

Yunkang CAO

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EDUCATION

Huazhong University of Science & Technology (HUST) Ph.D. Candidate in Mechanical Engineering	GPA: 88.26/100 Supervisor: Prof. Weiming Shen	Hubei, China 2020.09- present
Huazhong University of Science & Technology (HUST) B.E. in Mechanical Design, Manufacture & Automation	GPA: 91.55/100 Rank: 14/309	Hubei, China 2016.09- 2020.06

RESEARCH INTEREST

- **2D+3D Anomaly Detection:** Fuse 2D and 3D data to better detect anomalies.

PUBLICATIONS & MANUSCRIPTS

Journal Articles

- [1] **Y. Cao**, Q. Wan, W. Shen, L. Gao. Informative Knowledge Distillation for image anomaly detection. *Knowledge-Based Systems (KBS)*. (SCI, Q1). [\[Paper\]](#) [\[Code\]](#)
- [2] **Y. Cao**, X. Xu, Z. Liu, W. Shen. Collaborative Discrepancy Optimization for Reliable Image Anomaly Localization. *IEEE Transactions on Industrial Informatics (IEEE TII)*, (SCI, Q1). [\[Paper\]](#) [\[Code\]](#)
- [3] **Y. Cao**, X. Xu, W. Shen. Open-set Supervised Anomaly Localization via Union Discrepancy Learners. *IEEE Transactions on Cybernetics (IEEE TCYB)*, Under Review.
- [4] C. Liu, J. Wang, **Y. Cao**, M. Liu, W. Shen. GON: End-to-end Optimization Framework for Constraint Graph Optimization Problems. *Knowledge-Based Systems (KBS)*. (SCI, Q1). [\[Paper\]](#)
- [5] Y. Jiang, **Y. Cao**, W. Shen. A Masked Reverse Knowledge Distillation Method Incorporating Global-Local Information for Image Anomaly Detection. *Knowledge-Based Systems (KBS)*, Under Review.

Conference Papers

- [1] **Y. Cao**, Y. Song, X. Xu, S. Li, Y. Yu, Y. Zhang, W. Shen. Semi-supervised Knowledge Distillation for Tiny Defect Detection. *2022 IEEE 25th International Conference on Computer Supported Cooperative Work in Design (CSCWD)*. [\[Paper\]](#)
- [2] Q. Wan, **Y. Cao**, L. Gao, W. Shen, X. Li. Position Encoding Enhanced Feature Mapping for Image Anomaly Detection. *2022 IEEE 18th International Conference on Automation Science and Engineering (CASE)*. [\[Paper\]](#) [\[Code\]](#)
- [3] C. Liu, **Y. Cao**, C. Sun, W. Shen, X. Li, L. Gao. An Outlier-Aware Method for UWB Indoor Positioning in Non-line-of-sight Situations. *2022 IEEE 25th International Conference on Computer Supported Cooperative Work in Design (CSCWD)*. [\[Paper\]](#)

Ongoing Papers

- [1] **Y. Cao**, W. Shen. VIDF: Viewpoint-Invariant Deep Feature for Point Cloud Anomaly Detection. **To be submitted** to *Pattern Recognition (PR)*.

RESEARCH PROJECT

Unsupervised and Open-set Supervised 2D Anomaly Detection	2021.03- 2022.07
➤ Informative Knowledge Distillation for image anomaly detection [Paper] [Code]	

- Analyzed the overfitting problem in knowledge-based anomaly detection methods caused by the inconsistency between the capacity of a neural network and the amount of knowledge.
- Proposed Informative Knowledge Distillation (IKD) to mitigate the overfitting problem, which contains a novel context similarity loss and a novel adaptive hard sample mining method, both help to distill informative knowledge and offer a strong supervision signal.
- Conducted extensive experiments on ablation to demonstrate the effectiveness of IKD in alleviating the overfitting problem.

➤ Collaborative Discrepancy Optimization for Reliable Image Anomaly Localization

- Analyzed the over-generalized problem in discrepancy learning-based anomaly detection methods caused by generalization abilities of neural networks.
- Proposed Collaborative Discrepancy Optimization (CDO) to alleviate the over-generalized problem, which explicitly enlarges the margin and decreases the overlap between the normal and abnormal score distributions with the help of synthetic abnormal samples.
- Evaluated the proposed CDO on MVTec2D and MVTec3D and proved that the CDO achieved state-of-the-art performance with excellent real-time computation efficiency.

➤ Open-set Supervised Anomaly Localization via Union Discrepancy Learners

- Articulated a new anomaly localization scenario called Open-set Supervised Anomaly Localization (OSAL) to simultaneously unleash the power of both plentiful normal samples and few-but-precious anomaly samples to improve anomaly localization performance.
- Proposed an OSAL framework called Union DIScrepancy Learners (UDISL) equipped with several model agnostic stage-specific discrepancy learners to utilize the corresponding stage-specific knowledge.
- Studied the effectiveness, generality, and scalability of the proposed framework UDISL comprehensively.

3D Incorporated Anomaly Detection

2022.07- present

➤ VIDF: Viewpoint-Invariant Deep Feature for Point Cloud Anomaly Detection

- Introduced 3D information in detecting anomalies, as anomalies in 2D information sometimes cannot be distinguished well.
- Proposed Viewpoint-Invariant Deep Feature (VIDF) which empowered descriptive 2D pretrained networks to extract point-wise point cloud deep features.
- Validated the significantly better image-level anomaly detection performance and the effectiveness on 3D data.

SELECTED HONORS

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| • First-class Scholarship for Postgraduates of HUST (<10%) | 2020.09 & 2021.09 & 2022.09 |
| • Mathematical Modeling Stars Nomination (Top2) of China Mathematical Modeling Contest | 2022.05 |
| • Student Award for Research and Innovation (<5%) | 2022.01 |
| • Merit Postgraduate student of HUST (<5%) | 2021.09 |
| • Excellent Graduates of HUST (<10%) | 2019.06 |
| • National Scholarship (the highest scholarship for B.E) | 2017.09 & 2019.09 |

ACADEMIC SERVICE

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- **Reviewer: TII, CASE2022, CSCWD2023**

REFERENCES

Prof. [Weiming Shen](#), Ph.D., CAE Fellow, IEEE Fellow, Fellow of the Engineering Institute of Canada (EIC)

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