IEEE ICMA 2018 Conference Workshop

World Youth Development Workshops on

Opto-Mechatronics

Sunday, August 5, 2018
13:30 - 15:40
Conference Room 1, 1F
Sheraton Changchun Jingyuetan Hotel, Changchun, China

Optical, Mechanical and Electronic Integration: Theory and Practice

Venue: Conference Room 1, 1F
Sheraton Changchun Jingyuetan Hotel, Changchun
Date and Time: 13:30 - 15:40, August 5, 2018

Organizers:

Dr. Dapeng Tian, Changchun Institute of Optics, Fine Mechanics and Physics, Chinese Academy of Sciences, Changchun, China
Dr. Jianli Wang, Changchun Institute of Optics, Fine Mechanics and Physics, Chinese Academy of Sciences, Changchun, China

About the workshop:

Optical, Mechanical and Electronic integration technology is one of the core technologies of advanced manufacturing. It is the basis of robots, machine tool and several industrial devices. Youth is the backbone of future research. The Youth Innovation Promotion Association is a new force in the scientific and technological innovation of the Chinese Academy of Sciences. We assemble a group of Youth Innovation Promotion Association members who engage in the front-line research in the field of optics and mechatronics. Their latest research results will be introduced and presented.

List of Speakers and Schedule

Time	Topics	Speaker List
13:25-13:30	Welcome speech	
13:30-13:50	Diode-Pumped Alkali-Vapor Lasers	Fei Chen, State Key Laboratory of Laser Interaction with Matter
13:50-14:10	Researches on space structural dynamics and space robot in CIOMP	Zhenbang Xu, Innovation Lab of Space Robot System, Space Robotics Engineering Center, Changchun Institute of Optics, Fine Mechanics and Physics, Chinese Academy of Sciences
14:10-14:30	Advanced Motion Control and Its Applications	Dapeng Tian, Key Laboratory of Airborne Optical Imaging and Measurement, Chinese Academy of Sciences
14:30-14:50	Motion Compensation of TDI CCD Camera in Remote Sensing System	Dejiang Wang Changchun Institute of Optics, Fine Mechanics and Physics, Chinese Academy of Sciences
14:50-15:10	Computer Vision and Robots Design	Ye Zhang, Changchun Institute of Optics, Fine Mechanics and Physics, Chinese Academy of Sciences.
15:10-15:30	Experiment analysis of adaptive optics based free space optic communication system with a 349-element deformable mirror	Kainan Yao Changchun Institute of Optics, Fine Mechanics and Physics, Chinese Academy of Sciences
15:30-15:40	Panel Discussion	Moderators: All speakers

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Talk 1

Diode-Pumped Alkali-Vapor Lasers

Fei Chen

Associate Professor, State Key Laboratory of Laser Interaction with Matter,

Innovation Laboratory of Electro-Optical Countermeasures Technology,

Changchun Institute of Optics, Fine Mechanics and Physics, Chinese Academy of Science

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Abstract

The diode-pumped alkali-vapor lasers (DPALs) have the preferred properties of solid-state lasers and gas lasers, such as higher quantum efficiency, larger stimulation emission cross-section, small refractive index perturbation, easy heat elimination and good optical characteristics. The DPALs are expected to obtain near-infrared laser output with high power, high efficiency and high beam quality, which has potential applications in military and civilian. In addition, it is a new way to achieve blue-violet laser with high efficiency and high power by frequency doubling of DPALs, which has important applications in scientific research, medical treatment, environmental monitoring, laser displays and underwater communication. In addition, cascade output of mid-infrared and visible laser could be obtained employing two-photon excitation.

The experimental investigations on a diode-pump cesium-vapor laser (Cs-DPAL) and its

frequency doubling to obtain blue-violet laser are carried out. A Cs-DPAL is constructed. By optimizing the parameters, the CW Cs laser with fundamental transverse mode is obtained. Then the researchers on blue-violet laser by extra-cavity and intra-cavity frequency doubling are presented by using the phase matching method with LBO crystal. In order to obtain the dual-wavelength emission of mid-infrared and blue-violet laser, a model on the absorption cross-section of the simultaneous two-photon excitation in Rb-vapor four-wave mixing process is established. Additionally, two approaches to improve absorption efficiency are proposed.

Dr. Chen is an associate professor and a doctoral supervisor. He received his Doctoral degree in physical electronics from Harbin Institute of Technology in 2011. At the same year, he joined the State Key Laboratory of Laser Interaction with Matter in Changchun Institute of Optics, Fine Mechanics and Physics, Chinese Academy of Sciences. His research interests include novel lasers and laser frequency conversion. He has been publishing 108 papers (38 papers as the first author or corresponding author) in top journals and international conferences such as “Light: Science&Applications”, “Optics Letters”, “Optics Express” and ASSP, CLEO, ICOP, etc. Among them, 69 papers are recorded in SCI, and 30 papers are recorded in EI. The cited time of his papers recorded in SCI has reached more than 1200 times. He holds 3 academic books and 4 patents. He organized or participated in over 10 projects, including the Natural Science Foundation of China, the Major State Project, the Major Science and Technology Project, and the Major Science and Technology Biding Project of Jilin Province, etc. He was elected in the Youth Innovation Promotion Association of Chinese Academy of Sciences in 2017, and received the financing of the Youth Science and Technology Innovation Leaders and Team Project of Jilin Province at the same year.

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Talk 2

Researches on Space Structural Dynamics and Space Robot in CIOMP

Zhenbang Xu

Innovation Lab of Space Robot System, Space Robotics Engineering Center, Changchun

Institute of Optics, Fine Mechanics and Physics, Chinese Academy of Sciences, Changchun

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Abstract

The presenters' group has been studying on space structural dynamics and space robot in CIOMP. In space structural dynamics, the main research work concentrates on the analysis and control of the jitter of the space device, including the integrated opto-mechanical analysis of the space optical device, passive and active micro-vibration control and the ground experiments technique of the jitter and so on. Some achievements have been applied to the multifunctional optical facilities on chinese space station, which is a flagship project of the china aerospace. In space robot, we have researched the space parallel robot and the space series robot. The space parallel robot is mainly used to be the adjustable mechanism of the large space telescope. The space series robot is used to construct ultra-large space telescope in orbit. This report introduces some recent works and main achievements in the above-mentioned areas.

Dr. Xu received doctor degree from the university of science and technology of china (USTC) in 2010. After his career, he is currently a professor at Changchun Institute of Optics Fine Mechanics and Physics (CIOMP). His research interests include space structural dynamics, passive and active micro-vibration control and space robot. He has been publishing more than 30 journal papers in these areas.

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Talk 3

Advanced Motion Control and Its Applications

Dapeng Tian

Associate Professor

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Abstract

Motion control theory and technology is one of the cores of industrial practice. Controlling the motion of an object means that the acceleration, velocity and position follow the orders accurately. Advanced motion control contains three aspects. Firstly, signal processing algorithm should be improved. The quality of feedback signal and also command signal directly influence the performance of the whole system. Secondly, an internal loop robust control should be added. Such a control loop improves disturbance rejection of a motion control system and even the overall performance. Thirdly, control algorithm in application lays should be focused on. The presenter has been investigating motion control for several years. An idea of designing the differentiator is proposed based on feedforward. Disturbance observer based internal loop control is also investigated combining sliding mode control. A haptic bilateral

teleoperation is focused on in the application lay. Transparency haptic transmission is achieved with and without communication delay between a master robot and a slave robot.

Dr. Tian received B.E and Dr. E. from Beijing Institute of Technology in 2007 and Beihang University in 2012, respectively. From 2009 to 2012, he was with Keio Advanced Research Center, Keio University as a co-research fellow supported by Chinese Scholarship Council. From 2012 to 2014, he was with Changchun Institute of Optics, Fine Mechanics and Physics, Chinese Academy of Sciences (CAS) as an assistant professor. He is currently an associate professor and member of the Youth Innovation Promotion Association, CAS. His research interests include high speed and high accuracy control, bilateral teleoperation and haptics. He has published over 40 papers and achieved 5 patents for invention. He is an editorial board member of the journal of optics and precision engineering. The First prize for the academic achievements of Natural Science in Jilin, 2017’s Outstanding Science and Technology Achievement Prize of the Chinese Academy of Sciences (Major Contributor) are presented to him.

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Talk 4

Motion Compensation of TDI CCD Camera in Remote Sensing System

Dejiang Wang

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Abstract:

Clock smear caused by charge transfer of time delay and integration charge coupled device is the natural component in remote sensing system, and it could not be eliminated by traditional motion compensation schemes. After researching on the operation of a typical TDI CCD, we give a thorough understanding on causes of clocking smear. Then an elaborate mathematical model describing the charge transfer procedure is developed, and the modulation transfer function losses due to charge transfer is also presented, which shows that nearly one pixel smear will be introduced by traditional phased timing. Therefore we proposed a novel charge transfer method, a series of image simulations are made for two, three and four phase TDI CCD in which clocking smear is caused by our and conventional charge transfer methods respectively. The experimental results confirm that image quality improvement can be achieved by our method.

Dr. Wang received B.E and Dr. E. from Nankai university in 2004 and Qsinghua University in 2007, respectively. From 2007 to 2014, he was with Changchun Institute of Optics, Fine Mechanics and Physics, Chinese Academy of Sciences (CAS) as an assistant professor. He is currently an associate professor and member of the Youth Innovation Promotion Association, CAS. His research interests include dim point detection using infrared camera and motion compensation in remote sensing cameras. Published more than 20 articles, such as Optics Express, Applied Optics, Optics Communication, etc. Authorized more than 5 patents, as a tutor or assistant tutor of optical engineering discipline doctoral, master of 4 graduate students. He has hosted or participated in a number of national, provincial or ministerial funds or projects.

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Talk 5

Computer Vision and Robots Design

Zhang Ye

Associate Professor

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Abstract:

In this work, we propose a nurturance robot system. The robot system follows a modularize design style which is consists of several interrelated functions modules, including vision, auditory, and speech. This system design enables us easily to be able to integrate other functions. Combining some existing state-of-art approaches, the Nurturance robot system integrates face recognition, human computer interaction and facial expression display. We elaborate the design and implementation of the system from two aspects, software and hardware, respectively. Includes two aspects. Firstly, we propose a method for combining several software modules of speech recognition and vision. Secondly, we construct a simple and effective experimental system to realize our design and design a pretty and smart nurturance robot.

Zhang Ye received PhD. degree from Changchun Institute of Optics, fine Mechanics and Physics, Chinese Academy of Sciences in 2008. Previously engaged in ground,

aviation, aerospace and military related computer vision and artificial intelligence work, with the team transferred to the State Key Laboratory of Applied Optics, engaged in the design and research and development of artificial intelligence-related civil products. Published more than 20 articles, including a study about deep learning with an SCI impact factor 6.387, authorized more than 10 patents, as a tutor or assistant tutor of artificial intelligence discipline doctoral, master of 8 graduate students. She has hosted or participated in a number of national, provincial or ministerial funds or projects. In 2018, she will complete a transformation of scientific and technological achievements, and planned to set up a business, taking artificial intelligence as the core, to serve industrial and civilian.

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Talk 6

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Experiment analysis of adaptive optics based free space optic communication system with a 349-element deformable mirror

Kainan Yao

Associate Professor

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Abstract:

Due to the influence of atmospheric turbulence, the decrease of fiber coupling efficiency leads to the decline of free space optical communication (FSOC) system performance. Adaptive optics (AO) can reduce atmospheric turbulence effect and improve fiber coupling efficiency effectively. To improve the performance in FSOC system, AO system must be designed to compensate both high spatial and temporal frequency wavefront aberrations. In this paper, we describe an AO system with a 349-element deformable mirror used for FSOC system and evaluate its performance under different Greenwood frequency. The simulative and experimental results show that the coupling efficiency can be significantly improved after AO correction. And

more element number of deformable mirror and higher close-loop control bandwidth can offer more enhancements for FSOC performance. This experiment analysis provides a reference for the design of FSOC system.

Kainan Yao was born in December 1987, received the Doctor's degree from University of China Academy of Sciences in 2015.He is currently a associate professor at Changchun Institute of Optics, Fine Mechanics and Physics, Chinese Academy of Sciences, Member of the Youth Innovation Promotion Association of the Chinese Academy of Sciences. His major research directions including the adaptive optics technology and the novel wave front sensing method. He has more than 10 journal papers, including the first author or corresponding author in Optics Express, Applied Optics, IEEE Photonics Journal. Based on the related work, he got fundings, such as National Natural Science Foundation of China, National Defense Science and Technology Innovation Fund Project of Chinese Academy of Sciences and Military Commission Science and Technology Committee Innovation Project. He won the Chinese Academy of Sciences President award in 2015.