2024/02/06

第 117 回　大阪大学工業会機械工学系　技術交流会

― 大学院博士後期課程学生発表会　世界から阪大へ、阪大から世界へ―

【趣旨】

本学機械工学専攻の博士後期課程（ドクターコース）には，国内だけでなく世界各国より若手研究者達が集まり，日々最先端の機械工学研究に励んでいます．今回の技術交流会では，明日の科学技術を担う彼ら若手研究者により，研究の成果と今後の展望，そして研究の根幹にある考えについて発表していただきます．研究テーマは材料検査技術，計測技術から生物工学にいたるまで，多岐にわたります．多くの会員の皆様に積極的にご参加いただき，発表者との意見を交換する機会となれば幸いです．

記

日　時： 2024 年 3 月 1 日（金）13:30　～　15:10

会　場： 大阪大学大学院工学研究科機械工学専攻

対面（M4 棟 2 階 201 講義室）ならびにオンライン（Zoom 配信）のハイブリッド形式

http://www2.mech.eng.osaka-u.ac.jp/access/

----------《スケジュール》----------

13:00～　　開場・受付

13:30～13:35　開会のご挨拶

13:35～13:50　Mingqian Xia 氏（材料評価工学領域　林研究室）
13:50～14:05　Elie Magnon 氏（ナノ加工計測学領域　高谷・水谷研究室）
14:05～14:20　Mona Yadi 氏（ナノ加工計測学領域　高谷・水谷研究室）

14：20～14：35　休憩
14:35～14:50　Yan Zhao 氏（生命機械融合ウェットロボティクス領域　森島研究室）
14:50～15:05　Chao-Shin Hsu 氏（生命機械融合ウェットロボティクス領域　森島研究室）

15：05～15：10　閉会のご挨拶

※講演者はいずれも大阪大学大学院工学研究科博士後期課程に在籍．

以上

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講演者 1：Mingqian Xia 氏（材料評価工学領域　林研究室）
題目：Numerical analysis of the phased array imaging with a stacked plate buffer

概要：This research investigated the imaging with a phased array transducer attaching to a stacked thin plate buffer numerically. The buffer is designed for 16-element phased array transducer to guarantee the performance of phased array transducer when doing the inspection for the high-temperature object. Results of numerical calculation show that the expected functions can be achieved by the buffer in partial conditions. Experiments still need to be conducted in the future work.

講演者 2：Elie Magnon 氏（ナノ加工計測学領域　高谷・水谷研究室）
題目：Toward Industry-Oriented Quantum Imaging with Quantum Ghost Imaging

概要：Quantum Imaging has demonstrated great potential in various applications, including biomedicine, security, and remote sensing, due to its superior sensitivity compared to classical imaging techniques. However, the practical implementation of Quantum Imaging systems in industrial settings remains challenging, primarily due to high noise sensitivity. This study aims to address this issue by focusing on Quantum Ghost Imaging (QGI), which harnesses the spatial correlations between entangled photon pairs to produce images. To enhance usability and user-friendliness, a numerical simulation model was developed as an exploration tool for designing new QGI-based systems. We introduce a novel QGI design and multiple data processing techniques to overcome its main weaknesses, such as long acquisition time and noise sensitivity. These innovative data processing techniques also open the door to specific use cases, such as imaging with a minimum number of photons for light-sensitive materials, as well as to interesting applications like super-resolution microscopy. The methods are validated through simulation results, revealing significant improvements in the imaging capabilities of Quantum Ghost Imaging.

講演者 3：Mona Yadi 氏（ナノ加工計測学領域　高谷・水谷研究室）
題目：Stroboscopic sampling moiré microscope for investigation of QTF’s mechanical properties

概要：Understanding and precisely analyzing the mechanical properties of microelectromechanical systems (MEMS) like comb-drive actuators and quartz tuning forks (QTFs) is crucial for understanding the device functionality and performance. Accurately measuring the dynamic properties of a QTF, for example, can greatly improve the imaging resolution of QTF-based scanning probe microscopy systems. Common methods like nalytical and numerical methods are not accurate and adequate for such measurements. In the case of QTF, analytical methods have the limitation of being based on the double cantilever configuration and numerical methods like the finite element method provide an approximation of the real-world behavior of the system and should always be validated through physical testing. Since investigation of in-plane vibration behavior of MEMS plays a crucial role in understanding and analyzing their dynamics, this study proposes an experimental method to first investigate in-plane vibration behaviors of QTF and then uses its results for measuring QTF’s

mechanical parameters. The developed setup combines stroboscopic and sampling moiré (SM) techniques. A fast-switching power LED and a customized driving circuit generate nanometer-scale optical pulses, resulting in a bandwidth of several megahertz. These light pulses are then applied to a microscope setup and synchronized with the sinusoidal excitation voltage of the QTF controlled by a separate driver. By adjusting the phase of the light pulses and employing image averaging, the high frequency vibration of the QTF is effectively frozen, enabling observation using a standard CCD camera. To extract the full surface profile of the vibrating sensor, the SM analysis technique is employed. Prior to analysis, a sample preparation step involves patterning a periodic microstructure on the vibrating device using electron beam lithography. The analyzed data obtained from the technique is used for the experimental measurement of the dynamic properties of the sensor. This technique can be extended to various micro-devices that are compatible with the sample preparation process.

講演者 4：Yan Zhao 氏（生命機械融合ウェットロボティクス領域　森島研究室）
題目：Wearable Sensor for Plant Monitoring

概要 : In plant, xylem is the tissue that conducts water and minerals upward from root to leaf. Phloem transports the soluble organic compounds (sugar sucrose) made during photosynthates. They are responsible for long transportation in plant. Sap flow measurement is one of the most effective methods for quantifying plant water use. Sap flow sensor can continuously measure sap flow in stem. Though heat-pulse method, we can get plant physiological indicators.

講演者 5：Chao-Shin Hsu 氏（生命機械融合ウェットロボティクス領域　森島研究室）
題目：Mechanical Evaluation System of Microtubules for Enhancing the Contractibility of Biomolecular Artificial Muscle

概要：Currently, biomolecular artificial muscle is facing plentiful challenges, and the role of microtubules is crucial among all the materials in this field from our perspective. The research proposed a system for evaluating the mechanical properties of microtubules like length, orientation, stiffness, etc., which are expected to enhance the contractibility of biomolecular artificial muscle.