

# 精密機械系統研究室 (PMS Lab) Precision Machinery Systems Lab

負責老師：王郁仁 Yu-Jen Wang

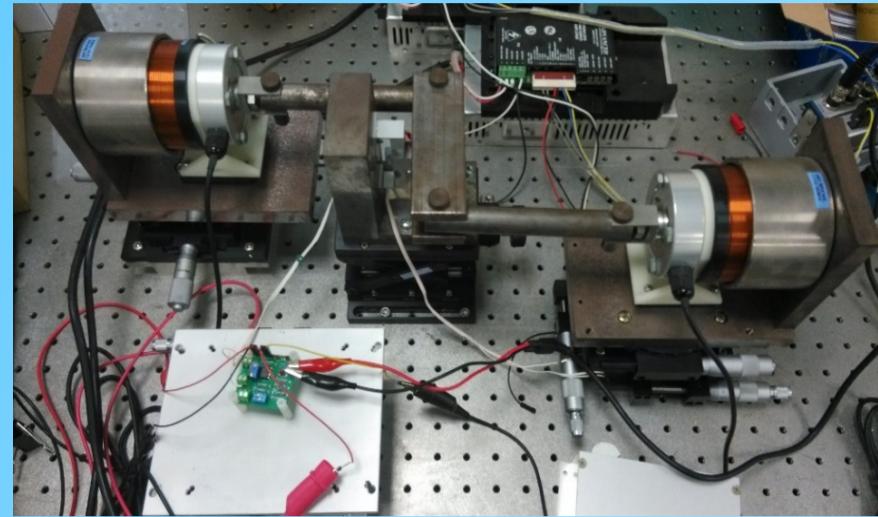


## Automation technologies: 實現自動化組裝、邁向工業4.0

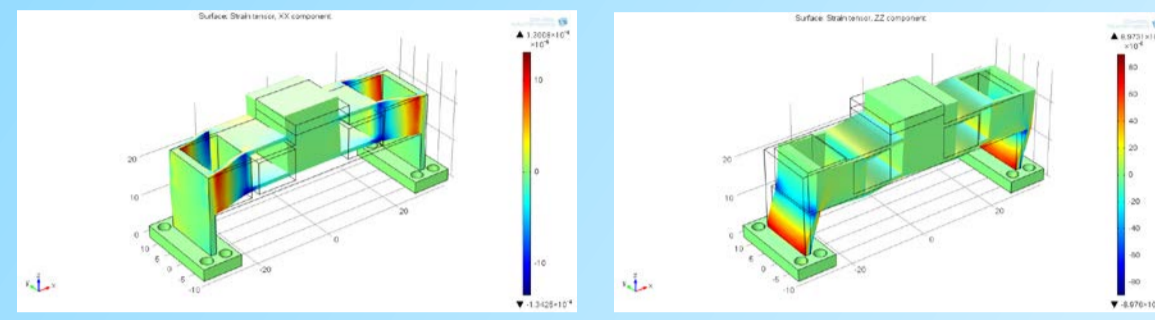
- Force sensor for robot arm 機器手臂力量感測模組



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



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

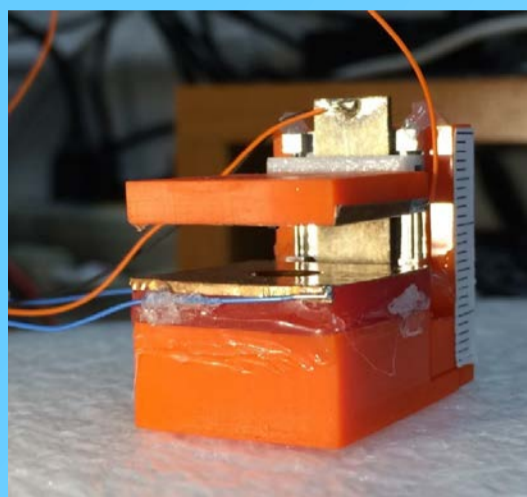


Multi-axis coupling matrix

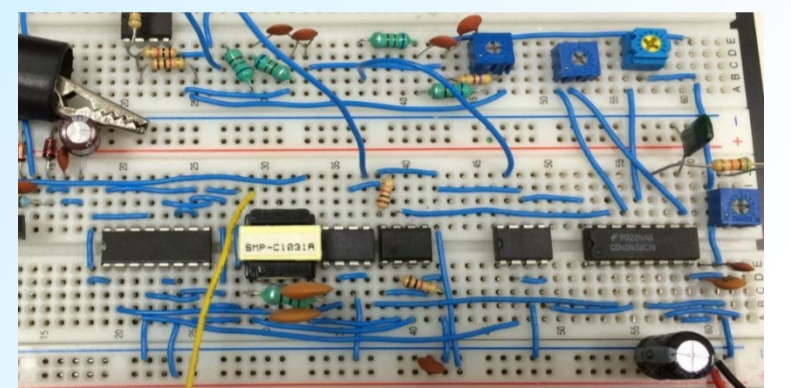
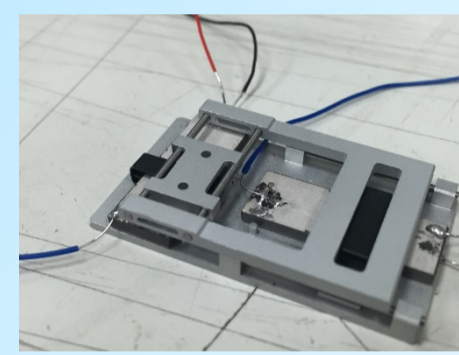
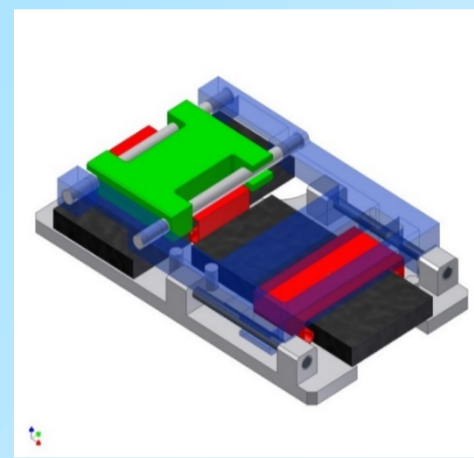
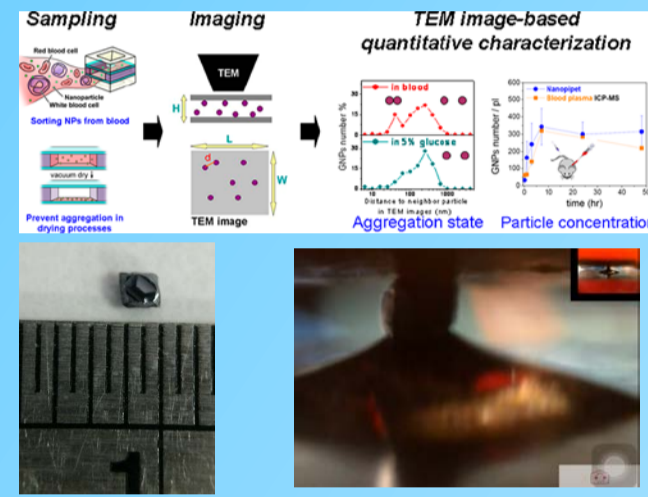


Robot arm integration

- Fast assembly stage 快速組裝定位平台



Piezo stage for pico-liter liquid feeding using capillarity force



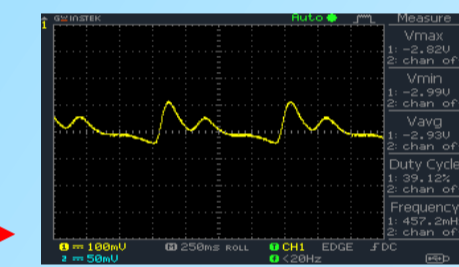
Bi-axis PZT stage and Resonance frequency tracking circuit

## Medical devices: 銀髮族照護、智慧型手錶血壓脈搏監控

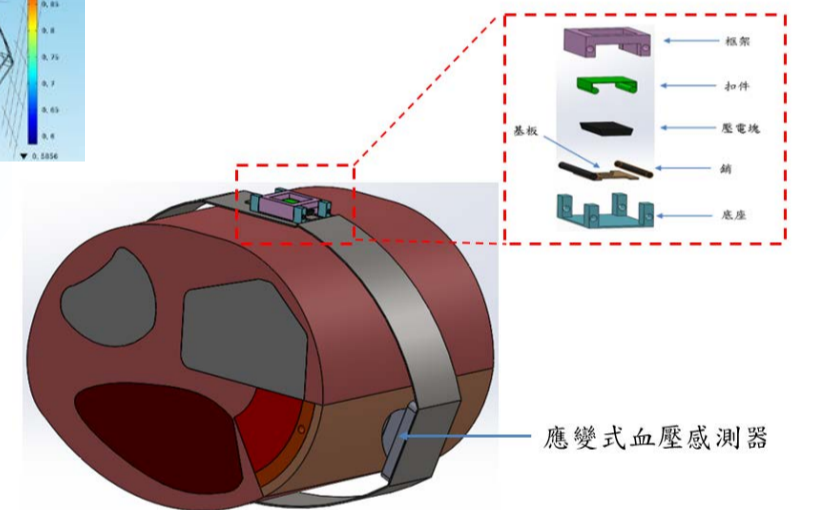
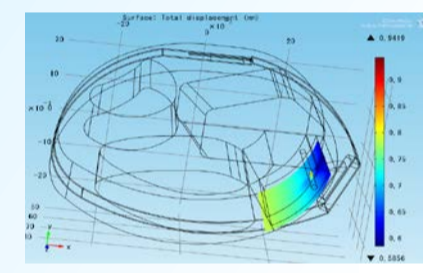
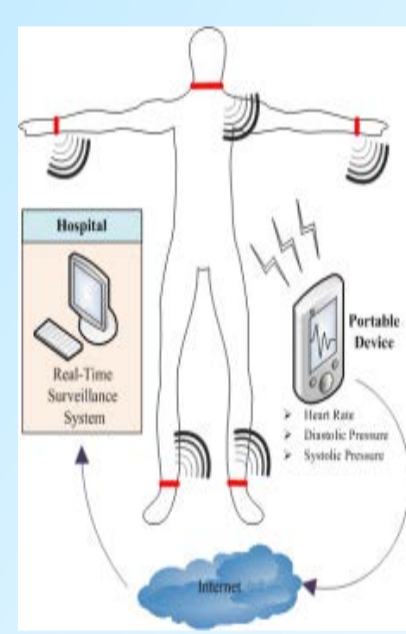
- Watch type manometer using sphygmus strain 應變型血壓計，實現智慧型手錶血壓監控功能



SBP,DBP (收縮壓與舒張壓)

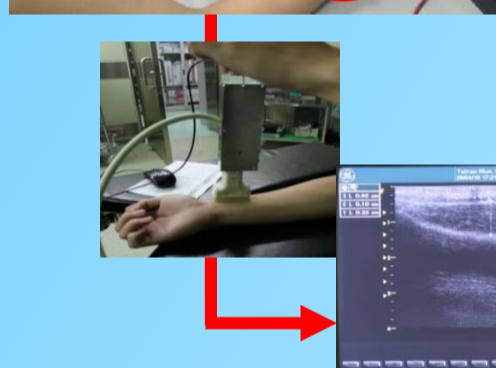


Strain signals of strain sensor

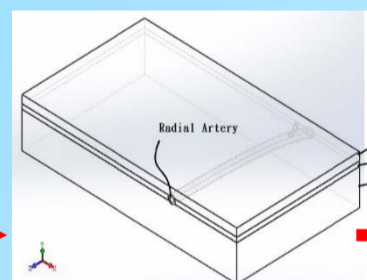


應變式血壓感測器

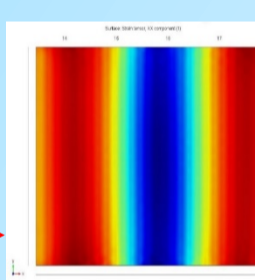
Scenarios and adjustable watchband for strain-type wrist manometers



Skin-vessel model



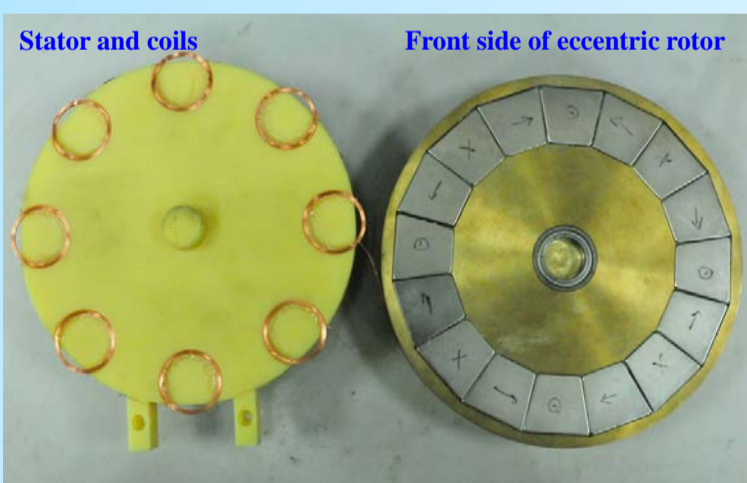
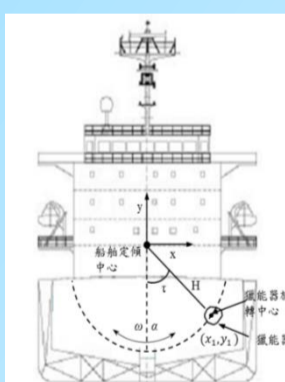
Finite element model



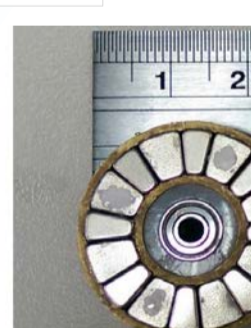
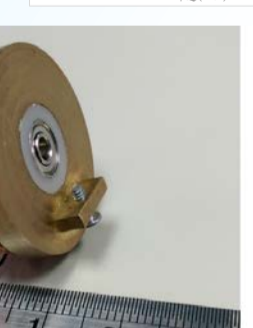
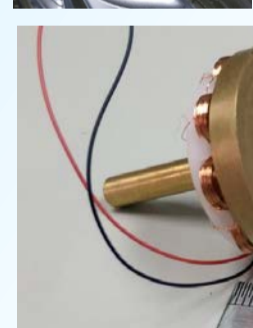
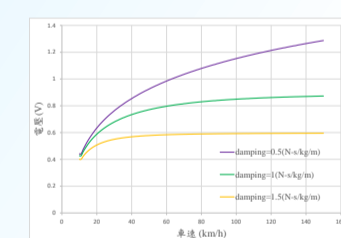
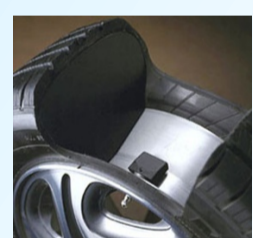
Strain map

Blood Pressure

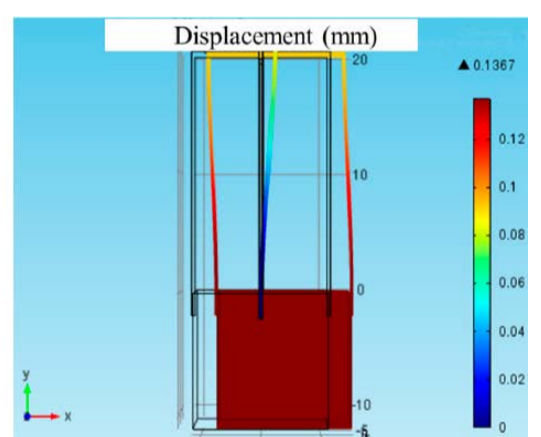
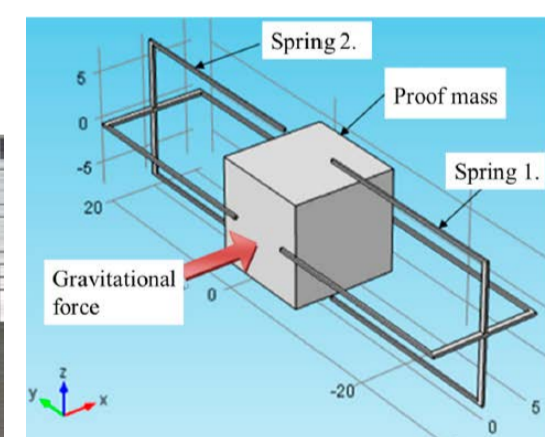
## Green energy: 能量擷取技術於船體動能轉換與感測器供電



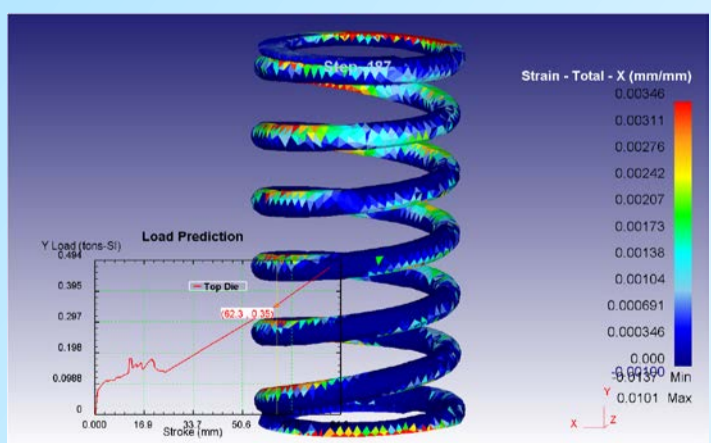
Enhancement of rolling energy conversion of boats using eccentric rotors



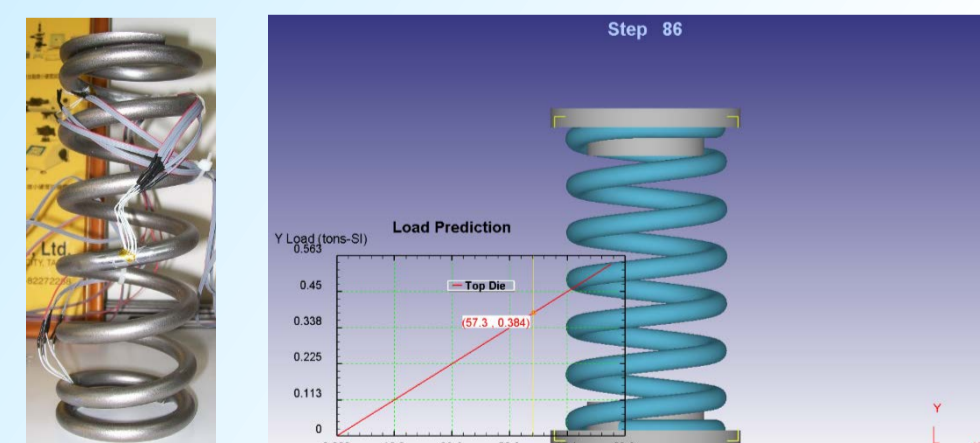
Nonlinear spring and rotor types energy harvester for TPMS, Prototypes



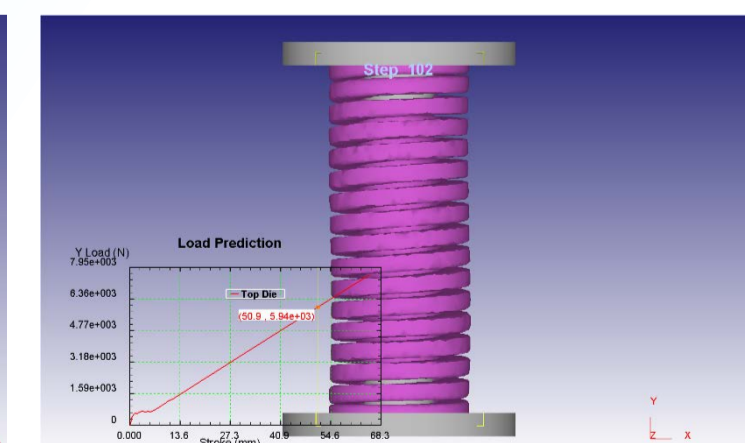
## Industry service: 產學合作、協助建立分析與研發能力



汽機車彈簧應變應力分析與模擬



異型彈簧設計與剛性分析



- Dynamics analysis
- Solid mechanism
- 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

### 合作對象

- 科技部、工研院、斯特樂科技、闔康生物科技、金屬中心、向騰科技、誠芳太陽能、上銀科技.....持續增加中

# 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、壓電致動器與控制電路，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-July 2017 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

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  
2014 MOST Best Applied Project Poster Award  
2012 The Chinese Institute of Electrical Engineering: Outstanding Youth Electrical Engineer Award

## 指導學生與服務獲獎

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  
2017 SPINTECH Technology Thesis Award  
2017 中山大學工學院優良導師獎  
2016 大專院校智動化設備創作佳作獎  
2016 科技部應用型產學計畫海報展示優良獎  
2015 中山大學「跨領域工程專題競賽與成果展」銀牌

## Selected journal publications (2013-2017)

1. **Y. J. Wang\***, C. Lee, Y. B. Jiang, K. C. Fu, "Design and dynamic analysis of a piezoelectric linear stage for pipetting liquid samples", *Smart Materials and Structures*, 26 6 (2017) 065004
2. **Y. J. Wang\***, T. Y. Chuang, J. H. Yu, "Design and Kinetic Analysis of Piezoelectric Energy Harvesters with Self-adjusting Resonant frequency", *Smart Materials and Structures*, 26 9 (2017) 095037
3. C. Lee\*, **Y. J. Wang**, "Psychrometer based on a contactless infrared thermometer with a predictive model for water evaporation", *Biosystems Engineering*, 160 (2017) 84-94
4. **Y. J. Wang\***, T. Y. Chen, M. C. Tsai and C. H. Wu, "Noninvasive blood pressure monitor using strain gauges, a fastening band, and a wrist elasticity model", *Sensors and Actuators A*, 252(1) (2016) 198-208.
5. **Y. J. Wang\***, J. H. Yu, "Enhancement of rolling energy conversion of a boat using an eccentric rotor revolving in a hula-hoop motion", *Ocean Engineering*, 116 (2016) 21-31.
6. **Y. J. Wang\***, K. C. Fu, C. C. Wang, "A Smart Pinless Ejection Mechanism Using Dual-Resonance Excitation Langevin Piezoelectric Transducers", *Smart Materials and Structures*, 25 1 (2015) 015014.
7. **Y. J. Wang\***, C. D. Chen and Chien Li, "Design and analysis of a compact synthetic-jet-based air pump for large airflow", *Microsystem Technologies*, DOI 10.1007/s00542-014-2257-x (2014).
8. **Y. J. Wang\***, C. D. Chen and C. K. Sung, "System design of a weighted-pendulum type electromagnetic generator for harvesting energy from a rotating wheel", *IEEE/ASME Transactions on Mechatronics*, 18, 2 (2013) 754-763.
9. **Y. J. Wang\*** and C. D. Chen, "Design and jump phenomenon analysis of an eccentric ring energy harvester", *Smart Mater. Struct.*, 22, 10 (2013) 105019.