

# Yunkang CAO

 <https://github.com/caoyunkang> |  <https://caoyunkang.github.io> |  [caoyunkang0207@gmail.com](mailto:caoyunkang0207@gmail.com)

## EDUCATION

---

Huazhong University of Science & Technology (HUST) <b>Ph.D. Candidate</b> in Mechanical Engineering	<b>GPA:</b> 88.26/100 Supervisor: <a href="#">Prof. Weiming Shen</a>	<i>Hubei, China</i> 2020.09- present
Huazhong University of Science & Technology (HUST) <b>B.E.</b> in Mechanical Design, Manufacture & Automation	<b>GPA:</b> 91.55/100 <b>Rank:</b> 14/309	<i>Hubei, China</i> 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)*, (Major Revision).
- [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**). [\[Paper\]](#)

### 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)*.
- [2] Y. Jiang, **Y. Cao**, W. Shen. A Masked Reverse Knowledge Distillation Method for Anomaly Detection. **To be submitted** to *IEEE Transactions on Industrial Informatics (IEEE TII)*.

## RESEARCH PROJECT

---

Unsupervised and Open-set Supervised 2D Anomaly Detection	2021.03- 2022.07
➤ Informative Knowledge Distillation for image anomaly detection <a href="#">[Paper]</a> <a href="#">[Code]</a>	

- 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 Detection

- 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

- 
- |   |                             |
|---|-----------------------------|
| • First-class Scholarship for Postgraduates of HUST (<10%)                                    | 2020.09 & 2021.09 & 2022.09 |
| • <b>Mathematical Modeling Stars Nomination (Top2)</b> 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                     |
| • <b>National Scholarship (the highest scholarship for B.E)</b>                               | 2017.09 & 2019.09           |

### ACADEMIC SERVICE

- 
- **Reviewer: CASE2022, CSCWD2023**

## REFERENCES

---

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

- Professor at the Huazhong University of Science and Technology, Wuhan, China
- Adjunct Professor at the University of Science and Technology, ON, Canada
- Email: [wshen@ieee.org](mailto:wshen@ieee.org) — Tel: (86) 027-8754-3129
- Relationship: Advisor (since Sep. 2020 to present)