

Biao Chen

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Huazhong University of Science and Technology, Wuhan, 430074, P.R. China

Education

Huazhong University of Science and Technology (HUST)

Sep 2020- Jul 2024

Bachelor of Science in Machine Design, Manufacturing and Automation

Overall GPA: 3.96/4.00

Core Coursework and Grades: Dynamics of Mechanical Systems (94/100), Linear Algebra (91/100), Calculus (92/100), Theoretical Mechanics (96/100), Complex Functions and Integral Transformations (94/100), Numerical Methods (92/100)

Research Experiences

Prediction of Displacement and Strain Fields in Material Testing Based on Deep Learning

Jul 2023-Present

Research Assistant, Advanced Intelligent Manufacturing Laboratory of Northwestern University (remote)

Advisor: Professor Ping Guo (Associate Professor of Mechanical Engineering, Northwestern University, Evanston, IL)

- Utilized deep learning to achieve robust prediction of displacement and strain fields during material testing.
- Proposed a Bayesian neural network based on the U-Net, directly obtaining the variance of the prediction of displacement and strain fields in material testing to reflect the prediction confidence
- Generated a series of high-quality datasets to evaluate how the datasets effect the accuracy and variance of prediction.

Batch Adaptive Defect Segmentation Networks Based on Feature Matching

May 2023-Jul2023

Research Assistant, National Engineering Research Center of Digital Manufacturing Equipment

Advisor: Professor Bin Li (Professor of School of Mechanical Science and Engineering, HUST)

- Proposed a batch adaptive network based on feature matching, achieving the adaptive detection of different batches of products through matching the same area between positive samples and test samples.
- Introduced the self-attention and cross-attention mechanisms to calculate the similarity of different regions between positive and negative samples.
- Designed a feature matching mechanism based on mutual nearest neighbor algorithm to match the normal area, allowing the network to accurately segment defect features.

Batch Adaptive Defect Segmentation Networks Based on Feature Alignment

Mar 2023-May 2023

Research Assistant, National Engineering Research Center of Digital Manufacturing Equipment

Advisor: Professor Bin Li (Professor of School of Mechanical Science and Engineering, HUST)

- Proposed a batch adaptive network based on feature alignment, allowing for adaptive detection of different batches of products through learning the difference between positive and test samples.
- Designed a sophisticated feature alignment mechanism based on a spatial transformer module to eliminate background displacement, rotation, texture change, and other noise, allowing the network to accurately extract defect features.
- Proposed a positive sample representative selection algorithm based on the pre-training model feature embedding method to dynamically adapt to the sample feature changes caused by tool and die wear.

Lightweight Real-Time Segmentation Network for Surface Defect Detection

Oct 2022-Mar 2023

Research Assistant, National Numerical Control System Engineering Technology Research Center

Advisor: Professor Wenyong Yu (Associate Professor of School of Mechanical Science and Engineering, HUST)

- Proposed a lightweight, real-time network including feature extraction stage and feature fusion stage for surface defect detection, with only 0.39M parameters and 0.44G FLOPs when input resolution was 224×224.
- Designed lightweight convolution blocks with residual connections for feature extraction and feature fusion stages.
- Fused low level details and high-level semantic information efficiently during the feature fusion phase to guide the network which focused on features at different levels simultaneously.

Lightweight Networks for Surface Defect Segmentation Based on Neural Architecture Search

Jun 2021-Oct 2022

Research Assistant, National Engineering Research Center of Digital Manufacturing Equipment

Advisor: Professor Bin Li (Professor of School of Mechanical Science and Engineering, HUST)

- Proposed a search space suitable for industrial applications through combining design experience and experimental results.

- Designed a new loss function which can simultaneously focus on the network weight parameters and structural light quantification parameters to balance model accuracy and computational efficiency.
- Obtained a lightweight network which performs with high competitiveness against other classical networks on three industrial datasets through the Neural Architecture Search programmed by Python.
- Searched for a lightweight network which can achieve competitive performance with the U-Net using only 30% of parameters.

Robot-Based High-Quality Grinding of Large Thermoplastic Composite Members

Oct 2021-May 2022

Research Assistant, State Key Lab of Intelligent Manufacturing Equipment and Technology

Advisor: Professor Huan Zhao (Professor of School of Mechanical Science and Engineering, HUST)

- Investigated relevant literature on composite grinding temperature measurement and roughness modeling to better understand existing research and methodology.
- Designed and constructed a robot grinding carbon fiber reinforced plastics (CFRP) platform and conducted orthogonal grinding experiments to test the surface quality of the work after grinding.
- Applied the back propagation algorithm to predict the composite's surface roughness after processing.

Publications

*All the publications are available on [my website](#).

[1] **Biao Chen**, Tongzhi Niu*, Ruqi Zhang, Hang Zhang, Yuchen Lin, Bin Li, "Feature Matching Driven Background Generalization Neural Networks for Surface Defect Segmentation", *under review*, Knowledge-Based Systems [J] (SCI, Q1, IF=8.800).

[2] Tongzhi Niu*, **Biao Chen**, Qianhang Lv; Bei Li; Wei Luo; Bin Li, "Scoring Bayesian Neural Networks for Learning from Inconsistent Labels in Surface Defect Segmentation", *under review*, Measurement [J] (SCI, Q1, IF=5.6).

[3] Tongzhi Niu, **Biao Chen** (Co-first author), Zhenrong Wang, Ruqi Zhang, Bin Li*, "Background-Adaptive Surface Defect Detection Neural Networks via Positive Samples", *accepted*, the 49th Annual Conference of the IEEE Industrial Electronics Society (IECON 2023).

[4] **Biao Chen**, Tongzhi Niu, Wenyong Yu*, Ruqi Zhang, Zhenrong Wang, Bin Li, "A-Net: A Lightweight Real-time Segmentation Network for Surface Defect Detection", *accepted*, IEEE Transactions on Instrumentation & Measurement [J] (SCI, Q1, IF=5.6).

[5] **Biao Chen**, Tongzhi Niu*, Yuchen Lin, Hang Zhang, Baohui Liu and Miao Wang, "Lightweight Convolutional Neural Networks for Surface Defect Segmentation Based on Neural Architecture Search", *submitted*, the Optics and Lasers in Engineering [J] (SCI, Q2, IF=4.6).

Awards

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| • Excellent Conclusion, National College Student Innovation and Entrepreneurship Project | 2023 |
| • Honorable Mention, Mathematical Contest in Modeling Certificate of Achievement (30%) | 2022 |
| • Science and Technology Innovation Scholarship, Huazhong University of Science and Technology (2/30) | 2021 |
| • First Prize, Advanced Mapping Technology and Product Modeling Innovation Competition (10%) | 2021 |
| • First Prize, Asian Engineering Mechanics Competition (30%) | 2021 |
| • First Prize, National College Mathematics Challenge (20%) | 2020 |

Leadership & Activities

League Branch Secretary of the Class

Sep 2020- Oct 2021

- Designed and organized activities for classmates and earned the award of "Vitality League Branch".
- Organized monthly study meetings to bring together classmates.
- Strengthened the collaboration and communication between school leaders and teachers and students.

Member of the Lang Ya Team

Nov 2020-Jul 2021

- Designed robots for RoboMaster competition alongside teammates;
- Managed team actively through team meetings and weekly communication about robot design

Skills

Programming: Python, PyTorch, MATLAB

Software: SolidWorks, Inventor, AutoCAD, LaTeX, Visio