. The Project attaches importance to exercising the principal roles of grassroots units, putting autonomous funds into schools and departments according to budgets as well as general plans, launching the "100 Talents Program" by learning best practices from high-level universities around the world in terms of their academic criteria and the processes they use for recruiting teachers. Therefore, 14 outstanding teachers were listed in the Program, and long-term employment and international appraisal systems were put into trial use. In addition, new to the faculty were 156 talented individuals, among whom, 88 came directly from foreign universities(accounting for 56.4%), 4 scholars belonged to the national "Recruitment Program of Global Experts", 15 scholars came from the national "Recruitment Program of Global Young Experts", 16 from the "Chang Jiang Scholars Program", 8 were winners of the National Science Fund for Distinguished Young Scholars (NSFDYS), and 17 were winners of the National Science Fund for Excellent Young Scholars. Besides, the public platforms of micro nano processing, bio-medical high-end electron microscopes, as well as the interdisciplinary center for high and new material chemistry, were initiated. The successful implementation of the Project will help upgrade academic team capacity, sharpen academic competitiveness, exercise the creativity and vitality of grassroots units and faculty, and bring about a cluster of world-renowned disciplines.

Planning a new round of first-class university development strategy. In succession to the national "985 Project" and "211 Project", ZJU plans a new round first-class university development strategy by meeting international academic frontiers, national and regional major requirements. For that end, major scientific projects covering 16 fields were organized to seize the vantage academic points of the future.

Top ESI ranking among Chinese universities. According to the ESI statistics issued on January 1st 2015, ZJU ranked second among Chinese universities with 17 disciplines within the top 1% among world academic institutions, among which, chemistry, material science, engineering and agricultural science ranked 22, 29, 31 and 44th respectively, computer science and mathematics came within the top 100 in the world, and ZJU was the Chinese university that placed highest in terms of the number of disciplines within the world's top 1% and top 100.

II. Innovative Talent Cultivation

Implementing quality student source program. In accordance with national reforms on the admission examination system: "admission on classifications, holistic appraisal, diversified enrollment", ZJU admitted 5,893 full-time undergraduates, 4,698 master candidates and 1,893 doctoral candidates in 2014. Among the postgraduates admitted, 55.1% of master's candidates and 87.2% of doctoral candidates were from key universities in the national "985 Project" and "211 Project". 1,516 students were conferred doctoral degrees, 6,289 master's degrees, and 5,331 bachelor's degrees. In addition, 97.18% of the students secured employment upon graduation and 55.99% of undergraduates went for further studies at home or abroad in 2014.

Promoting undergraduate quality education project.ZJU ranked first among Chinese universities with 3 new national excellent video open courses and 11 national teaching achievement awards for individualistic student development and reforms in majors and courses. Reforms in postgraduate cultivation mechanisms led to the First Prize Postgraduate Education Achievement Award by the Chinese Committee of Degrees and Postgraduate Education. In addition, an anonymous review and quality sampling system of dissertations was perfected to guarantee degree awarding quality.

Upgrading students' creativity. National university student innovation and entrepreneurship training plan and Student Research Training Program (SRTP) were organized to upgrade students' creativity. To sum up, 2,160 undergraduates person-time obtained 1 international grand prize, 33 international first prizes, 2 national grand prizes and 19 national first prizes in disciplinary competitions, among which, ZJUNlict Team made up of students from the Department of Control Science and Engineering, the School of Mechanical Engineering, and the College of Computer Science and Technology, beat a team of students from Carnegie Mellon University (USA) by a score of 2:0,successfully defending as international champion in the final competition of the small-scale world RoboCup held in Joao Pessoa, Brazil. Furthermore, ZJU students got 1 grand prize and 17 first prizes in an international college student mathematical modeling competition. 2014 marked the fifth consecutive year of winning grand prizes and 7 grand prizes have been obtained so far, ranking ZJU first among Chinese Universities. Besides this, students got 12 prizes in the Red Dot Design Award (Germany) and IF design competition, 1 grand prize and 5 first prizes in the college student energy-conservation &emission-reduction competition.

Supporting student entrepreneurship platforms and teams. ZJU has established entrepreneurship seed money, e-works entrepreneurship laboratory, project achievement application platform and attracted the venture investment and government subsidy of over 0.1 billion yuan into student entrepreneurship teams in 2014. Besides, in the national "Challenge Cup" college student entrepreneurship planning competition, ZJU made a historical high with 8 gold medals and 2 silver medals, ranking first among Chinese universities in the number of gold medals. For enhancing international entrepreneurship education exchange and cooperation, ZJU chaired the UNESCO China Entrepreneurship Education Union, held the "Xinshang Cup" College Student Entrepreneurship Invitational Match, the "China Dream • Entrepreneurship Dream" College Student Entrepreneurship Summit Forum, the "Famous entrepreneurs and investors Conversing with the Presidents of Famous Universities" Entrepreneurship Education Summit Forum, and the cultural festival of postgraduate entrepreneurship.

Highlighting international student education. There are 5,746 international students in ZJU (including those for non-degree studies), a rise of 9.1% over the previous year. The students for degree studies came to 2,682, a rise of 7.3% over 2013. ZJU China Studies Center was established, and activities for "Celebrating 10th Anniversary of Confucius Institute" were held to popularize Chinese culture. Beside this, ZJU won the title of "Advanced Unit for International Student Education in China".

III Research Capacity

Expanding research scale. With the vision of the "Thirteenth Five-year Plan for Economic and Social Development", ZJU carried out the research policies of "Being targeted at frontier disciplines, disciplines needed by the state and research-based development" as well as the principle of "conducting research in a connotative way and being oriented by quality" to satisfy national scientific planning and administration. Total research funds of 3.121 billion yuan were delivered to ZJU, ranking second among Chinese universities.

Accelerating key research platform and base construction. Several key platforms were initiated, e.g. the National Engineering Laboratory for Industrial Control System Security Technology, the United Center for Data Science and Application, and the International United Laboratory of Photonics and Technology.

Advancing basic research capacity. ZJU had two new principal scientists of the "973 Plan", 2 new principal scientists of key scientific research plans and 1 special young scientist program. In addition, there were 739 National Natural Science Foundations of China (NSFC) with the funds of 0.561 billion yuan, among which, 1 was an extension fund program of an innovative research group science foundation, 3 were special (free application) programs of key research instrument and equipment development, 18 were key programs, and 17 were deemed excellent young science foundations, ranking top among Chinese universities.

Upgrading the capacity for key research missions. ZJU played a leading role in 2014 public welfare special projects of the Ministry of Agriculture and China Meteorological Administration, got sustainable fund support in key scientific projects (e.g. transgenosis, prevention and treatment of infectious diseases and treatment of water contamination), and was in charge of the development of one experimental satellite for military use in the "863 High Technology Research and Development Plan". Besides, many horizontal projects with the funds of over 10 million yuan were organized

and as many as 110 horizontal projects with the funds of over 10 million yuan were being conducted for the development of national and regional strategic emerging industries.

Making breakthroughs in the development of "2011 Cooperative Innovation Centers". The Cooperative Innovation Centers for "Coal Classification, Transformation and Clean Power Generation" and "Infectious Disease Diagnosis and Treatment" headed by ZJU were approved. The other two Cooperative Innovation Centers for "Artificial Microstructure Science and Technology" and "High-end Equipment Manufacturing," with ZJU as a major participant, were approved as well.

IV Academic Influence

Publishing high-level research papers. According to the statistics issued by the Institute of Scientific and Technical Information of China (ISTIC) in September 2014, ZJU ranked first among Chinese universities in the following indexes in 2013: 5,298 SCI articles and reviews with ZJU teachers as first authors, 2,098 good-performance papers, 6 international academic papers among top 100 most influential papers, 1,230 international coauthor papers with ZJU teachers as first authors, 29,004 cumulative citations (327,298 times) in the past decade and 219 papers in the journals with highest impact factors in different fields. Besides, 2 papers were published in Nature, 2 in the sub journal of Cell and 11 in the sub journal of Nature. Moreover, 49 coauthor papers were published in Cell, Science and Nature.

Achievement by Academician Li Lanjuan research team selected into 2014 "Top Ten Scientific Progress Programs of Chinese Universities". "The research on the changes of intestinal flora in liver cirrhosis" is of great significance in the treatment of liver cirrhosis and appraisal of its curative effect by establishing the first gene set for intestinal flora in liver cirrhosis in the world, clarifying structural changes, discovering for the first time the intrusion of patients' oral flora into intestinal tracts may lead to liver cirrhosis, figuring out 15 microbial genes of high specificity and sensitivity, and setting up a model for predicting liver cirrhosis. The research was published in Nature.

QLED designed by the Peng Xiaogang and JinYizheng research teams was selected into the 2014 "Top Ten Chinese Scientific Progress Programs". In the research, a new quantum dot LED (QLED) with a low manufacturing cost and high comprehensive capacity was developed by testifying that quantum dot LED can absorb the advantages of GaN quantum well LED and organic LED to offer solutions to carrier balance injection. QLED is powerful and competitive for future display and lighting technology, as its life will span 100,000 hours in practical use. The research was published in Nature.

Obtaining scientific achievement awards. ZJU ranked first among Chinese universities in 2014 with 13 State Science and Technology Awards, among which, there was 1 Second Prize State Science and Technology Award, 2 Second Prize State Technology and Invention Awards, and 2 Second Prize State Scientific Progress Awards with ZJU as the first unit of completion, and 8 with ZJU as a participating unit in getting 3 First Prize State Scientific Progress Awards, etc. Apart from that, a lot of research achievements were granted provincial and ministry-level awards.

Making breakthroughs in patent transfer.ZJU ranked first among Chinese universities in 2014 by securing 2,080 national patents, among which, invention patents amounted to 1,489. In addition, there were 11 American, Japanese and European patents, 9 application patents in PCT and 2 Chinese patents were granted Excellent Awards. In addition, 130 patents were transferred legally, among which, 22 invention patents by Professor Gao Chao and his team as well as 8 application patents were transferred in a package with the transfer fee of 30 million yuan.

V. Advances in Philosophy and Social Sciences

Making progress in humanities and social sciences. In 2014, research funds of 0.215 billion yuan were delivered to ZJU and 35 National Social Science Fund projects were secured, ranking second among China's Top 9 Chinese universities, among which, 9 were key projects, showing the capacity of ZJU experts and scholars in shouldering key practical issue missions. In addition, there were 323 SSCI papers, ranking third among mainland universities; 42 A&HCI papers, ranking first among mainland universities. Besides this, the Cooperative Innovation Center for "One Road and One Belt" Cooperation and Development was set up, the Institute for Advanced Studies in Humanities was set up, and the ZJU Institute for Land and National Development was co-established with the Ministry of Land and Resources. The Journal of Industrial Engineering and Engineering Management won the title of "the academic journal with the best international impact in China" for a second year. Furthermore, new-type think tanks serving national strategic needs came into being, and research conducted for national planning and many key research fruits and advisory suggestions was adopted and applied.

VI. International Cooperation and Exchange

Promoting the development of union colleges. Construction of international campuses was a key international cooperative strategy of ZJU, so advances were made from cooperation in projects, platforms and disciplines to sustainable co-operations between schools. "Union Laboratory for Applicational Data," co-established with Imperial College, London, came into formal existence. A united postgraduate cultivation program between ZJU and Imperial College was approved as one of the first funding projects for international cooperation and cultivation of innovative talents by the China Scholarship Council. A united school-running agreement with the University of Edinburgh was also signed. The prospects of establishing union colleges with the Wharton School of the University of Pennsylvania and Carnegie Mellon University were ongoing. While cultivating international innovation talent, international union colleges aimto accelerating the application of overseas high technological achievements into practical use, and attracting and encouraging overseas high technological achievements into China to better serve regional economic development.

Furthering the Overseas First-class Discipline Partner Program". The Program has given birth to the initial partnership between some disciplines of ZJU and several overseas first-class disciplines. Then, substantial cooperation between the College of Media and International Culture, the School of Management, the College of Chemical and Biological Engineering, the School of Aeronautics and Astronautics, the School of Biosystems Engineering and Food Science, and the Department of Physics, with the University of Oxford, the University of Cambridge, Harvard University, Princeton University and MIT, etc., were boosted in 2014. In addition, several first-class cooperation platforms were established, e.g. the University of Alberta—Zhejiang University Food and Health United Research Center, the International United Laboratory of Photonics and Technology (co-founded by ZJU and the University of Rochester [USA] and Lund University [Sweden]), Zhejiang University—University of Western Australia Ocean United Research Center and United Center for Data Science and Application (co-founded by ZJU and Imperial College, London).

Increasing Students' International Exchange and Joint Cultivation. Several high-level exchange programs were added, including the "University of Oxford Summer Program", "Imperial College Master Degree Program", "Durham University Exchange Student Program", and the "Eindhoven University of Technology Master Scholarship Program". In addition, several initial cooperative programs were signed, and overseas visiting groups of 1,768 person-time came to ZJU, and students and teachers of 6,651 person-time visited or studied in foreign countries, among whom, students of 3,161 person-time visited or studied overseas.

Making ZJU campus an international one. The activities of "ZJU-Imperial Day", "ZJU-Technical University of Berlin Day" were successfully held in ZJU. 2014 Intermediate Senior Officials Meeting (ISOM) of Fifth Asia-Europe Meeting of Ministers for Education (ASEMMES) and "Cross-Strait Symposium on School Management" entrusted by Ministry of Education were held at ZJU, adding glory to the image of ZJU. The project of "Qizhen Global Lecture Series", by attracting many overseas outstanding scholars, cultural celebrities and university presidents, has held 20 public lectures and exerted great impact.

Vigorous international academic exchange and cooperation. ZJU ranked first among Chinese universities in the number of international cooperative publications with ZJU teachers as first authors in 2014. It ranked third in China with 74 international academic conferences held in 2014, attracting a total number of 9,800 person-time, among whom, there were 2,200 overseas participants. In addition, many distinguished professors and experts were present at the conferences. For example, the 40th International Conference on Very Large Data Bases appealed to 800 participants, among whom 650 were from Stanford University, MIT, Yale University, and the University of Cambridge, as well as Google, Microsoft and Oracle, etc. raising the international impact of ZJU.

VII. Academic System Construction

Perfecting the organization structure and operation mechanism of academic committees at various levels. Notice on the Reforms of Optimizing Faculty System, Regulations of Zhejiang University Faculties (Trial) and Rules of the Academic (Professor) Committees of Zhejiang University Schools and Departments (Trial) issued stipulate that academic committees of faculties, advisory and appraisal organizations of ZJU academic fields, work under the guidance of ZJU academic committee; academic committees of schools and departments are supreme decision-review, appraisal and advisory organizations for academic affairs of schools and departments, which constitutes a holistic three-level operation mechanism of the academic committee of ZJU—faculties—schools and departments. On that basis, general election for the academic committees of faculties was conducted and the regulations for the academic committees of faculties were perfected to facilitate standard academic management.

Upgrading academic governance capacity. Based on Regulations for Academic Committees of Colleges and Universities [No. 35 Command of Ministry of Education (2014)] and Regulations of Zhejiang University Academic Committee, ZJU academic committee has tried its best to carry out missions, conduct consultation, appraisal and evaluation for serving disciplinary development, talent team building and creating the academic atmosphere of campus, playing an active part in boosting disciplinary development and academic prosperity. Moreover, ZJU academic committees have absorbed young members to exercise the role of young scholars in academic governance and to add to the vigor of academic committees.

Looking ahead, Zhejiang University will deepen its reforms and implement the "six school-strengthening strategies": cultivating talents catering to times, building disciplinary peaks, making high research platforms, gathering a galaxy of renowned teachers, accumulating cultural heights and exploring better reforms for building itself into a first-class global university with Chinese characteristics by conducting research in a way always being oriented toward the highest quality in every respect.

Solution-processed and high-performance light-emitting diodes based on quantum dots

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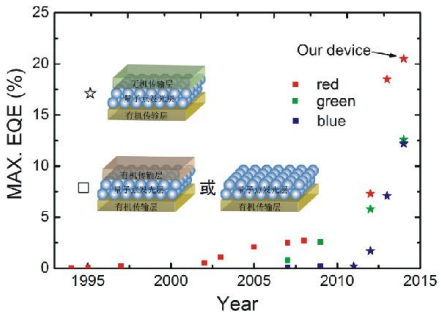
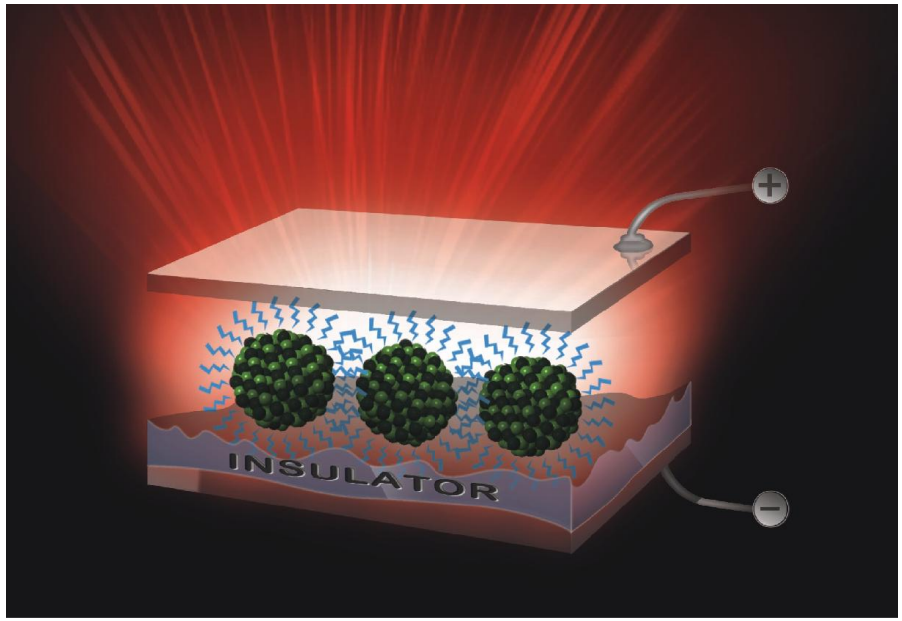
Selected as The TOP 10 Academic Advances of the Year

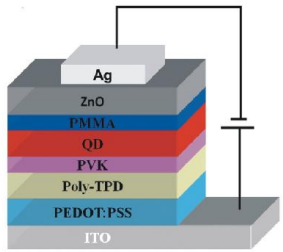
A team of led by Xiaogang Peng and Yizheng Jin at Center for Chemistry of High-Performance & Novel Materials, Zhejiang University have taken an important step forward in the development of solution-processed light-emitting diodes. This breakthrough indicates that high-performance and all-solution-processed QLEDs are promising for next-generation display and solid-state lighting technologies.

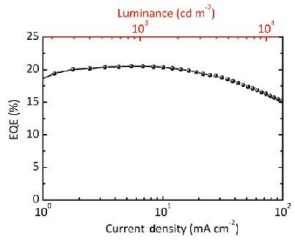
Project Leader: Xiaogang Peng Yizheng Jin

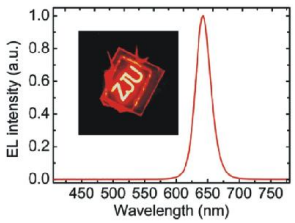
Solution-processed optoelectronic and electronic devices are attractive owning to the advantages of fabricating low-cost and large-area devices and the compatibility with light-weight and flexible plastic substrates. Solution-processed light-emitting diodes (LEDs) utilizing conjugated polymers or quantum dots (QDs) as emitters have attracted great interest over the past two decades. However the overall performance of solution-processed LEDs, including efficiency, efficiency roll-off at high current densities, turn-on voltage and lifetime at operational conditions, is inferior to that of the best vacuum-deposited organic light-Emitting diodes (OLEDs). Here we report a solution-processed multi-layer quantum-dot based LED (QLED) with outstanding performance and excellent reproducibility. The QLED exhibits color-saturated deep-red











emission, sub-bandgap turn on at 1.7 V, high external quantum efficiency (EQE) up to 20.5%, low efficiency roll-off (>15% of EQE at 100 mA cm-2), and a long operational lifetime of more than 100.000 hours at 100 cd m-2, making this device the best-performing solution-processed red LED to date and comparable to the state-of-art vacuum-deposited OLEDs. The exceptional optoelectronic performance is achieved by inserting an insulating interlayer between the QD layer and the oxide electron-transport interlayer (ETL) to optimize charge balance in the device and preserve the superior emissive properties of the QDs. We anticipate that our results will be a starting point for further research, leading to high-performance and all-solution-processed QLEDs ideal for next-generation display and solid-state lighting technologies.

Safety Disposal and Clean Energy Utilization of Sewage Sludge

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Selected as The TOP 10 Academic Advances of the Year

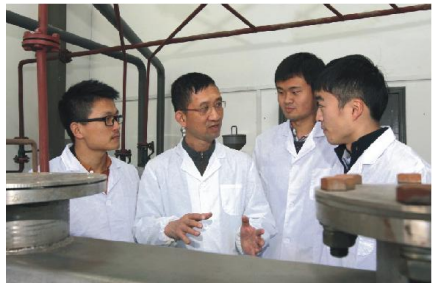
Sewage sludge is the byproduct of wastewater treatment plant. Given that sludge contains various pollutants, it should be treated properly to avoid contamination to the environment. An integrated sludge drying and incineration technique is developed. This novel technique played a significant role improving the level of sludge treatment in China.

Project Leader: Jianhua Yan

In every city we live in, different wastewater treatment plants, no matter in large or small capacities, are under operation every day. Wastewater from both municipal and industral processes, passes through the wastewater treatment plants to meet emission standards; and then re-enters the rivers and lakes. However, sewage sludge is the byproduct of wastewater treatment plant, which occupies a large quantity and contains various pollutants. If the sludge could not be treated properly, it will inevitably affect our living environment.

Professor Jianhua Yan is one of the earliest scientists focusing on the safety treatment and disposal of sewage sludge in China. Back in the 1980s during the treatment of “slurry” and other industral waste, prof. Jianhua Yan and his team have sensitively realized that the research on “sludge” is very important for environmental pollution provention, especially in the wastewater treatment process.

Agricultural utilization and open dumping are the most widely used sludge disposal methods in the past decades. Recent years, the vast growth of urbanization has resulted in a dramatic increase of wastewater and sewage sludge generation. Agricultural use and simple landfill are no longer suitable, since they are quite land intensive and cause secondary contamination to the soil and undergroundwater. Therefore, developed countries have gradually reduced the proportion of sludge landfill. On the contrary, drying and incineration has become the dominant sludge treatment technique in land resource scarce countries such as Japan, Germany, Netherlands, Belgium and Austria.



Integrated drying and incineration is an energy efficient and environmental friendly technique for the safety disposal of sewage sludge. It plays an important role in solving the environmental problems and meets the requirements of circular economy and sustainable development. However, considering that the sludge in China usually has characteristics of complicated composition and high moisture content, it is difficult to achieve efficient and clean sludge incineration. Moreover, imported sludge drying-incineration equipments, which are very expensive, may be unaccustomed to the reality. Realizing the fact, our project has proposed an innovative approach of heterotypic stir mixing after wide sampling and analyzing the sludge from all around China, especially for sludges with big viscosity and high sediment concentration which may lead to equipment viscous, wear and tear. The low-grade exhaut steam is used as media of sludge drying. By optimizing the blade arrangement and enhancing heat transfer, the agitation-type sludge drying equipment was successful developed, which could efficiently decrease the sludge moisture content from 80% to 30% or even lower. To achieve energy utilization and fully taken into consideration the sludge characteristics of low calorific value and spatial uneven combustion, a high efficiency and low emission circulating fluidized bed technique was developed to achieve sludge stable ignition and efficient incineration. Besides, the collaborative emission control technology during the whole sludge drying-incineration process is also developed. The flue gas emissions from sludge incineration satisfy the national standards; the concentration of dioxin is two orders of magnitude lower than the EU standards.

The project outcomes have been recommended as national standards and technical guidance. 31 patents have been authorized, including 13 patents of invention. 59 papers have been published in top SCI journals, such as Chemosphere, Environment Science & Technology. 2 professional books have been finished and 5 plenary lectures have been presented in international conferences. The technique is regarded as "in an international leading level" by professor NJ Themelis, who is the president of the International Waste Energy Research and Technology Council, member of U.S National Academy of Engineering, professor of Columbia University. The technique is widely applied in industrial enterprises. 112 sets of the related equipments have been promoted and also exported to South Korea. The main demonstration project has been selected as the first batch of "Wastewater Treatment Plant Sewage Sludge Treatment Demonstration Project". The technique shares more than 70% of the market, ranking the first in China. The newly increased output value is nearly 3.91 billion yuan in the latest three years. In conclusion, the technique has broken the technological monopoly of western developed countries, played a significant role improving the level of sludge treatment domestically and provided technical support for municipal wastewater treatment industry. The project was awarded as the second prize of the National Science and Technology Progress Award in 2014.

High End Digital Prototyping System for Flight Vehicle Design and Analysis

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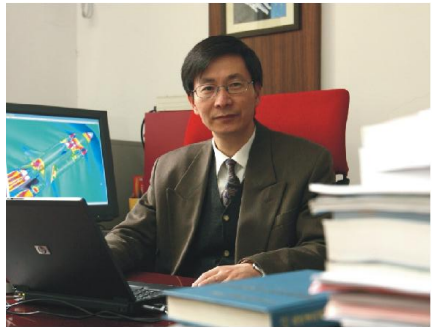
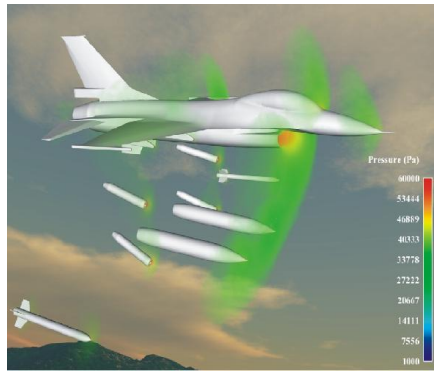
High End Digital Prototyping (HEDP) system is a design and analysis system capable of large-scale and multidisciplinary simulations. The simulations using the HEDP aid the design of a number of key vehicles developed in the main Chinese aerospace sector, and reduce the number of physical experiments remarkably.

Project Leader: Yao Zheng

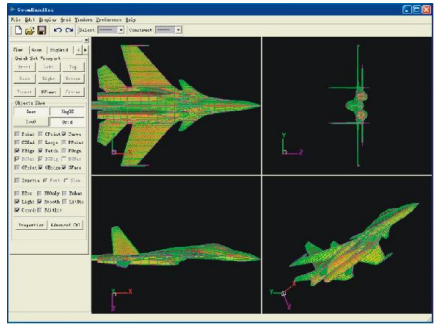
The level of using digital prototyping technologies for flight vehicle design is one of the main indices that evaluate the competitiveness of the aerospace industry of a country. Presently, simulation-based digital prototyping technologies are under developing in China. Consequently, vehicle design highly depends on physical experiments, and is therefore time-consuming and costly. Utilizations of commercial simulation systems have resolved this issue to some extent. However, almost all of these systems are developed by foreign vendors. Their commonly used versions charge a huge amount of money from the Chinese aerospace sector every year. Much worse, the advanced versions or key modules of these systems are usually in the list of trade embargo because of national security considerations. Therefore, to improve the competitiveness of the Chinese aerospace sector by using digital prototyping technologies, the only right way is to invest more on the fundamental theories and computational engineering algorithms, and to develop our own digital prototyping system for vehicle designs.

To break the monopoly and embargo of foreign simulation software in the field of flight vehicle design, researchers from Zhejiang University developed a simulation-based digital prototyping system with 13 year continuous efforts, namely the High End Digital Prototyping (HEDP) system. Dr. Yao Zheng is the leader of this research group, and he is also the Cheung Kong Chair Professor at School of Aeronautics and Astronautics.

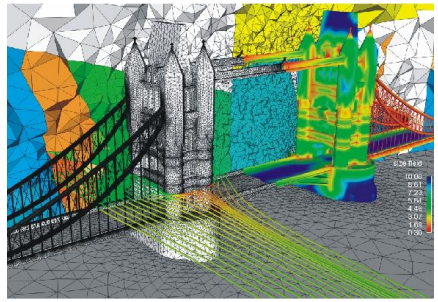




Simulation of an F16 aircraft store separation case.



A snapshot of a HEDP session: manipulating an aircraft model in the geometry builder.



The contest winner of the 23rd International Meshing Roundtable: parallel unstructured mesh generation for the London Tower Bridge model.

The research achievements on the HEDP were reported by the journal Aeronautical Manufacturing Technology as the cover story.

The HEDP system is a design and analysis system capable of large-scale and multidisciplinary simulations, and there are four categories of modules involved, namely pre-processing module, computing module, post-processing module, and platform control module. All these modules are coupled through a software bus, which makes the modules integrated seamlessly. An important feature of the HEDP system is its powerful parallel computing capability. Within the HEDP, not only the computing module is parallelized, but also the pre-processing and post-processing modules can run in a parallel fashion. In other words, the entire simulation cycle within the HEDP is parallelized, which enables efficient and accurate solution of many challenging simulation problems related to flight vehicle design, such as those in the fields of fluid dynamics, structure mechanics and combustion.

The HEDP has been successfully employed in several research institutes of CASIC (China Aerospace Science and Industry Corporation), CASC (China Aerospace Science and Technology Corporation) and AVIC (Aviation Industry Corporation of China). The simulations using the HEDP aid the design of a number of key vehicles developed in the main Chinese aerospace sector, and reduce the number of physical experiments remarkably. The accomplished simulations refer to computational aerodynamics, structural analyses, multi-body separation simulations and performance analyses of several new types of aerospace engines.

Presently, the research group is extending applications of the HEDP in the Chinese aerospace sector, and aiming at development of a more powerful system for collaborative design of flight vehicles.

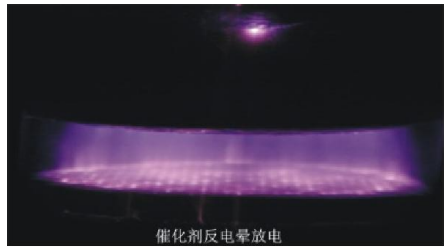
High voltage discharge and its industrial applications

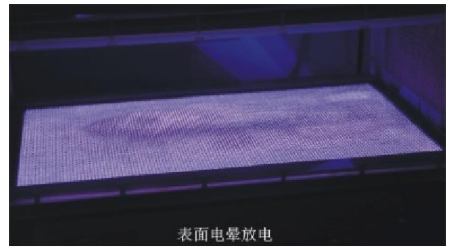
★ ★ ★ ★ ★

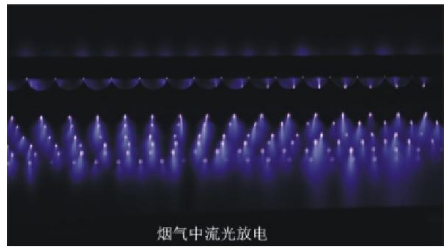
High-voltage discharge can produce strong sound, light, electromagnetic radiation, and reactive species in both air and water. By thoroughly understanding the fundamental process, Keping Yan successfully applied the high-voltage discharge in plasma sound source and PM2.5 ultra-low emission control, greatly contributed to our national security and haze governance.

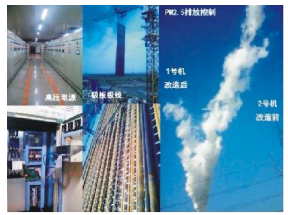
Project Leader: Keping Yan

To protect territorial waters and explore marine resources is the fundamental interests of our country. Under the support of 863 projects from Ministry of Science and Technology, 973 projects from Defense Department, and Innovation Project from General Armament Department, we have developed a series of plasma sound sources (Sonar) with the energy of 50-50000 Joules, by using a large-current (10-100kA) high-voltage pulsed discharge in water. These products can be used for marine geological survey, exploration and combat, and have been successfully applied in East China Sea, South China Sea, Arctic, Antarctic, ports and so on. Our cooperation partners include the First Institute of Oceanography, Second Institute of Oceanography, Ocean University of China, Institute of Acoustics, South China Sea Institute of Oceanology, China Shipbuilding Industry Corporation and so on. This technique can be used for not only shallow sea, but also the deep sea up to 5000 meters. The related study has been awarded as the First Prize of 2012 Science and Technology Award of China Marine Engineering, the Third Prize of 2013 Defense Science and Technology Progress Award, the First Prize of 2013 Defense Science and Technology Progress Award and so on. Typical application examples are “Qiongzhou Strait Project”, “Cangnan, Zhejiang Nuclear Engineering Seismic Exploration”, “South China Sea Liwan 3-1 Field Geological Disaster Risk Assessment”, “Huidong, Guangdong Nuclear Power Sea Survey”, East China Sea Exploration with Dongfanghong No.2, North and South Poles Expedition with Snow Dragon and Navy applications. The developed technique has served grand projects of marine construction, and significantly contributed to our national security.









To control fine particulate emissions of coal-fired boilers is one of the critical issues of haze governance. Through the study on the high-voltage discharge process of ESP and the efficient three-phase power supplies, we proposed a sizing model called ESP index for ESP sizing and upgrading, under the support of 863 Theme Project for Resources and Environmental technology called “Technologies and equipments for PM2.5 emission reduction and Process control of Key industries”. It has been successfully applied in more than 60 coal-fired boilers for ultra-low PM2.5 emissions of ESPs, e.g. 10mg/m^3 dust emissions at the ESP outlet WESP, this technique can not only achieve the ultra-low dust emission (2.5mg/m^3) by optimizing the electrostatic precipitator and desulfurization tower, but also reduce the costs in 4×250MW units of Huaneng Beijing Thermal Power Plant for the first time, and 5 mg/m^3 dust emission at the ESP outlet in 3rd boiler (330MW) of Tianjin Dagang Power Plant for the first time. Today, ESPs of Coal power plants have to be upgraded to meet the ultra-low emission regulation. Compared with the reported upgrading technique using DESP andWESP, this technique can not only achieve the ultra-low dust emission (2.5mg/m^3) by optimizing the electrostatic precipitator and desulfurization tower, but also reduce the costs significantly, e.g. 30-40 million RMB savings for each 600MW unit. Typical application examples are 2×600MW Wangqu power plant in Shanxi, 2×600MW power plant in northwest, new 1050 MW power plant in Wanzhou and one time pass the 168 operational acceptance. Special reports “For the Blue Sky” at Topic In Focus reported the environmental demonstration of Tianjin Dagang 4×330 MW Power Plant in November 7, 2014. This work has won the Cottrell award of the International Electrostatic Precipitator Society (2011).

The Research on Basic and Application of Cell based-Biosensors

★ ★ ★ ★ ★

Selected as The TOP 10 Academic Advances of the Year

Biomedical engineering is one of the frontiers in this century, innovation is inseparable from the development of the research methods in biomedical engineering. In recent years, with the rapid development of biomedical engineering and information technology, scientists can make biological and medical research on most basic unit-cellular level of life activities phenomenon with micro nano electronic means.

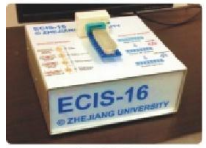
Project Leader: Ping Wang

Biomedical engineering is one of the frontiers in this century, innovation is inseparable from the development of the research methods in biomedical engineering. In recent years, with the rapid development of biomedical engineering and information technology, scientists can make biological and medical research on most basic unit-cellular level of life activities phenomenon with micro nano electronic means..

Professor Ping Wang research group studies cell-based biosensors for nearly 20 years, developed the various cell-based biosensors . Its basic principle is used as sensitive element by use of living cells and tissues to measure various signals, by many physiological parameter to reflect the change of measurands, and the physical and chemical transducers will transform these changes in cells into electrical or optical signals, and then complete the final detection by using measurement circuits. Cell-based biosensors have the characteristics of high sensitivity, real-time, nondestructive, long time without labeling are widely used in cell physiology, pharmacology, toxicology and related scientific research and practical applications.

多参数细胞生理参数分析仪

细胞微生理计

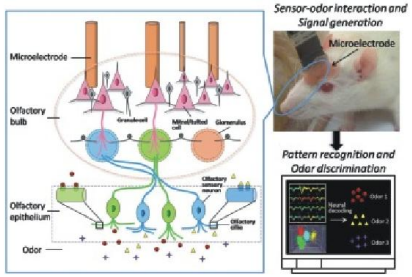


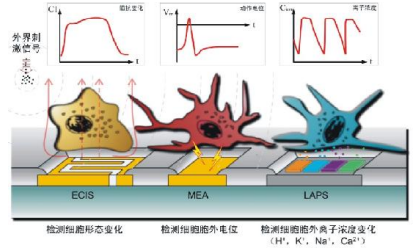
细胞阻抗分析仪

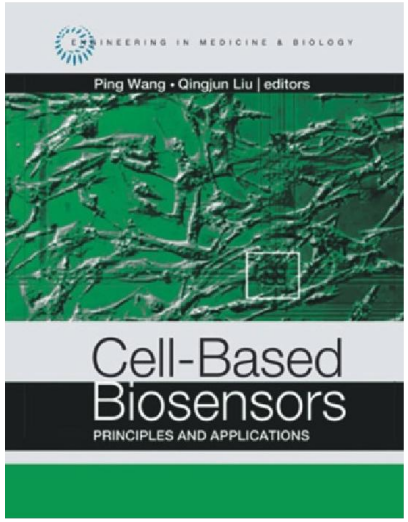
便携式阻抗分析仪

The research achievements in the world for the first time published books in english and chinese on cell-based biosensors. Published more than 180 papers indexed by SCI and impact factor of more than 45 is 1, more than 30 articles which impact factor is more than 5, SCI others cited more than 1200 times. Authorized national patents are more than 20, 3 plenary invited talks, invited more than 10 times of the reports and best paper award 3 times in the international conference these years. 2 outstanding research achievements of National Natural Science Foundation of China, the nomination award of National Excellent Doctoral Dissertation, the first award of Zhejiang Provincial Science and Technology, the second prize of Natural Science Award of Ministry of Education, the first award of Zhejiang Provincial Natural Science Academic in 2012, the national first prize of Xiaoping Innovation Team in 2014 and so on.

In 2014 June, Professor Wang Ping research group in top international journals "Chemical Reviews" (impact factor 45.661) published paper "Cell-based Biosensors and Their Application in Biomedicine", intruduced their research achievements of nearly 20 years in the cell-based biosensor fields and the forecast and prospect of cell-based biosensors development. The Chemical Reviews journal impact factor of 45.661, ranked third in the world. In 2015 February by the world's largest peer-reviewed papers indexed database Elsevier Scopus announced the 2014 annual world's most influential technology in the world, Professor Wang Ping is number one of biochemical field of Zhejiang University.







Dual Resolution Camera Successfully Acquired Group Photo of the Earth and the Moon in the third-step China moon mission.

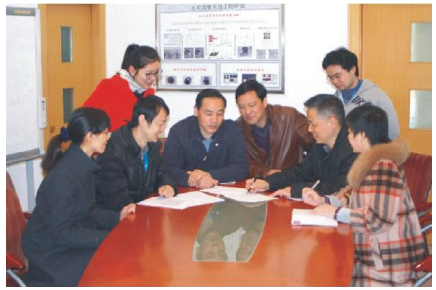
★ ★ ★ ★ ★

The testing space-craft of the third-step China moon mission achieved perfect success in November, 2014. The dual resolution camera which was originated from Zhejiang University onboard the space-craft successfully acquired the first group photo of the Earth and the Moon in the history of China.

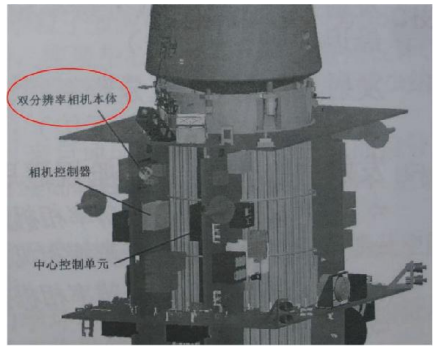
Project Leader: Zhihai Xu, Huajun Feng

Xu Zhihai research team from Zhejiang University proposed a novel design of dual resolution space camera in 2011. The team successfully developed a prototype camera in 2012, and got a patent of this design in 2013. The dual resolution camera was highly evaluated by the headquarters of China moon mission, and scheduled to on board the testing space-craft of the third-step China moon mission which will be launched in 2014, to take group photo of the Moon and the Earth for the first time in China space exploration history.

The dual resolution camera created a new imaging strategy which can acquire two field of view images with different resolving power to the same scene at the same time. It avoids the problem of contradiction between the wide field of view and high resolution in a conventional optical camera and exactly meets the demand of the mission to take pictures of the Moon and the Earth together.



Xu Zhihai team participated in the mission planning and the camera specification layout in 2013. They were in charge of design and manufacture the optical system for the flying camera. The research team took full use of technologies of thermal-free, anti-radiation and air pressure balance, overcame the difficulties of precision assembly and calibration in the micron dimension and the cemented lens reliability in launching process and outer space flying. After 2 rounds of design optimization and 3



rounds manufacture, the MTF of the optical system achieved above 0.3 at the spatial frequency of 156lp/mm, secured the excellent image quality in the rigorous space environment.

At 3:00 am October 28, 2014, the dual resolution camera carried by testing spacecraft of China moon mission successfully took the first picture of the Earth and the Moon together in the history of China at the distance of 12,000 KM to the Moon. At 16:00 pm November 9, 2014, the dual resolution camera acquired an image of the Earth and the Moon at the distance of 540,000KM to the Earth and 920,000 KM to the Moon. This is the first time of mankind to get group photos of the Earth and the Moon at this position in the space.

The Lunar Exploration and Space Engineering Center, which is the headquarters of China moon mission, gave a high appraisal to Zhejiang University team's work, "the dual resolution camera did excellent jobs, its optical lens took sharp and colorful images in the mission. …… Xu Zhiahi research team proposed the design concept, accomplished the demonstration prototype, designed and manufactured the optical system of the flying product. They have made prominent contribution to the dual resolution camera in the testing space-craft of the third-step China moon mission."

The idea of dual resolution camera originated from Zhejiang University. It characterized by its unique imaging strategy, high image quality, light weighted, compact size and nice adaptability to space application. The group photo of the Moon and the Earth successfully acquired by the dual resolution camera on the third-step China moon mission exhibited China space technologies once again, and inspired the interest of Chinese people to explore the mystery in the deep universe.

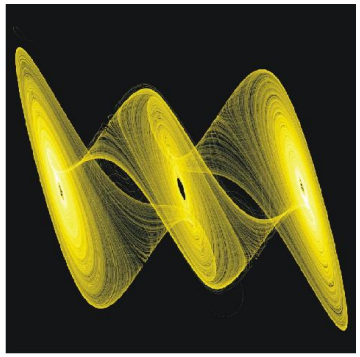
Sampled-data synchronization of nonlinear systems

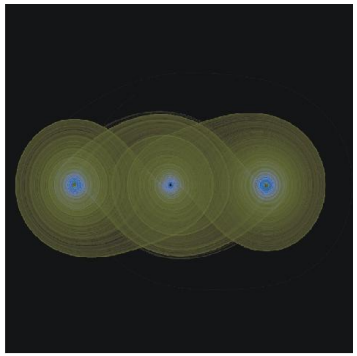
★ ★ ★ ★ ★

By developing a novel technique which fully utilizes the differential property of time-delay, we investigate both the nonlinear and sampled systems. The results we obtained is less conservative, which enlarges its practical applications.

Project Leader: Zhengguang Wu

As an essential property of many physical systems, nonlinearity commonly exists in nature world and industrial technology. In recent twenty years, there is a significant progress of research of the nonlinear system in both the theory and application fields. Due to their great universality, these relevant results not only have been widely used in many fields such as process control, aeronautical and Astronautic control, advanced robots, and biomedicine, but have presented their exuberant vitality and promising perspective. Especially, in recent years, the novel dynamic behavior and control performance, existing in the nonlinear system, also appear in the studies of biology, physics, society and engineering. It motivates the researchers to





think technical issues in the nonlinear dynamics view, and apply corresponding theories to system modeling, analysis, and synthesis. With the development of control science, computer technology, neural science, and Mathematics, neural network have gained its wide applications in many fields, e.g., industry, agriculture, economy, and medical treatment and so on.

Due to rapid development of computer technology and gradually improved theories on digital signal processing, the sampled systems have been widely used in majorities of the practical projects, e.g. power systems, traffic control, and chemical industry. The prominent feature of the sampled systems is that they contain continuous as well as discrete-time signals, which definitely makes the mathematical model, analysis, and design of the sampled systems different from those of the pure continuous systems or pure discrete-time ones. One of the main methods studying the sampled systems is the time-delay approach. That is to transform the sampled systems to the systems with time-delay. The resulting time-delay appears in jagged edges structure, i.e. bounded time-delay. Except for the time of sampling, it is differential everywhere. In the past decade, with the development of the networked control systems, the time-delay systems and the Lyapunov stability theory have been used to investigate the sampled systems. While, subject to the limitation of Lyapunov stability theory itself, almost all the results can only utilize the boundedness of the time-delay, and the differential property, that is the jagged structural information, of the time-delay cannot be effectively used, which leads to a conservative results and limits its applications. Therefore, a novel technique, fully utilizing the differential property of time-delay, is required to make the results less conservative, and its applications larger.

Flower-visiting insects and their potential impact on transgene flow in rice

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Selected as The TOP 10 Academic Advances of the Year

The results substantially advance our understanding of gene flow in rice by showing that insects play a key role in cross pollination that until now was unknown. These results also have implications for other major grain crops that also produce anemophilous flowers as they suggest the importance of insects in pollination may also be under-recognized. As such, the flower-visiting insects must be seriously considered during the ecological risk assessment of transgene flow in rice.

Project Leader: Xuexin Chen

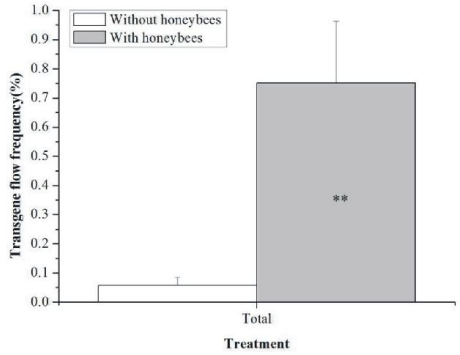
Rice is one of the most important crops in the world, and exhibits high rates of self-pollination before flower opening, which reduces the frequency of cross-pollination. Many studies focus on wind-mediated gene flow of self and wind-pollinated crops such as rice while gene flow due to flower-visiting insects of these plants has received surprisingly little attention. Several transgenic varieties of rice have been developed, and some have recently entered pre-production trials. One concern with genetically modified (GM) crops is transgene escape, but prior studies suggest this risk is low for rice because it is self-pollinated and the dispersal of pollen by wind is limited. However, little is known about the impact of pollen transport by insects.

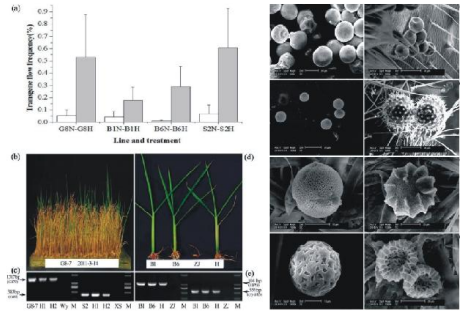
Dr. Xue-xin Chen from Zhejiang University in Hangzhou, China, and his team characterized the diversity of insects in China that visit rice during anthesis and the effects of insect pollination on gene flow. A two-year nationwide survey identified more than 510 insect species that visited rice flowers. These include honeybees,

hoverflies and several other species which loaded large amounts of pollen. The European honeybee *Apis mellifera* visited rice flowers regularly with daily foraging activity peaking between 12.00 and 13.00 h. Twenty European honeybee colonies located 100 – 1000 metres away from rice fields in mixed agricultural landscapes were monitored and the honeybees were found to be able to carry viable pollen at least 500 m away from the rice pollen source. Field-cage experiments with four GM rice lines as pollen donors, their non-GM parental varieties as pollen recipients and the European honeybee as the pollinator were carried out to assess whether honeybees increase the frequency of gene flow in rice. Results from screening over 1.5 million germinated offspring seeds over a 3-year study period demonstrated that honeybees significantly increase transgene flow in rice. Taken together, these findings highlight that insects disperse rice pollen and increase gene flow much more than previously assumed.

The results substantially advance our understanding of gene flow in rice by showing that insects play a key role in cross pollination that until now was unknown. These results also have implications for other major grain crops that also produce anemophilous flowers as they suggest the importance of insects in pollination may also be under-recognized. As such, the results enhance understanding of gene escape in self-pollinated and/or anemophilous crops at the landscape level, and the flower-visiting insects must be seriously considered during the ecological risk assessment of transgene flow in self-pollinated and/or other anemophilous crops.

These research findings entitled "Flower-visiting insects and their potential impact on transgene flow in rice" were published in the *Journal of Applied Ecology* by the British Ecological Society on June 27, 2014. The latest findings were featured by *Nature* Research Highlights on July 3, 2014.





The genomic mechanisms of the rice planthopper and its fungal and bacterial endosymbiont interactions

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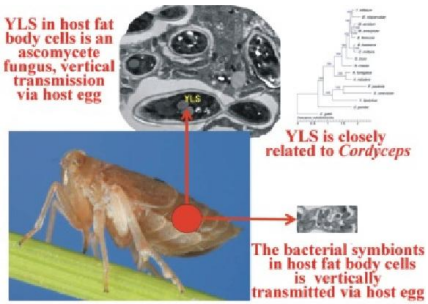
The brown planthopper is the most destructive pest of rice. The research team led by Chuanxi Zhang successfully revealed genomic mechanisms of insect-symbiont interactions. These findings highlight potential directions for effective pest control of BPH.

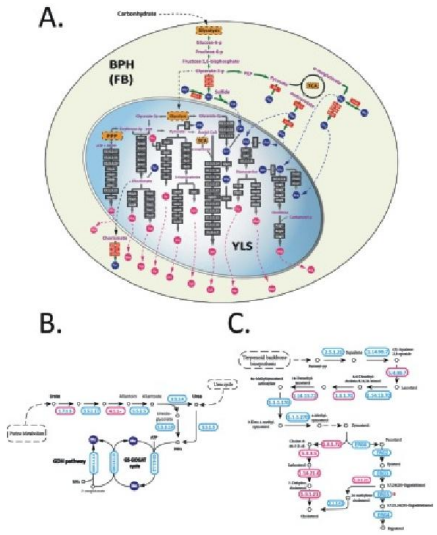
Project Leader: Chuanxi Zhang

The brown planthopper, *Nilaparvata lugens*, the most destructive pest of rice, is a typical monophagous herbivore that feeds exclusively on rice sap, and migrates over long distances. Its outbreaks have been very frequent in several decades, which pose an enormous barrier to crop safety in China. Although various new rice varieties with high resistance to BPH and new insecticides have been developed and implemented, Asian countries have continually experienced serious outbreaks of BPH. The research team led by Chuan-Xi Zhang of the Institute of Insect Science, Zhejiang University, in collaboration with BGI-Shenzhen, successfully revealed the comlementary genomes of the brown planthopper and its fungal and bacterial endosymbionts. The findings were published in Genome Biology (Xue et al. Genome Biology 2014, 15: 521). It offers an opportunity to understand how a monophagous sap-sucking arthropod herbivore has adapted to its exclusive host selection and to provide insights to improve pest control.



The researchers employed a hybrid method that integrates WGS sequences with pooled fosmid sequencing and finally obtained a 1.14 Gbp draft BPH genome and identified 27,571 protein-coding genes. Rice sap is extremely imbalanced nutritionally, thus unable to cater to the demand for the growth and reproduction of the brown planthopper. To better understand how a monophagous sap-sucking arthropod herbivore adapts to its exclusive host selection, researchers focused on revealing the complicated symbiotic system composed of the insect and its fungal yeast-like symbiont (YLS) and its bacterial symbiont *Arsenophonus nilaparvatae* . The YLS genome was assembled into 582 scaffolds with a total size of 26.8 Mbp and this bacterial genome was assembled into into 20 scaffolds and estimated a draft genome size of 2.96 Mbp. By analyzing the complementary genomes of the brown planthopper, YLS and endosymbionts, they found that the brown planthopper is lacking in the ability to produce 10 essential amino acids, including Histidine, Arginine, Phenylalanine, Tryptophan, Leucine, Isoleucine, Methionine, Threonine, Lysine and Valine, whose corresponding synthesis pathway genes are all found in YLS. Moreover, it is also discovered that YLS is capable of utilizing uric acids to develop a complete nitrogen cycle with the brown planthopper. YLS is also able to synthesize the central complex of zymosterol, which the brown planthopper can use to further synthesize cholesterol, thus forming a complete synthesis pathway. Furthermore, both YLS and the brown planthopper have flaws in the synthesis of vitamins, but the symbiotic bacterial belt is characterized by a complete avenue for the synthesis of Vitamin B, indicative of this endosymbiont's potential of providing vitamins. These findings not only open up a new direction for effective pest control of the planthopper, but also offer a genome basis for inter-species differences and migration.

Whole genome sequencing of BPH and its fungal and bacterial endosymbionts revealed genomic mechanisms of insect-symbiont interactions. The complementarity of the three genomes with regard to nutritional pathways enables BPH to thrive on a low-nutrient diet provided solely by rice. These findings highlight potential directions for effective pest control of BPH. Additionally, with a reference sequence available, more extensive resequencing in different global populations will improve the understanding of BPH's migratory routes, and aid in identifying potential differences between populations that cause different levels of destruction.



Alterations of the human gut microbiome in liver cirrhosis

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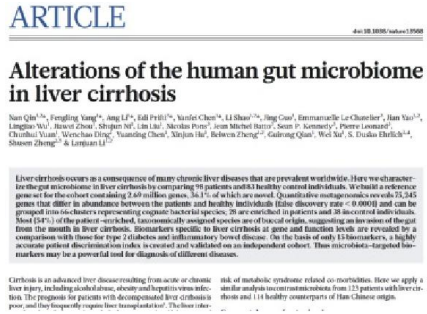
Selected as The TOP 10 Academic Advances of the Year

Researchers from the State Key Laboratory for Diagnosis and Treatment of Infectious Diseases in the First Affiliate Hospital of Zhejiang University, carried out the first study of relationship between the human gut microbiome and liver cirrhosis, which reveal the mechanism of the development of cirrhosis from the perspective of intestinal flora disorders. This research had been published on the Journal 'Nature' (IF: 42.351) in 2014

Project Leader: Lanjuan Li

Liver cirrhosis occurs as a consequence of many chronic liver diseases that are prevalent worldwide. Some studies have revealed that alterations in the gut microbiota are important in complications of end-stage liver cirrhosis, but definitive associations of gut microbiota and liver pathology in humans are still lacking. How these phylogenetic alterations relate to changes in the functioning of this ecosystem is, however, unclear. To solve these problems, a team of researchers, led by Professor Lanjuan Li and Dr. Nan Qin, made an important breakthrough of in the field of infectious microecology after a three-year long study.

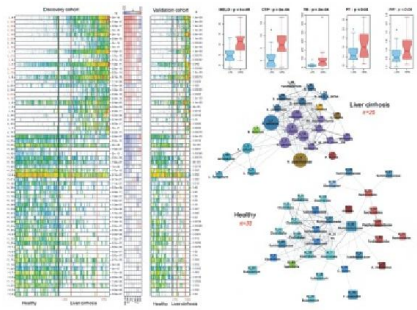
Our investigation included two phases. The first was discovery, where we compared 98 patients with liver cirrhosis and 83 healthy controls. The second was validation, with additional 25 patients and 31 controls. Here we characterize the gut microbiome in liver cirrhosis by comparing 98 patients and 83 healthy control individuals through metagenomic sequencing.



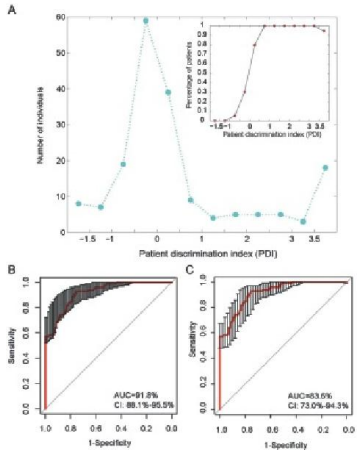
ARTICLE

Alterations of the human gut microbiome in liver cirrhosis

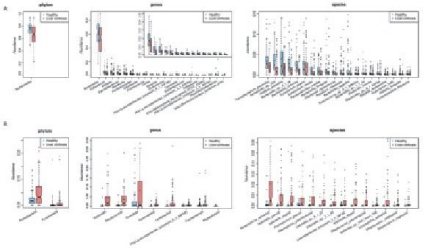
The research of gut microbiome alternations in liver cirrhosis



Liver cirrhosis closely related metagenomic species (MGS)



Based on 15 biomarkers, a highly accurate patient discrimination index (PDI) is created



The different abundance of gut microbiome in liver cirrhosis patients and healthy controls

We build a reference gene set for the cohort containing 2.69 million genes, 36.1% of which are novel. Quantitative metagenomics reveals 75,245 genes that differ in abundance between the patients and healthy individuals (false discovery rate, 0.0001) and can be grouped into 66 clusters representing cognate bacterial species; 28 are enriched in patients and 38 in control individuals. Most (54%) of the patient-enriched, taxonomically assigned species are of buckle origin, suggesting an invasion of the gut from the mouth in liver cirrhosis. Biomarkers specific toliver cirrhosis at gene and function levels are revealed by a comparison with those for type 2 diabetes and inflammatory bowel disease. On the basis of only 15 biomarkers, a highly accurate patient discrimination index is created and validated on an independent cohort. Thus microbiota-targeted biomarkers may be a powerful tool for diagnosis of different diseases.

This research paper has been published on the Journal 'Nature' (IF: 42.351) in 2014, in addition, this research results was reported in the "Top ten scientific and technological progress in China.

Completely laparoscopic ALPPS using round-the-liver ligation to replace parenchymal transection

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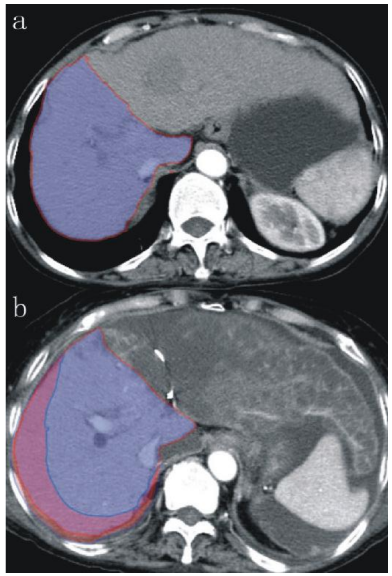
Selected as The TOP 10 Academic Advances of the Year

Liver resection is the most effective treatment for patients with liver cancer, but not all the patients are able to undergo a major liver resection. Liver transplantation is the only choice for them, but most of them can't have transplantation finally for the shortage of donor liver. The new procedure provide some patients who are waiting for liver transplantation a new hope to be treated by liver resection.

Project Leader: Xiujun Cai

Liver resection is the most effective treatment for patients with liver cancer, but not all the patients can undergo the procedure. Some patients have severe liver cirrhosis and are unable to undergo a major liver resection (future liver remnant volume less than 40%) for the high occurrence rate of postoperative liver failure. Liver transplantation might be the only choice for them to fight the cancer, but most of them can't have transplantation for the shortage of donor liver.

Recently, associating liver partition with portal vein ligation for staged hepatectomy (ALPPS) was reported by germen surgeries. The first-stage operation of liver partition and portal vein ligation could induce a fast regeneration of the liver remnant and was followed by the second-stage operation of liver resection 1 to 2 weeks later. By using this procedure, surgeries could perform major liver resections on some patients who were



Supposed to have liver transplantation before. However, there are two problems in this procedure: the bile leakage after the first-stage operation and the doubled surgical trauma, so it is difficult to adopt it as a routine procedure worldwide. Prof. Cai modified this procedure on the base of the technique of laparoscopic selective hepatic inflow occlusion which was established by himself in 2005 and solved the two problems by using the round-the-liver ligation to replace liver partition in the first-stage operation to avoid bile leakage and by performing the two operations laparoscopically to decrease the surgical trauma.

The establishment of the new procedure by Prof. Cai paves the way to popularize this treatment. Some patients were supposed to have liver transplantation before could be treated by liver resections and the problem of donor liver shortage could be partially solved by the popularization of this procedure. In addition, the cost is decreased by about 70% compared with the liver transplantation and the laparoscopic procedure has less impact on the immune system compare with the open procedures that help the early comprehensive anti-cancer therapies.

Transcatheter heart valve replacement or repair

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Selected as The TOP 10 Academic Advances of the Year

Professor Jianan Wang, one of the leaders in performing transcatheter heart valve replacement or repair in China, has achieved a high procedural success as well as extended the indication, optimized the key technique and improved the procedure approach, thus make extraordinary contributions in pushing the development of interventional cardiology in China.

Project Leader: Jianan Wang

With aging of the population, the incidence of valvular heart disease increases rapidly. It has been shown that the incidence was as high as 13.3% in those over 75 years old, presenting with severe symptom, poor prognosis and high mortality, therefore, posting a serious threat to human health.

Surgical valve replacement is the traditional treatment, but there are quite a few disadvantages such as the need for general anesthesia, cardiopulmonary bypass, and open chest procedure, heavy operational trauma, high-risk operation and slow recovery. Many critical ill patients are intolerant for the surgery, hence they are extreme painful and have to face death every day.

In 2013, the heart valve team led by prof Jianan Wang carried out transcatheter valve replacement and repair, a landmark step forward in the field of interventional cardiology, and brought a complete novel treatment to patients with valvular heart diseases. The procedure adopted femoral vascular pathways, thus embracing the advantage of less trauma, low-risk, quick recovery, no scars, etc., and raised hope for patients who lost the opportunity for surgery.

They made tremendous endeavor and achieved breakthrough progress in the field of transcatheter interventional treatment for valvular heart diseases:

1. One of leaders in performing TAVI and MitraClip in China and the procedural success was as high as 98.6%.

2. Extension of the procedural indication. Bicuspid aortic valve (BAV) is considered to be the relative contradiction for TAVI. However, the incidence of BAV in Chinese population is significantly higher than that in western countries, presenting a large demand for the treatment. Prof Jianan Wang applied balloon sizing to downsize for the selection of valve and moderately high implantation technique during TAVI procedure, leading to significant improvement of safety and effectiveness. He timely summed up the experience, and published a paper titled with "Evaluation of the safety and efficacy of transcatheter aortic valve implantation in patients with a severe stenotic bicuspid aortic valve in a Chinese population". The achievement was highly commented by a Germany expert in this filed, regarding it as the First report on Chinese population and providing valuable implications for clinical practice and clinical trials to expand the indication for TAVI. Aortic regurgitation is also not recommended for TAVI. However, Prof Jianan Wang overcome the technical problems such as valve fixation difficulty and firstly carried out the procedure in China, saving patients' life.

3. Prof Jianan Wang has accomplished the largest cases of MitraClip in China. He found that the atrial septal puncture site was the key to the success of the procedure. Therefore, he mended the operation approach by introducing precisely 3D echo guided atrial septal puncture, contributing to a raise of the procedural success to 100% and improvement of cardiac function compared with pre-operation.

4. Prof Jianan Wang has been invited by two most important cardiovascular interventional conferences in international and Asia-Pacific region (TCT and TCTAP) for talks, and performed live procedural demonstration in Congress of Chinese Interventional Therapeutics and annual scientific session of Chinese Society of Cardiology. Prof Jianan Wang and his heart valve team make extraordinary contributions in pushing the development of interventional cardiology in China.