Special Session XI

Special Session Basic Information:

专栏题目 Session Title	中文：光机电一体化技术 英文：Opto-Mechatronics Technology

专栏介绍和征稿主题
Introduction and topics

中文：

随着智能制造的深入推进，光机电一体化技术作为集光学、精密机械、电子控制和计算机技术于一体的综合性学科，正成为驱动高端装备、智能系统与前沿科学仪器发展的核心引擎。其在微纳制造、航空航天、精密测量等关键领域发挥着不可替代的作用。然而，要实现光、机、电等多物理场的高性能融合，面临着系统设计、动态控制、故障诊断、集成精度与智能化水平等方面的严峻挑战。

本专栏旨在聚焦光机电一体化领域的前沿进展与创新应用，探讨如何通过多学科交叉与协同优化，突破现有技术瓶颈，提升复杂系统的感知、驱动、控制与执行能力。我们欢迎涉及理论研究、技术突破与典型工程应用的稿件，尤其鼓励以下主题方向的投稿：

- 先进光学系统设计与集成
- 精密机械结构与新型驱动技术
- 光机电系统的多物理场建模、仿真与协同优化方法
- 面向光机电系统的智能感知与精密控制算法
- 光机电系统的智能化与数字孪生技术
- 多学科协同设计方法与系统架构研究
- 光机电系统的精确建模与故障诊断

英文：As smart manufacturing continues to advance, opto-mechatronics—an interdisciplinary field that integrates optics, precision mechanics, electronics and computer science—is becoming the core engine powering high-end equipment, intelligent systems and cutting-edge scientific instrumentation. Its impact is already indispensable in micro/nano manufacturing, aerospace and precision metrology. Yet the high-performance fusion of optical, mechanical and electrical multi-physics domains still poses formidable challenges in system design, dynamic control, fault diagnosis, integration accuracy and intelligence level.

This Special Session aims to spotlight cutting-edge advances and innovative applications in opto-mechatronics, and to explore how multi-disciplinary crossover and cooperative optimization can break current technical bottlenecks and enhance the sensing, actuation, control and execution capabilities of complex systems. We welcome manuscripts related to theoretical research, technological breakthroughs, and typical engineering applications, and particularly encourage submissions in the following thematic areas:

- Advanced optical system design and integration
- Precision mechanisms and novel actuation technologies
- Multi-physics modelling, simulation and co-optimization of opto-mechatronic systems
- Intelligent sensing and precision control algorithms for opto-mechatronic systems
- Intelligence and digital-twin technologies for opto-mechatronic systems
- Multi-disciplinary collaborative design methods and system architectures
- High-fidelity modelling and fault diagnosis of opto-mechatronic systems

Special Session Chair(s):

姓名 Name	田大鹏 (Dapeng Tian)
称谓 Prefix	研究员 (Professor)
部门 Department	动态光学成像与测量全国重点实验室基础研究部 Department of Basic Research, State Key Laboratory of Dynamic Optical Imaging and Measurement
单位 Organization	中国科学院长春光学精密机械与物理研究所 Changchun Institute of Optics, Fine Mechanics and Physics (CIOMP), Chinese Academy of Sciences.
城市/地区 City/Region	长春，中国

Organizer's Brief Biography

中文：

田大鹏研究员是中国科学院长春光学精密机械与物理研究所动态光学成像与测量全国重点实验室基础研究部主任、全国重点实验室副主任、IET Fellow、国家级高层次青年人才、省级领军人才，任中国科学院 B 类先导专项首席科学家。他长期专注于动态光学成像前沿交叉多学科研究工作，尤其在空基光学成像、多物理场表征与识别分析、高精度运动控制、抗干扰控制等领域实现了原创性的理论突破、关键技术推广与应用。

田大鹏研究员在动态光学成像、多物理场仿真与优化、复杂机电系统建模与控制等方面取得了多项突破性研究成果。他主持国家自然科学基金优秀青年基金项目、中国科学院 B 类先导专项、国家重点研发计划青年科学家项目等国家/省部级项目 20 余项。一方面，他提出了跟踪微分器的前馈架构和滑模辅助干扰观测方法，有效提高了运动控制的性能，实现了从应用基础研究到关键技术的突破；另一方面，他提出了面向动态光学成像的多物理场仿真和光学设计新方法，解决了多项高速机载光学成像的技术难题。

英文：

Professor Dapeng Tian is the Director of the Department of Basic Research at the National Key Laboratory of Dynamic Optical Imaging and Measurement, Changchun Institute of Optics, Fine Mechanics and Physics (CIOMP), Chinese Academy of Sciences (CAS), and also serves as the Deputy Director of the National Key Laboratory. He also holds titles such as an IET Fellow, a National High-Level Young Talent, a provincial leading talent, and the chief scientist of Class B Leading Special Projects of CAS. He has long been dedicated to cutting-edge interdisciplinary research in dynamic optical imaging, with notable achievements in original theoretical breakthroughs and technological applications in areas such as space-based optical imaging, multi-physics field characterization and identification analysis, high-precision motion control, and anti-disturbance control.

Professor Dapeng Tian has made multiple breakthroughs in dynamic optical imaging, multi-physics field simulation and optimization, and modeling and control of complex electromechanical systems. He has led over more than 20 national, provincial and ministerial level projects, such as the Outstanding Youth Fund of the National Natural Science Foundation of China, Class B Leading Special Projects of CAS, the National Key R&D Program for Young Scientists. He proposed a feedforward structure for tracking differentiators and a sliding-mode-assisted disturbance observation method, effectively improving the performance of motion control and achieving breakthroughs from basic application research to key technologies. Additionally, he introduced a novel method for multi-physics field simulation and optical design for dynamic optical imaging, addressing several critical technical challenges in high-speed airborne optical imaging.

姓名 **Name**	徐瑞 (Rui Xu)
称谓 **Prefix**	研究员 (Professor)
部门 **Department**	动态光学成像与测量全国重点实验室基础研究部 Department of Basic Research, State Key Laboratory of Dynamic Optical Imaging and Measurement
单位 **Organization**	中国科学院长春光学精密机械与物理研究所 Changchun Institute of Optics, Fine Mechanics and Physics (CIOMP), Chinese Academy of Sciences.
城市/地区 **City/Region**	长春，中国

Organizer's Brief Biography

中文：

徐瑞，博士，中国科学院长春光学精密机械与物理研究所动态光学成像与测量全国重点实验室研究员。入选中国科学院高层次人才计划择优支持、中国科学技术协会青年人才托举工程等人才项目，主要从事光学致动元件的精密控制、物像运动补偿控制理论与应用技术相关的创新研究工作，聚焦于主动光学致动元件的复杂非线性建模与控制、光电系统的精细抗干扰及运动补偿控制等方法研究。

徐瑞研究员系统深入地针对机载光学成像中复杂抗干扰、视轴稳定和像移补偿等问题开展研究，利用压电快速反射镜、压电微扫描平台及可变形快速反射镜等光学致动单元器件，提出了干扰估计与补偿、非光滑控制、力反馈双向控制等先进控制方法。主持国家自然科学基金、中国科学院创新重点部署专项项目、中国科学院 B 类先导专项课题、中国博士后特别资助项目和吉林省自然基金面上项目等纵向项目 10 余项，为新一代动态光学成像装备的研制提供了技术基础。

英文：

Dr. Rui Xu is a professor at the State Key Laboratory of Dynamic Optical Imaging and Measurement, Changchun Institute of Optics, Fine Mechanics and Physics (CIOMP), Chinese Academy of Sciences (CAS). He has been selected into several talent programs, including the Excellence Support Program for High-Level Talents of CAS and the Youth Talent Promotion Project of the China Association for Science and Technology. He is primarily engaged in innovative research on the precision control of optical actuators, object-image motion compensation control theory, and related application technologies. His work focuses on complex nonlinear modeling and control of active optical actuators, as well as fine anti-disturbance and motion compensation control methods for optoelectronic systems.

Professor Rui Xu conducts in-depth research on complex anti-disturbance techniques, line-of-sight stabilization, and image motion compensation in airborne optical imaging. By utilizing unit-level optical actuation devices such as piezoelectric fast steering mirrors, piezoelectric micro-scanning platforms, and fast deformable mirrors, he has developed several advanced control methods, including disturbance estimation and compensation, non-smooth control, and bilateral force feedback control. He has led more than ten scientific research projects, including those funded by the National Natural Science Foundation of China, the Key Deployment Project of Innovation of CAS, the Class-B Leading Special Project of CAS, the Special Funding Project for Chinese Postdoctoral Researchers, and the General Project of the Jilin Provincial Natural Science Foundation. These efforts have laid a technical foundation for the development of a new generation of dynamic optical imaging systems.