Zhengrui TAO

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EDUCATION BACKGROUND

Shanghai Jiao Tong University **Shanghai, China**
M.Sc. in Mechanical Engineering *Sept. 2017 - June 2020*
- Major GPA: **3.61**/4.00, Overall GPA: **3.75**/4.00

Harbin Institute of Technology, WEIHAI **Weihai, China**
B.Eng. in Mechanical Design Manufacturing and Automation *Sept. 2013 - June 2017*
- Major GPA: **92.30**/100 (**3.92**/4.00), Overall GPA:**91.80**/100 (**3.88**/4.00); First Three Years Ranking: **2nd**/160

PUBLICATIONS & PRESENTATIONS

[J1] **Z. Tao**, Q. An, G. Liu, M. Chen. 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. *International Journal of Advanced Manufacturing Technology*, 105.7 (2019): 3165-3182.

[J2] Q. An[&], **Z. Tao**[&], X. Xu, M. El Mansori (&co-first). A Data-driven Model for Milling Tool Remaining Useful Life Prediction with Convolutional and Stacked LSTM Network. *Measurement*, 154 (2020): 107461.

[J3] J. Li, **Z. Tao**, X. Cai, Q. An. Experimental and Finite Element Analysis of the Formation Mechanism of Serrated Chips of Nickel-based Superalloy Inconel 718. *International Journal of Advanced Manufacturing Technology*, 107 (2020): 4969-4982.

[J4] X. Xu, **Z. Tao**, Q. An, M. Chen. Intelligent monitoring and diagnostics using a novel integration model based on deep learning and data fusion. *Measurement*, 165 (2020): 108086.

[J5] Q. An, J. Chen, **Z. Tao**, W. Ming. Experimental investigation on tool wear characteristics of PVD and CVD coatings during face milling of Ti-6242S and Ti-555 titanium alloys. *International Journal of Refractory Metals and Hard Materials*, 86 (2020): 105091.

[J6] C. Cai, X. Liang, Q. An, **Z. Tao**. Cooling/lubrication performance of dry and supercritical CO2-based minimum quantity lubrication in peripheral milling Ti-6Al-4V. *International Journal of Precision Engineering and Manufacturing-Green Technology*, (2020): 1-17.

[J7] **Z. Tao**, J. Dang, J. Xu, Q. An, M. Chen, L. Wang, F. Ren. Eddy Current Distance Measurement Calibration Method for Curved Surface Parts Based on Support Vector Machine Regression. *Journal of Shanghai Jiao Tong University*, 54.7 (2020): 674.

[J8] **Z. Tao**, J. Dang, J. Xu, Q. An, F. Ren, L. Wang. High-precision calibration method and application for coating thickness measurement of curved surface based on eddy current displacement sensor. *Journal of Zhejiang University (Engineering Science)*, 54.6 (2020): 1218-1227.

[C1] **Z. Tao**, Q. An, M. Chen, J. Xu. Cutting Performance Evaluation of Helical Milling Specialized Tool for CFRP/Titanium Alloy. *Proc.14th China-Japan International Conference on Ultra-Precision Machining Process (CJUMP2018)*, Harbin, China, Sept. 13-15, 2018. (Best Paper Award, **Top 2**%)

[C2] **Z. Tao**, G. Liu, Q. An, M. Chen. Hierarchical Dirichlet Process Hidden Semi-Markov Model-based Method for Tool Wear Estimation in High-Speed Milling Ti-6Al-4V. *Proc.8th International Conference on High-Speed Machining (ICHSM2018)*, Guangzhou, China, Nov. 22-24, 2018. (Excellent Poster Award, **Top 2**%)

[P1] M. Chen, F. Ren, **Z. Tao**. Non-contact Type Measuring Method and Device for Metal Surface Coating Thickness. China Patent, CN109141325A.

RESEARCH EXPERIENCES

Tool Performance Quick Evaluation System: Cutting parameters Analysis and Tool Life Prediction **Shanghai, China**
Advisor: Prof. Ming Chen & Prof. Qinglong An *Sept. 2020 - Present*
- Established a tool performance Quick Evaluation System(TPQES), including cutting parameters analysis and tool life prediction, contributing to a **60**% reduction in evaluation time and **32**% increase in tool life for metal shell processing of 3C products
- Set-up of machine, tool and fixture in virtual machining module, got the cutting parameters along the cutting path, and obtained the the most representative processing parameters

- Conducted cutting experiment with the above processing parameters, combined the measured wear amount with TPQES to derive the tool wear curve

Virtual Machining System: Chatter Stability Analysis and Feed Rate Optimization **Shanghai, China**
Advisor: Prof. Ming Chen *Sept. 2019 - May 2020*

- Established a Virtual Machining System specific to thin-wall workpieces, including chatter stability analysis and feed rate optimization, contributing to a **43**% reduction in average cycle time and **7.4**-fold improved surface finish for automotive engine turbine machining
- Established milling dynamics model considering regenerative chatter, and got Stability Lobe Diagram using zero-order frequency domain solution of which the relative transfer function includes the modal parameters of tool and workpiece
- Obtained the cutter-workpiece engagement area by geometric simulation, utilized the Boolean operation to extract geometrical parameters according to the minimum octants contacting with the cutter, and optimized the feed rate in NC code with Genetic Algorithms to maximize the Material Removal Rate

Tool Condition Monitoring: Diagnostics, Prognostics, and Remaining Useful Life Prediction **Shanghai, China**
Advisor: Prof. Ming Chen & Prof. Mohamed EL Mansori *Sept. 2018 - Sept. 2019*

- Developed a hybrid framework based on LSTM and HMM capable of performing TCM during high-speed milling Ti-6Al-4V with diagnostic accuracy reaching up to **0.96** and prognostics MSE decreasing by **93.9**%
- Employed the global model (stacked LSTM network) to identify the current tool wear stage, inferred the wear accumulation state sequence using the best-fitted HMM, then calculated the mean wear amount and the associated confidence interval based on the state sequence and wear statistics
- Proposed another integrated model combining CNN with stacked bidirectional and unidirectional LSTMs (SBULSTM) to predict remaining useful life during machining 6063 aluminum alloy smartphone backplate with the three metrics (RMSE/ accuracy/ score) decreased by **77**%, increased by **25**% and improved by **38**% compared with the Random Forest model
- Utilized CNN for local feature extraction and dimension reduction, introduced the SBULSTM network to denoise and encode the temporal information, built multiple fully connected layers on the top of the CNN-SBULSTM network to add nonlinearity, and employed one regression layer to generate the target RUL

Research on Helical Milling Specialized Tool for CFRP/Titanium alloy **Shanghai, China**
Advisor: Prof. Jingyang Xu *Sept. 2017 - July 2018*

- Designed a specialized helical milling tool with distributed multi-point front cutting edge, and evaluated the cutting performances with machined titanium alloy holes burr-free, CFRP holes without delimitation and the service life improved by **50**% and **35**% compared to the traditional end mill
- Analyzed the chip-splitting results by simulating the undeformed chip formation and each cutting edge's trajectory, and proceed to iteratively update the structure and geometric parameters of the specialized tool based on the simulation results

Structural Design and Sealing Performance Analysis of Biomimetic Flexible Sealing Ring **Shanghai, China**
Advisor: Prof. Jingyang Xu *Sept. 2016 - July 2017*

- Designed a biomimetic sealing ring inspired by the functional surface of earthworm, which avoids rolling and distortion in dynamic sealing with with service life increased by **33.5**% and **47.9**% compared to O- and rectangular-ring
- Selected the Mooney-Rivlin model to describe the mechanical characteristics of rubber linings, and established two-dimensional axisymmetric FEM of the biomimetic ring, groove, and slide bar based on the actual sealing setting to analyze Von-Mises stress and contact stress

Research and Development of Low-Shock Non-Explosive Separation Device **Weihai, China**
Advisor: Prof. Jian Wu *Dec. 2014 - July 2015*

- Developed a Non-Explosive separation device to connect the launch vehicle and small satellite reliably and release the connection rapidly, and adopted divided nuts to the connect and separate bolt, the four-bar mechanism to control the movement of releasing clamps (divided nuts), eight circumferentially distributed balls to lock the device, and the dual redundant DC motors to unlock the device
- Generated Solidworks model, drawing and assemblies for the device, verified the bearing capacity by simulation and conducted the pre-stress modal analysis to avoid unlocking mistakenly by external vibration excitation in ANSYS, and simulated the unlocking and separation process by ADAMS

HONORS & AWARDS

National Graduate Scholarship, Nation-wide (**Top 1%**) 2019
Sandvik Coromant Scholarship, Sandvik Coromant Company (**Top 3%**) 2018
Outstanding Graduates of Shandong Province, Province-wide (**Top 2%**) 2017
National Undergraduate Scholarship, Nation-wide (**Top 1%**) 2016
First Prize in the 3rd New Concept Structure Design Competition, Nation-wide (**Top 3%**) 2015

MISCELLANEOUS

Mechanical/Electronics Lathes, Mills, CNC Programing, Electron Microscopy (SEM, EDS)
Professional Software Solidworks, UG, ABAQUS, LabVIEW
Programming C/C++, Python, MATLAB
Teaching Assistant, Course: *Introduction to Engineering* Sept. 2018 - Dec. 2018
Academic Services: *Journal of Materials Processing Technology, WEAR, International Journal of Advanced Manufacturing Technology*