

# Zhengrui TAO

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## EDUCATION

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### Shanghai Jiao Tong University

Shanghai, China

*M.S. in Mechanical Engineering*

*Sep. 2017 - Mar. 2020 (expected)*

- Major GPA:**88**/100, Overall GPA:**95**/100
- **Core Courses(Selected):** Tribology Lubrication (A+), design of complex mechatronics system (A+), Mathematical optimization (A), Plastic Deformation Theory and Numerical Simulation (A), Elastic and Plastic Mechanics (A-)
- **Advisor:** Prof. Qinglong An

### Harbin Institute of Technology, WEIHAI

Weihai, China

*B.Eng. in Mechanical Engineering*

*Sep. 2013 - Jun. 2017*

- Ranking: 2nd/137
- Major GPA:**93.13**/100, Overall GPA:**90.12**/100
- **Core Courses(Selected):** Digital Electronic Technology (94), Analogical Electronics (99, rank 1st), College Physics (100/92), Computer Organization (98, rank 1st), Numerical Control Technology (96), Discrete Mathematics (95, rank 1st), Functions of Complex Variables Integral Transformations (100), Automatic Control Theory (96), Mechanics of Materials (98)
- **Advisor :** Prof. Jian Wu

## PUBLICATIONS & PRESENTATIONS

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**[J1] - A Novel Method for Tool Condition Monitoring Based on Long Short-Term Memory and Hidden Markov Model Hybrid Framework in High-Speed Milling Ti-6Al-4V**

- **Zhengrui Tao**, Qinglong An, Gongyu Liu, Ming Chen
- *Accepted to the International Journal of Advanced Manufacturing Technology*

**[J2] - Eddy Current Distance Measurement Calibration Method for Curved Surface Parts Based on Support Vector Machine Regression**

- **Zhengrui Tao**, Jiaqiang Dang, Jingyang Xu, Qinglong An
- *Accepted to the Journal of Shanghai Jiaotong University*

**[J3] - High-precision calibration method and application for coating thickness measurement of curved surface based on eddy current displacement sensor**

- **Zhengrui Tao**, Jiaqiang Dang, Jingyang Xu, Qinglong An
- *Accepted to the Journal of Zhejiang University (Engineering Science)*

**[J4] - Experimental investigation on tool wear characteristics of PVD and CVD coatings during face milling of Ti-6242S and Ti-555 titanium alloys**

- Qinglong An, Jie Chen, **Zhengrui Tao**, Weiwei Ming
- *Accepted to the International Journal of Refractory Metals and Hard Materials*

**[J5] - Tool Remaining Useful Life Prediction Based on Convolutional Neural Network-Stacked Bidirectional and Unidirectional LSTM Network Hybrid Model**

- Qinglong An<sup>&</sup>, **Zhengrui Tao**<sup>&</sup>, Jie Chen, Gongyu Liu (&co-first authors)
- *Submitted to the Measurement*

**[J6] - Experimental investigation on tool wear characteristics of PVD and CVD coatings during face milling of Ti-6242S and Ti-555 titanium alloys**

- Junli Li, **Zhengrui Tao**, Xiaojiang Cai, Qinglong An
- *Submitted to the International Journal of Advanced Manufacturing Technology*

**[J7] - Monitoring and prognostics: a new method based on deep learning and multi-sensor information fusion**

- Xingwei Xu, **Zhengrui Tao**, Qinglong An, Ming Chen
- *Submitted to the International Journal of Precision Engineering and Manufacturing-Green Technology*

**[J8] - Experimental study on the cooling/lubrication performance of dry and supercritical CO<sub>2</sub>-based minimum quantity lubrication in peripheral milling Ti-6Al-4V**

- Chongyan Cai, Xu Liang, Qinglong An, Zhengrui Tao
- *Submitted to the International Journal of Precision Engineering and Manufacturing-Green Technology*

**[C1] - Cutting Performance Evaluation of Helical Milling Specialized Tool for CFRP/Titanium Alloy**

- Zhengrui Tao, Qinglong An, Ming Chen
- *14th China-Japan International Conference on Ultra-Precision Machining Process*, Harbin, Sept 13-15, 2018

**[C2] - Hierarchical Dirichlet Process Hidden Semi-Markov Model-based Method for Tool Wear Estimation in High-Speed Milling Ti-6Al-4V**

- Zhengrui Tao, Gongyu Liu, Qinglong An, Ming Chen
- *8th International Conference on High Speed Machining*, Guangzhou, Nov 22-24, 2018

## RESEARCH EXPERIENCES

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**Tool Condition Monitoring, Diagnostic, Prognostics, and Remaining Useful Life Prediction** **Shanghai, China**  
*Research Assistant, supervised by Prof. Qinglong An* *Sep. 2018 - Present*

- Developed a novel method based on Long Short-Term Memory network and hidden Markov model (LSTM-HMM) hybrid framework for tool condition monitoring to diagnose tool wear status and track the flank wear during high-speed milling Ti-6Al-4V
- Proposed an integrated model that incorporates convolutional neural network (CNN) with stacked bidirectional and uni-directional LSTM (SBULSTM) network, named CNN-SBULSTM, to address sensor data collected by cyber-physical system for remaining useful life prediction during machining smartphone backplate

**Chatter Stability Analysis and Feed Rate Optimization in the Milling Process** **Shanghai, China**  
*Research Assistant, supervised by Prof. Qinglong An* *Jul. 2017 - Sep. 2018*

- Obtained the cutter-workpiece engagement area using geometric simulation and established the milling force model; the analytical regenerative chatter prediction model was presented and the time/frequency domain solutions were employed to obtain Stability Lobe Diagrams
- With constant cutting force as the optimization target, considering the machining stability, cutting force, torque and machine power constraints, a single-objective optimization model is established. The smoothness and efficiency of machining process are improved through feed-rate optimization by segments

**Analysis and Experimental Study on Contact Characteristics of Aviation Sealing Profile** **Weihai, China**  
*Research Assistant, supervised by Prof. Jian Wu* *Sep. 2016 - July. 2017*

- Micro surface morphology of the sealing profile is obtained by OLYMPUS optical digital microscope. Fractal characteristics were studied based on the structural function and fractal parameters were obtained. The V-M function was employed to characterize the fractal surface, and the fractal contact model was established based on the single asperity contact model and area distribution function
- A multi-scale contact model of the sealing profile is developed based on the finite element model, and the contact characteristics of sealing profile in complex environment were studied
- Macro and micro contact characteristics of an aviation seal profile are investigated by theoretical analysis, numerical simulation and experimental testing. And A new method for calculating the real contact area is proposed by coupling the theory and finite element method, which provides a reference for the design and application of seals

**Design of Separation Device Using Redundant Motors Basing on Two-sectional Segmented Nut** **Weihai, China**  
*Research Assistant, supervised by Prof. Huiying Liu* *Dec. 2015 - July. 2016*

- Designed innovatively a separation device to make sure the two separated parts are reliably connected, and the connection between the two parts can be rapidly released when receiving separation signal
- Manufactured, assembled the parts, and tested the device's separation time and reliability in vacuum and low temperature environment

## SELECTED PROJECTS

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## **Design of Flexible End-actuator for Tank Insulation-layer Grinding and Research on Process Technology Shanghai,China**

*NSF Project*

*Sep. 2017 - Dec. 2018*

- Designed a flexible end-actuator for insulation-layer grinding, with the function of thickness measurement and automatic radial feed adjustment
- Planned the machining Process referring to bar turning. Namely, the eddy current displacement sensor determines the radial depth of cut, the tank rotates around the axis and the robot arm carries the end-actuator along the axis

## **Multifunctional Medical Nursing Bed**

Shanghai,China

*Course Project*

*May 2018 - Sep. 2018*

- Modified a commonly used manual nursing bed and added multi functions, such as anti-slip, easy dismantling and hemorrhoids prevention
- The new designed medical nursing bed can promote the blood circulation of the patient's legs and reduce the muscle atrophy caused

## **The Angle Parameters Testing Platform of Main Hub for Helicopter**

Changzhou,China

*Enterprise Project*

*Sep. 2016 - Mar. 2017*

- Developed a specific testing platform to measure angle parameters and implemented control system based on C++
- Analyzed the kinematics of the drive mechanism to make sure that the platform can cover the testing angle range and position accurately at a specific angle

## **HONORS & AWARDS**

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National Graduate Scholarship, Nation-wide ( <b>top 0.2%</b> )	2019
Sandvik Coromant Scholarship, Sandvik Coromant Company ( <b>top 3%</b> )	2018
The Excellent Poster Award of 8th International Conference of High-Speed Machining ( <b>top 2%</b> )	2018
The Best Paper Award of 14th China-Japan International Conference on Ultra-Precision Machining Process ( <b>top 2%</b> )	2018
First Prize in the Graduate Course Competition of Complex Electromechanical Practice, School-wide ( <b>top 1%</b> )	2018
Outstanding Graduates of Shandong Province, Province-wide ( <b>top 2%</b> )	2017
National Undergraduate Scholarship, Nation-wide ( <b>top 0.2%</b> )	2016
Merit Student of Harbin Institute of Technology, University-wide ( <b>top 3%</b> )	2016
First Prize in the 3rd New Concept Structure Design Competition, Nation-wide ( <b>top 3%</b> )	2016
National Aspiration Scholarship, Nation-wide ( <b>top 5%</b> )	2015

## **TECHNICAL SKILLS**

### **Computer Aid Design/Software**

- Solidworks, UG
- Abaqus, CutPro, Thirdwave

### **Programming**

- C/C++, Python, MATLAB

### **Mechanical/Electronics**

- Lathes, Mills, CNC Programing, Electron Microscopy (SEM, EDX)
- Instrumentation and Controls (LabVIEW, Simulink)

## **MISCELLANEOUS**

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Teaching Assistant, Course: <i>Introduction to Engineering</i>	Sep. 2018 - Dec. 2018
Volunteer, The First International Import Expo	Nov. 2018
Volunteer, 2018 Shanghai International Marathon	Nov. 2018
Volunteer, 2018 WAIC(World Artificial Intelligence Conference)	Sep. 2018
Hobbies: Cooking (Huaiyang and Shanghai cuisine), Sports (Badminton, Running)	
International Reviewer: International Journal of Machine Tools and Manufacture, Journal of Materials Processing Technology, Smart Materials and Structures, WEAR, Advanced Engineering Materials, International Journal of Advanced Manufacturing Technology	