# *Resume*


# Zhipeng Wu 吴志鹏

✉ Email: whuwuzhipeng@163.com

Academic page: https://whu-wzp.github.io/wzpacademicpages.github.io


## Research Interests

The design and application of piezoelectric MEMS devices.

The design and realization of sensor system for IOT.

The fusion of robot and sensor.

## Education

2019.09 ~ 2022.06: Wuhan University, China

Major: Mechatronic Engineering

Degree: Ph.D.

2012.09 ~ 2016.06: Wuhan University, China

Major: Mechanical Design and Automation

Degree: Bachelor of Engineering

2016.09 ~ 2019.06: Wuhan University, China

Major: Mechanical Manufacture and Automation

Degree: Master of Science

## Research Experience

**Ph.D. dissertation: Research on AlN-based Piezoelectric Micromachined Ultrasonic Transducer and the Range-finding System (Supervisor: Professor Chengliang Sun and Liang Lou)**

This research is focus on the development of ultrasonic range-finding sensor based on the AlN PMUTs and the fusion of robot and MEMS sensor. The main content of this dissertation is as follows:

**1. The influence of ringdown on AlN PMUTs and the strategy for suppressing ring-down:**

(1) The method of adjusting the characteristics of AlN PMUTs through the DC bias voltage is proposed, and the effects of DC bias voltage on characteristics for AlN PMUTs are investigated.

(2) A novel ring-down suppression system based on transfer function is proposed to suppress the ring-down time and decrease the blind area of PMUTs.

**2.The design of an ultrasonic range-finding system based on AlN PMUTs:**

(1) Designed an ultrasonic range-finding sensor based on AlN PMUTs, which is mounted on FPCB and can be applied on the surface of UR3 manipulator.

(2) Built the scheme of the range-finding system and designed the digital signal processing program through LabVIEW.

(3) Realized ultrasonic writing in a two-dimensional plane based the proposed ultrasonic range-finding system.

**3.The design of a human-robot interaction system based on AlN PMUTs and the UR3 manipulator:**

(1) Built the scheme of the human-robot interaction system based on the UR3 manipulator and the above ultrasonic range-finding sensor.

(2) Gesture recognition is demonstrated through this system, then this information can control the motion of UR3 manipulator through ROS.

(3) The built human-robot interaction system can realize gesture tracking and obstacle avoidance.

**Other research experiences during Ph.D.:**

1. Designed and developed an ultrasonic proximity sensing skin for robot safety control based on PMUTs.
2. Designed a PMUTs based on piston mode.
3. Designed a broadband PMUTs with a resonant cavity.

**The research experiences when working in Shanghai Industrial μTechnology Research Institute:**

1. Designed and developed a miniaturized transit-time ultrasonic flowmeter based on ScAlN PMUTs for small-diameter applications.
2. Designed and developed a high-sensitivity bowel sound electronic monitor based on PMUTs.
3. Designed and developed a high sensitivity AlN-based MEMS hydrophone for pipeline leak monitoring.
4. Designed and developed an ultrasonic target detection system based on PMUTs.
5. Designed and developed a high-sensitivity MEMS accelerometer using the $Sc_{0.8}Al_{0.2}N$-based four beam structure.
6. Designed and developed an acoustic localization sensor based on MEMS microphone array for partial discharge.

**The research experiences during Master of Science:**

1. Designed a new self-adjusting support structure for the in-pipe robot to improve its motion ability in different pipe condition especially in vertical pipe.
2. Proposed a hierarchical fuzzy controller for the above robot, which can be utilized to implement autonomous movement in the pipe.

## Work Experience

**Shanghai Industrial μTechnology Research Institute (SITRI)** (2022.06~2023.06)

Position: trainee, MEMS engineer, product development manager

**The work during trainee:**

1. An ultrasonic range-finding system is designed based on AlN PMUTs, which can realize ultrasonic writing and gesture recognition.
2. The ultrasonic range-finding system based on AlN PMUTs is combined with the UR3 manipulator based on ROS to realize the human-robot interaction between humans and collaborative robots. The experimental results show that the built human-robot interaction system can realize gesture tracking and obstacle avoidance.

**The work during MEMS engineer:**

1. The design, simulation and measurement of piezoelectric MEMS devices, especially PMUT, microphone, accelerometer, hydrophone, SAW and etc.
2. The development of sensor based on piezoelectric MEMS devices, such as ultrasonic flowmeter, bowel sound electronic monitor, MEMS hydrophone and accelerometer for pipeline leak monitoring, ultrasonic target detection system based on PMUTs, acoustic localization sensor for partial discharge.

**The work during product development manager:**

(In this time, our department was separated from SITRI and established Shanghai XinQing Technology Ltd.)

1. Participated the technical proposal for the first sensor product (a noise logger for pipe leak detection), and collaborated with engineers to complete this product.
2. Signal processing and analysis for the noise logger and hydrophone.
3. Built the leak detection and location algorithm for noise logger and hydrophone. Several algorithms have been development, which can be applied in the MCU of noise logger or the server of website. The effect of the leak detection algorithm applied in the MCU of noise logger is similar to the current mature products. And the algorithms applied in the server of website can provide more accurate water leakage analysis.
4. The analysis and writing of patent.

## Funding & Honors

**Funding:**

2022.09~2023.07: As an algorithm engineer of “The pressure and leakage monitoring project of a long-distance pipeline in Inner Mongolia”(内蒙某长输管线压力与漏损监测项目), total research expenditure: RMB 2 million.

2021.01~2022.06: As a team member of “The crucial technology and platform of MEMS piezoelectric film and device based on Silicon”(硅基 MEMS 压电薄膜及器件关键技术与平台), **National Key Research and Development Program of China**, total research expenditure: RMB 45 million.
2020.07~2021.09: As a team member of “The development and industrialization of AlN MEMS acoustic sensor chip for IOT”(面向物联网的压电氮化铝 MEMS:声学传感器芯片与工艺平台开发与产业化), total research expenditure: RMB 0.3 million.
2019.07~2022.06: As a team member of “The crucial technology of portable blood cell separator”(便携式血细胞分离技术与装置), total research expenditure: RMB 20 million.
2019.3~2020.1: As a team member of “Research on the development of high performance RF filter”(高性能滤波器发展方向研究), total research expenditure: RMB 0.3 million.
2016.08~2019.01: As a team leader of “The development of in-pipe ultrasonic detection robot with video monitoring”(融合视频监测的锅炉管道内超声检测机器人的研发), total research expenditure: RMB 0.14 million.
2014.03~2016.06: As a team member of “The nondestructive testing robot based on ultrasonic guided wave measurement technology”(基于超声导波检测技术的无损检测机器人), total research expenditure: RMB 0.5 million.

**Honors:**
Nov. 2018 acquired **National Scholarship** (The award ratio is only 0.2% every year in China).
Aug. 2018 acquired **First Prize** in The 13th China Postgraduate Electronic Design Competition (Team leader).
Aug. 2017 acquired Second Prize in The 12th China Postgraduate Electronic Design Competition (Team leader).
Dec. 2017 acquired outstanding Postgraduate of Wuhan University.
Dec. 2018 acquired outstanding Postgraduate of Wuhan University.
Dec. 2020 acquired outstanding Postgraduate of Wuhan University.

## Publications

Paper:
1. Zhipeng Wu, Wenjuan Liu, Zhihao Tong, Yao Cai, Chengliang Sun and Liang Lou, “Tuning Characteristics of AlN-Based Piezoelectric Micromachined Ultrasonic Transducers Using DC Bias Voltage”, *IEEE Transactions on Electron Devices*, vol. 69, no. 2, pp. 729-735, Feb. 2022, doi: 10.1109/TED.2021.3137766.
2. Yunfei Gao, Minkan Chen, Zhipeng Wu, Lei Yao, Zhihao Tong, Songsong Zhang, Yuandong Alex Gu and Liang Lou, “A Miniaturized Transit-Time Ultrasonic Flowmeter based on ScAlN Piezoelectric Micromachined Ultrasonic Transducers for Small-Diameter Applications”, *Microsystems & Nanoengineering*, vol. 9, no. 1, p. 49, doi: 10.1038/s41378-023-00518-y.
3. Yunfei Gao, Zhipeng Wu, Minkan Chen and Liang Lou, “A Miniaturized Transit-Time Ultrasonic Flowmeter Using PMUTS for Low-Flow Measurement in Small-Diameter Channels”, *2023 IEEE 36th International Conference on Micro Electro Mechanical Systems (MEMS)*, Munich, Germany, 2023, pp. 115-118, doi: 10.1109/MEMS49605.2023.10052185.
4. Zhihao Tong, Haiyan Hu, Zhipeng Wu, Shuxin Xie, Guodong Chen, Songsong Zhang, Liang Lou and Huicong Liu, “An Ultrasonic Proximity Sensing Skin for Robot Safety Control by Using Piezoelectric Micromachined Ultrasonic Transducers (PMUTs)”, *IEEE Sensors Journal*, vol. 22, no. 18, pp. 17351-17361, 15 Sept.15, 2022, doi: 10.1109/JSEN.2021.3068487.
5. Lei Wang, Wei Zhu, Zhipeng Wu, Wenjuan Liu and Chengliang Sun, “A Novel Coupled Piezoelectric Micromachined Ultrasonic Transducer Based on Piston Mode”, *IEEE Transactions on Ultrasonics, Ferroelectrics, and Frequency Control*, vol. 68, no. 11, pp. 3396-3405, Nov. 2021, doi: 10.1109/TUFFC.2021.3090043.
6. Wei Zhu, Lei Wang, Zhipeng Wu, Wenjuan Liu and Chengliang Sun, “Broadband Piezoelectric Micromachined Ultrasonic Transducer with a Resonant Cavity”, *IEEE Transactions on Ultrasonics, Ferroelectrics, and Frequency Control*, vol. 69, no. 1, pp. 340-349, Jan. 2022, doi: 10.1109/TUFFC.2021.3119669.

7. Zhipeng Wu, Wenjuan Liu, Zhihao Tong, Songsong Zhang, Yuandong Gu, Guoqiang Wu, Alexander Tovstopyat, Chengliang Sun, and Liang Lou, "A Novel Transfer Function Based Ring-Down Suppression System for PMUTs," *Sensors*, vol. 21, no. 19, p. 6414, Sep. 2021, doi: 10.3390/s21196414.
8. Zhipeng Wu, Yao Wu, Siyu He and Xiaohui Xiao, "Hierarchical fuzzy control based on spatial posture for a support-tracked type in-pipe robot", *Transactions of the Canadian Society for Mechanical Engineering*, vol. 44, no. 1, pp. 133-147, 2019, doi: 10.1139/tcsme-2018-0052.
9. Xiaoxia Ding, Zhipeng Wu, Mingze Gao, Minkan Chen, Jiawei Li, Tao Wu and Liang Lou , "A High-Sensitivity Bowel Sound Electronic Monitor Based on Piezoelectric Micromachined Ultrasonic Transducers," *Micromachines*, vol. 13, no. 12, p. 2221, Dec. 2022, doi: 10.3390/mi13122221.
10. Jiaming Yan, Caihui Chen, Zhipeng Wu, Xiaoxia Ding and Liang Lou, "An Acoustic Localization Sensor Based on MEMS Microphone Array for Partial Discharge", *Sensors*, vol. 23, no. 3, p. 1077, Jan. 2023, doi: 10.3390/s23031077.
11. Baoyu Zhi, Zhipeng Wu, Caihui Chen, Minkan Chen, Xiaoxia Ding and Liang Lou, "A High Sensitivity AlN-Based MEMS Hydrophone for Pipeline Leak Monitoring", *Micromachines*, vol. 14, no. 3, p. 654, Mar. 2023, doi: 10.3390/mi14030654.
12. Mingze Gao, Zhihao Tong, Zhipeng Wu and Liang Lou, "An Ultrasonic Target Detection System Based on Piezoelectric Micromachined Ultrasonic Transducers", *Micromachines*, vol. 14, no. 3, p. 683, Mar. 2023, doi: 10.3390/mi14030683.
13. Zhenghu Zhang, Linwei Zhang, Zhipeng Wu, Yunfei Gao and Liang Lou, "A High-Sensitivity MEMS Accelerometer Using a Sc0.8Al0.2N-Based Four Beam Structure", *Micromachines*, vol. 14, no. 5, p. 1069, May 2023, doi: 10.3390/mi14051069.

Patent:
1. Chengliang Sun, Zhipeng Wu, Lei Wang, Wei Zhu, Bohao Hu, Binghui Lin, Huihua Zhan, A MEMS piezoelectric Ultrasonic Transducers with pipe(一种具有声管的 MEMS 压电超声换能器), Patent number: ZL201911154366.3.
2. Chengliang Sun, Zhipeng Wu, Wei Zhu, Lei Wang, Bohao Hu, Binghui Lin, Huihua Zhan, A MEMS piezoelectric Ultrasonic Transducers with trumpet structure(一种具有喇叭结构的 MEMS 压电超声换能器), Patent number: ZL201911156019.4.
3. Chengliang Sun, Lei Wang, Zhipeng Wu, Wei Zhu, Bohao Hu, Binghui Lin, Huihua Zhan, A MEMS piezoelectric Ultrasonic Transducers based on Piston-mode and mass proof which can change its resonant frequency(一种基于 Piston-mode 的带质量负载可调谐 MEMS 压电声换能器), Patent number: ZL201911140181.7.
4. Chengliang Sun, Bohao Hu, Zhipeng Wu, Lei Wang, Binghui Lin, Wei Zhu, Huihua Zhan, A high-sensitivity vibration sensor(一种高灵敏度的振动传感器), Patent number: ZL202010027154.5.
5. Chengliang Sun, Bohao Hu, Zhipeng Wu, Binghui Lin, Wei Zhu, Lei Wang, Yu Zhou, A high-sensitivity MEMS microphone(一种高灵敏度 MEMS 压电式麦克风), Patent number: ZL201910799686.8.
6.Chengliang Sun, Lei Wang, Zhipeng Wu, Wei Zhu, Bohao Hu, Binghui Lin, Huihua Zhan, A Piezoelectric Micromachined Ultrasonic Transducers based on the couple of vibration film(基于多振膜耦合的压电微机械超声换能器), Patent number: ZL 202011485094.8.
7. Chengliang Sun, Wei Zhu, Zhipeng Wu, Lei Wang, Binghui Lin, Bohao Hu, A MEMS Ultrasonic Transducers with high emit preference(高发射性能的 MEMS 超声换能器), Patent number: ZL202110034536.5.
8. Xiaohui Xiao, Zhipeng Wu, Xiao Chen, Haodong Shao, An in-pipe leakage flux measurement machine which can change its diameter(一种可变直径的管道内漏磁检测装置), Patent number: ZL201810391436.6.
9. Xiaohui Xiao, Zhipeng Wu, Haiyan Hu, A modularized support-tracked type in-pipe robot(一种模块化支撑履带式管道内机器人), Patent number: ZL201811277390.1.
10. Xiaohui Xiao, Xiao Chen, Zhipeng Wu, Taohan Wang, Weining Wang, Jiangkun Guo, A support-type in-pipe robot which can adapt different diameter of pipe(一种柔性自适应的支撑式管道内检测机器人), Patent number: ZL

201610049434.X.

11. Liang Lou, Zhipeng Wu, Shuai Huang, Zhihao Tong, Yuandong Gu, A human-machine interaction system and method based on Piezoelectric Micromachined Ultrasonic Transducers(基于压电微机械超声换能器的人机交互系统及方法), Patent number: CN202111011781.0.

12. Liang Lou, Zhipeng Wu, Zhihao Tong, Yang Liu, Songsong Zhang, A 3D pen-type interaction system and method based on Piezoelectric Micromachined Ultrasonic Transducers(基于压电微机械超声换能器的三维笔式交互系统及方法), Patent number: CN202111014198.5.

13. Liang Lou, Zhipeng Wu, Shuai Huang, Linwei Zhang, Yang Liu, A 2D pen-type interaction system and method based on Piezoelectric Micromachined Ultrasonic Transducers(基于压电微机械超声换能器的二维笔式交互系统及方法), Patent number: CN202111014227.8.

14. Liang Lou, Zhipeng Wu, A received Piezoelectric Micromachined Ultrasonic Transducers system and method based on DC Bias Voltage(基于直流偏置的接收压电微机械超声换能器系统及方法), Patent number: CN202110931604.8.

15. Liang Lou, Zhipeng Wu, A Piezoelectric Micromachined Ultrasonic Transducers system and method based on DC Bias Voltage(基于直流偏置的压电微机械超声换能器系统及调节方法), Patent number: CN202110930999.X.

16. Zhipeng Wu, Liang Lou, Yang Liu, Zhihao Tong, A Ring-Down and blind area Suppression System and method based on feedback system (基于反馈系统减小超声换能器余振和盲区的系统及方法), Patent number: CN202011172361.6.

17. Zhipeng Wu, Liang Lou, Yang Liu, Zhihao Tong, A Ring-Down and blind area Suppression System and method based on Transfer Function(基于传递函数减小超声换能器余振和盲区的系统及方法), Patent number: CN202011172364.X.