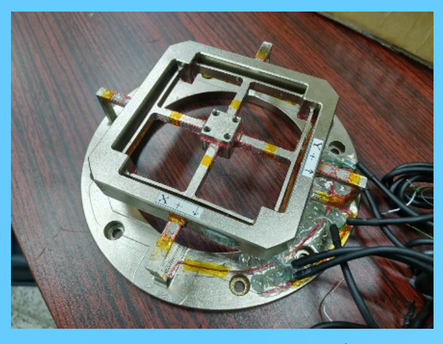
精密機械系統研究室 (PMS Lab)

Precision Machinery Systems Lab

負責老師：王郁仁博士 Dr. Yu-Jen Wang

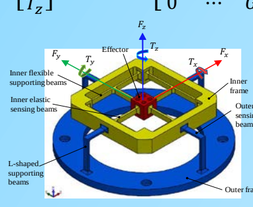
Automation technologies:開發多軸力量感測器、實現工業4.0

- Multi-axis Force and Torque sensor for robot arm 機器手臂多軸力量感測模組

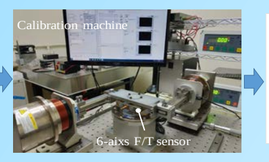


6 and 4-axis force/torque sensors design, Calibration machine

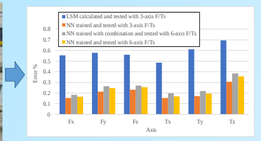
$$\begin{bmatrix} F_x \\ F_y \\ F_z \\ T_z \end{bmatrix} = \frac{1}{4}[\alpha]_{4\times4} \begin{bmatrix} 0 & \cdots & \cdots & \cdots & \cdots & G_{13} & G_{14} & G_{15} & G_{16} \\ G_1 & G_2 & G_3 & G_4 & \cdots & \cdots & \cdots & \cdots & 0 \\ 0 & \cdots & \cdots & G_9 & G_{10} & G_{11} & G_{12} & \cdots & 0 \\ 0 & \cdots & G_5 & G_6 & G_7 & G_8 & \cdots & \cdots & 0 \end{bmatrix}_{4\times16} \begin{bmatrix} \varepsilon_1 \\ \varepsilon_2 \\ \vdots \\ \varepsilon_{16} \end{bmatrix}_{16\times1} + [\beta]_{4\times1}$$



Dual-Frame Force and Torque Sensor, Design and Optimization process



Automatic calibration machine

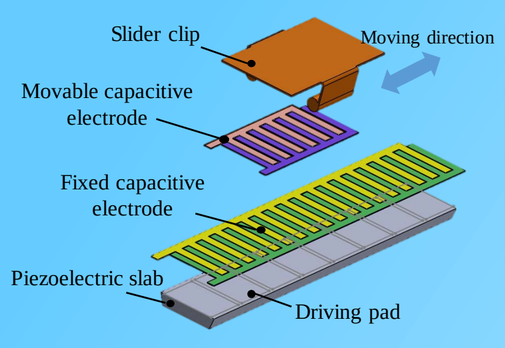


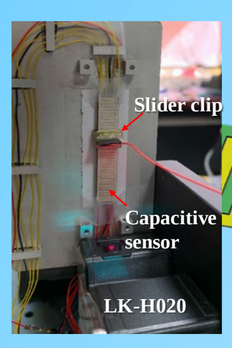
Calibration error of 0.25% from neural network.

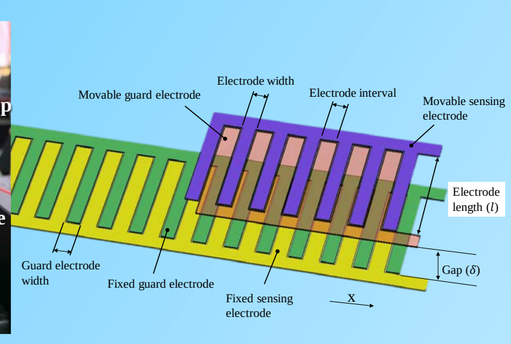
Multi-axis coupling matrix

Robot arm integration

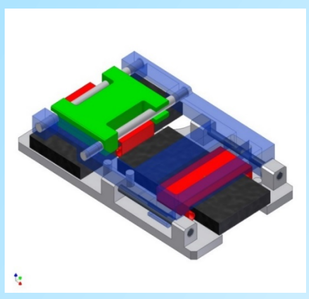
- Piezoelectric actuator 壓電致動器

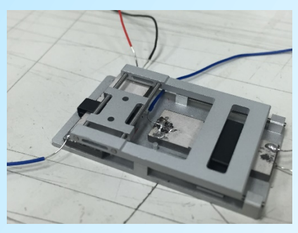


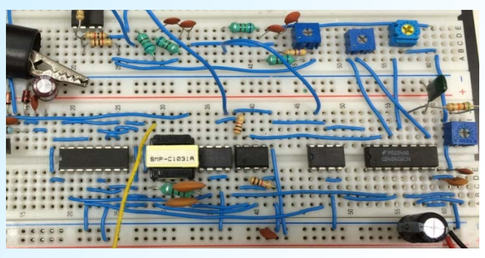




Ultra-long stroke PZT linear actuator and self-positioning



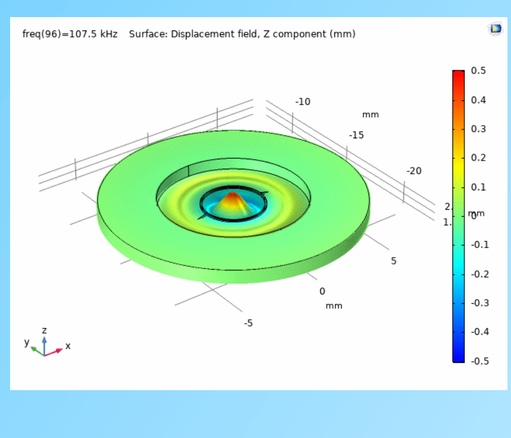




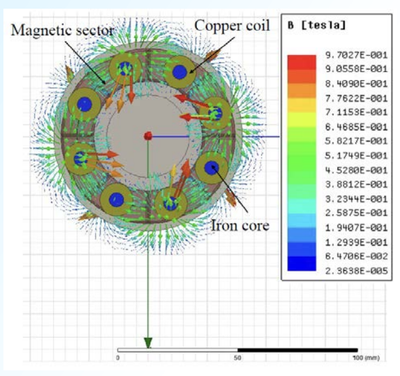
Bi-axis PZT stage and Resonance frequency tracking circuit

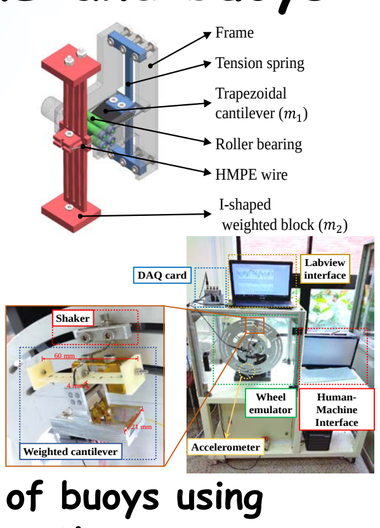
Green energy: 鋰電池粉體製造、免電池裝置

- PZT vibrator and mesh plate for aerosol atomizing



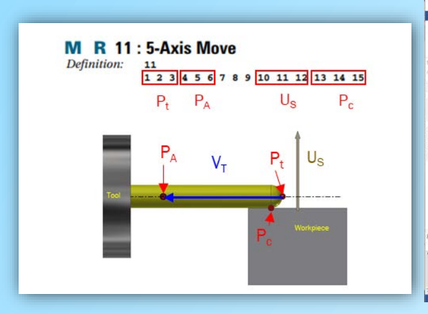
- Energy harvester for TPMS and buoys

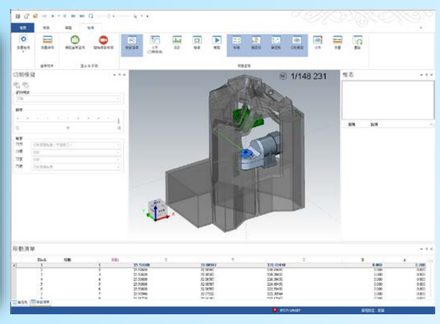




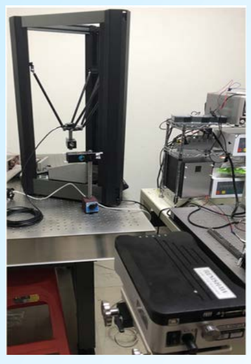
Enhancement of rolling energy conversion of buoys using eccentric rotors. PZT energy harvester for tire pressure sensor.

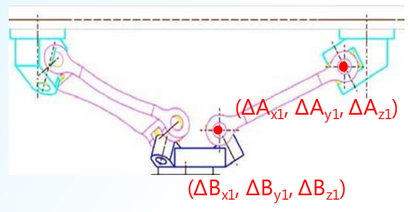
Precision machines: 定位精度智慧校正、力量控制



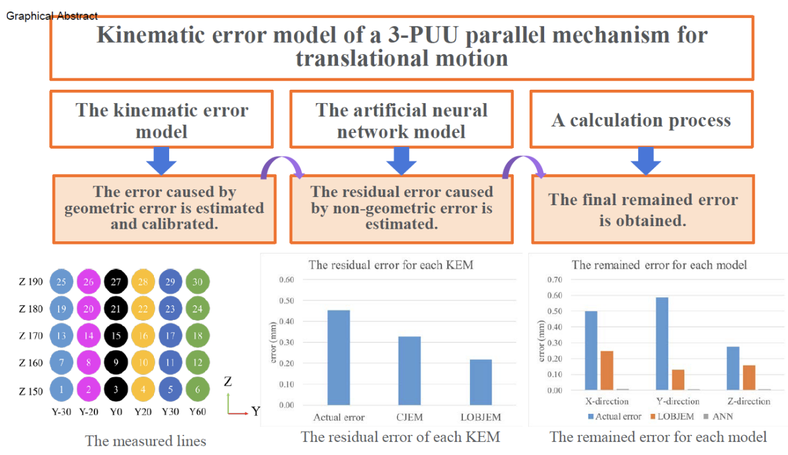


CAM post processor from NCI to G-code.

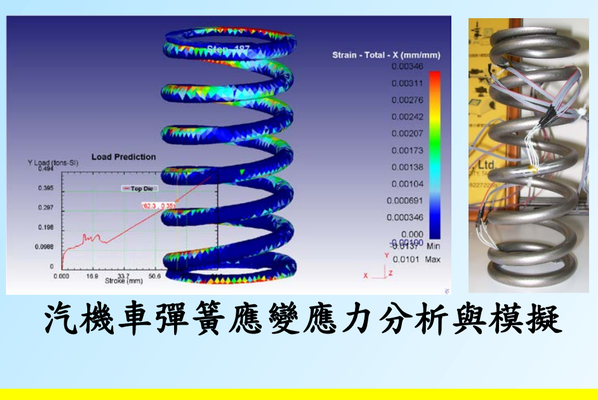




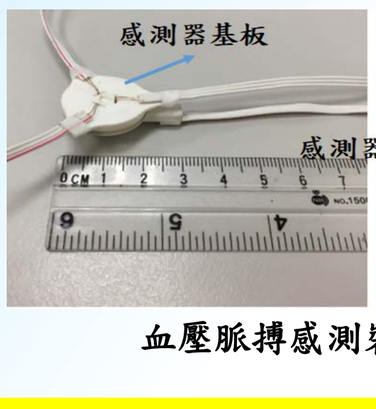
PUU mechanism calibration.

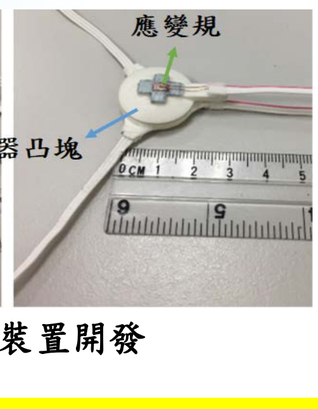


Industry service: 產學合作、協助建立分析與研發能力



汽機車彈簧應變應力分析與模擬





血壓脈搏感測裝置開發

- Dynamics analysis
- F/T sensor design
- Precision stage design
- Actuator design

- 培養學生實務型研究技術開發能力
- 深耕精密機電系統專業技術
- 前瞻工業與產品應用作為研究方向

感謝各單位對於研究的支持

- 國科會、工業技術研究院、壹久科技、全立衡器、闔康生物科技、金屬中心、向騰科技、誠芳太陽能、上銀科技、國家實驗研究院……等。

研究方向說明

- 王郁仁老師與研究生致力於動態系統開發，核心技術包含機構設計、機電整合、壓電致動器與多軸力量感測器，透過實務型研究題目培養學生機電系統設計與分析能力，鼓勵同學提出自己的創見解決研究時所遭遇的問題。

Biography: Yu-Jen Wang was born in Tainan, Taiwan, in 1977. He received his Ph.D. from Department of Power Mechanical Engineering at National Tsing Hua University, Taiwan, in 2011. He served as a Manager (2003 to 2012) in the Micro Systems Technology Center, Industrial Technology Research Institute (ITRI), Taiwan, where he led a worldwide group working on advanced actuator systems, coordinating efforts for two product lines. Currently, he is an assistant professor of Mechanical and Electromechanical Engineering Department, National Sun Yat-sen University, Taiwan. His major research interests include machine dynamics, actuator design and energy harvesters. Prof. Wang was the recipient of the 2012 CIEE Outstanding Youth Electrical Engineer Award; the 2014, 2015 and 2017 MOST Best Project Poster Award; the 2012 MOEA Excellent Achievement Project Award; and 2010 National Invention Silver Medal Award. He was the Track Co-Chair of the 2016 ASME ISPS and IoT conference in Santa Clara, CA, USA.

Education/Qualifications

2007-2011 Dept. of Power Mechanical Engineering, National Tsing Hua University, Dr. of Engineering.
2000-2002 Dept. of Power Mechanical Engineering, National Tsing Hua University, M. D.

Employment to Date/Work Experience

July 2017-present Dept. of Mechanical and Electromechanical Engineering, National Sun Yat-sen University, Associate professor
Aug. 2014-July2017 Dept. of Mechanical and Electromechanical Engineering, National Sun Yat-sen University, Assistant professor
Aug. 2013-July 2014 Dept. of Mechanical Engineering, National Taipei University of Tech., Assistant professor.
Aug. 2012-July 2013 Dept. of Computer-aid Engineering, National Formosa University, Assistant professor.
Jan. 2003-July 2012 Microsystems Tech. Center, Industrial Technology Research Institute (ITRI), Department Manager.

Research and professional experience

Mar.-Dec. 2008 Carnegie Mellon University (Penn. state USA), Visiting Researcher.

Awards

2020 Future Tech. Taiwan Award
2019 S&A Outstanding contribution in reviewing
2018 NSYSU Best Teachers
2017 Young scholar award of TCUS
2017 CSME Kaohsiung branch, Outstanding Youth Mechanical Engineer Award
2017 IEEE ICASI 2017 First Prize Paper Award
2016 IEEE ICASI 2016 Best Paper Award
2015 MOST Best Project Poster Award

指導學生與服務獲獎

2021萬潤創新創意競賽 碩博士論文組佳作 羅宇然同學
2020 中國機械工程學會 碩士論文佳作 何杰霖同學
2020 中華民國機構與機器原理學會碩士論文優等獎
2019 指導鄭軻陽等同學 榮獲108年中山大學跨領域工程專題競賽-工程創新組金牌獎 風力攀牆機器人
2017 第三屆旭泰科技論文銀研獎
2017 程泰工具機專題實作競賽優等(第一名)
2017 IEEE ICASI 2017 First Prize Paper Award
2015 中山大學「跨領域工程專題競賽與成果展」銀牌

Selected journal publications (2017-2022)

1. J. D. Ke, **Y. J. Wang*** and J. C. Tsai, "Kinematic error model of a 3-PUU parallel mechanism for translational motion," *Measurement*, 202 (2022) 111853. (SCI, IF= 5.6, Instruments & Instrumentation: 9/63)
2. **Y. J. Wang***, R. Y. Huang, C. Y. Sue and Yeng-Tseng Wang, "Triaxis Static Force Sensing for Langevin-Type Ultrasonic Tools Using Lead-Zirconate-Titanate Ceramic Rings," *IEEE Sensors Journal*, 21 20 (2021), pp. 22518-22526.
3. **Y. J. Wang***, J. L. Ho and Y. B. Jiang, "A self-positioning linear actuator based on a piezoelectric slab with multiple pads," *Mechanical Systems and Signal Processing*, 150 (2021), 107245. (SCI, IF= 8.9, Engineering, Mechanical: 4/137).
4. **Y. J. Wang***, C. W. Hsu and C. Y. Sue, "Design and Calibration of a Dual-Frame Force and Torque Sensor," *IEEE Sensors Journal*, 20 20 (2020) pp. 12134-12145.
5. C. Lee and **Y. J. Wang***, "Development of a cloud-based IoT monitoring system for fish metabolism and activity in aquaponics," *Aquacultural Engineering*, 90 (2020) 102067.
6. **Y. J. Wang***, C. Yang, C. Y. Sue and Y. T. Wang, "Analysis of a 0.1-μm stepping bi-axis piezoelectric stage using a 2-DOF lumped model," *Microsystem Technologies*, 26 (2020) pp. 425-436.
7. **Y. J. Wang*** and C. K. Lee, "Dynamics and power generation of wave energy converters mimicking biaxial hula-hoop motion for mooring-less buoys," *Energy*, 185 15 (2019) pp. 547-560.
8. **Y. J. Wang***, T. Y. Chuang and C. Lee, "Resonant frequency self-tunable piezoelectric cantilevers for energy harvesting and disturbing torque absorbing," *Sensors and Actuators A: Physical*, 285 1 (2019) pp. 25-34.
9. **Y. J. Wang***, C. H. Chen, C. Y. Sue, W. H. Lu and Y. H. Chiou, "Estimation of blood pressure in the radial artery using strain-based pulse wave and photoplethysmography sensors," *Micromachines*, 9 11 (2018) pp. 556.
10. **Y. J. Wang*,** T. Y. Chuang and J. H. Yu, "Design and Kinetic Analysis of Piezoelectric Energy Harvesters with Self-adjusting Resonant frequency," *Smart Materials and Structures*, 26 1 (2017) 095027.