Yunkang CAO

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Education

Huazhong University of Science & Technology (HUST) — **GPA**: 88.26/100 — *Hubei, China*
Ph.D. Candidate in Mechanical Engineering — Supervisor: Prof. Weiming Shen — 2020.09- present

Huazhong University of Science & Technology (HUST) — **GPA**: 91.55/100 — *Hubei, China*
B.E. in Mechanical Design, Manufacture & Automation — **Rank**: 14/309 — 2016.09- 2020.06

Research Interest

- ***2D+3D Anomaly Detection***: Fuse 2D and 3D data to detect both texture and geometry 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)**.

[2] **Y. Cao**, X. Xu, Z. Liu, W. Shen. Collaborative Discrepancy Optimization for Reliable Image Anomaly Detection. 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)**.

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**)*.

[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**)*.

[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**)*.

Research Project

Automated Industrial 2D Anomaly Detection — 2021.03- 2022.07

➢ **Informative Knowledge Distillation for image anomaly detection** [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 Detection** [code]

- 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** [code]

- 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.

Automated Industrial 3D Anomaly Detection **2022.07- present**

➢ **VIDF: Viewpoint-Invariant Deep Feature for Point Cloud Anomaly Detection** [code]

- 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 both 3D and 3D+2D data.

Selected Honors

- 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

- **Reviewer: CASE2022**

Professional Skills

- Programming: Python, PyTorch, C++, TensorRT, LaTeX
- IELTS: 7 (Listening 7.5, Reading 8, Writing 6, Speaking 6)