

CableInspect-AD: An Expert-Annotated Anomaly Detection Dataset

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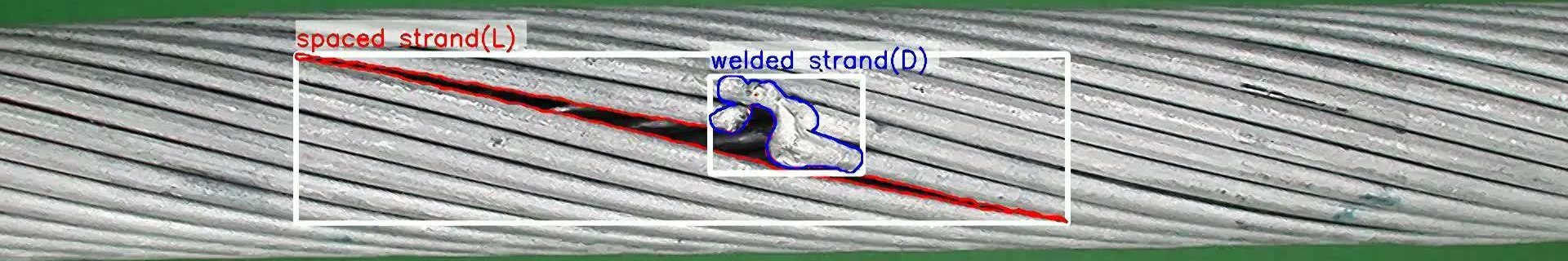
*equal contributions

Introduction

- Visual anomaly detection (VAD) for industrial preventative maintenance offers cost savings, efficiency, and safety.
- Robotic power line inspection represents a specialized and highly challenging domain characterized by a wide range of anomalies.
- We introduce a new public dataset, CableInspect-AD, created and annotated by domain experts for power line inspection.



CableInspect-AD



Enhanced-PatchCore

- Enables thresholding using only the training set, which contains a limited number of nominal images in few-shot and many-shot settings.
- Builds on PatchCore by constructing a memory bank of nominal image embeddings during training.
- At test time, calculates anomaly scores by measuring the distance between test image embeddings and their nearest neighbors in the memory bank.
- Threshold is set using 4 strategies: max, boxplot outliers, and two 95th percentile estimates (parametric and empirical).

VLMs for anomaly detection

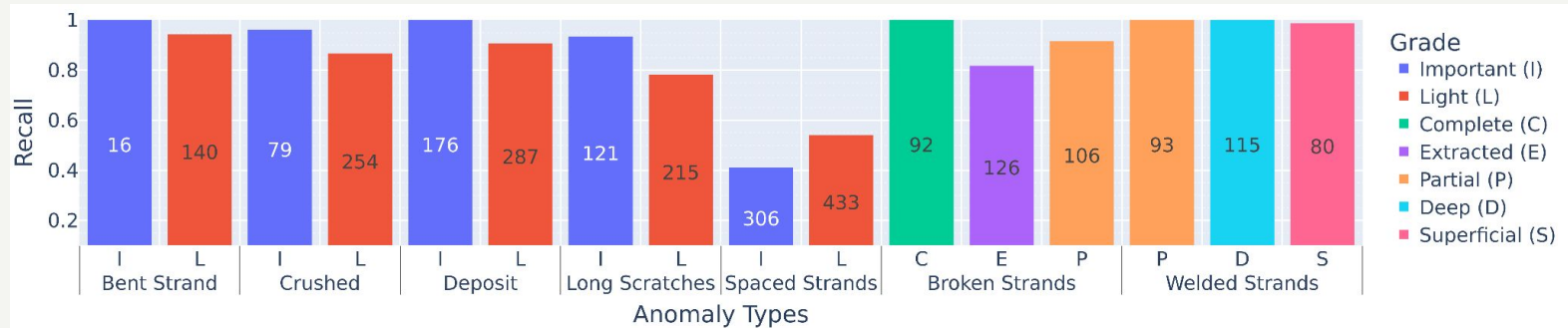
- We evaluate LLaVA 1.5-7B/13B, BakLLaVA-7B, CogVLM-17B, CogVLM2-19B and WinCLIP models in a zero-shot setting.
- We prompt the models with q: “Does this figure show an anomalous or defective object? Please answer Yes or No.”

Results

Model	F1 Score \uparrow	FPR \downarrow	AUPR \uparrow	AUROC \uparrow
LLaVA 1.5-7B	0.59 ± 0.07	0.32 ± 0.19	0.75 ± 0.05	0.68 ± 0.04
LLaVA 1.5-13B	0.69 ± 0.02	0.66 ± 0.21	0.74 ± 0.04	0.66 ± 0.03
BakLLaVA-7B	0.69 ± 0.02	0.53 ± 0.19	0.77 ± 0.04	0.71 ± 0.03
CogVLM-17B	0.77 ± 0.02	0.34 ± 0.21	0.83 ± 0.03	0.79 ± 0.04
CogVLM2-19B	0.66 ± 0.04	0.04 ± 0.01	0.91 ± 0.02	0.86 ± 0.03
WinCLIP	-	-	0.76 ± 0.06	0.70 ± 0.04
<i>Enhanced-PatchCore</i>	0.75 ± 0.03	0.55 ± 0.19	0.84 ± 0.06	0.78 ± 0.05

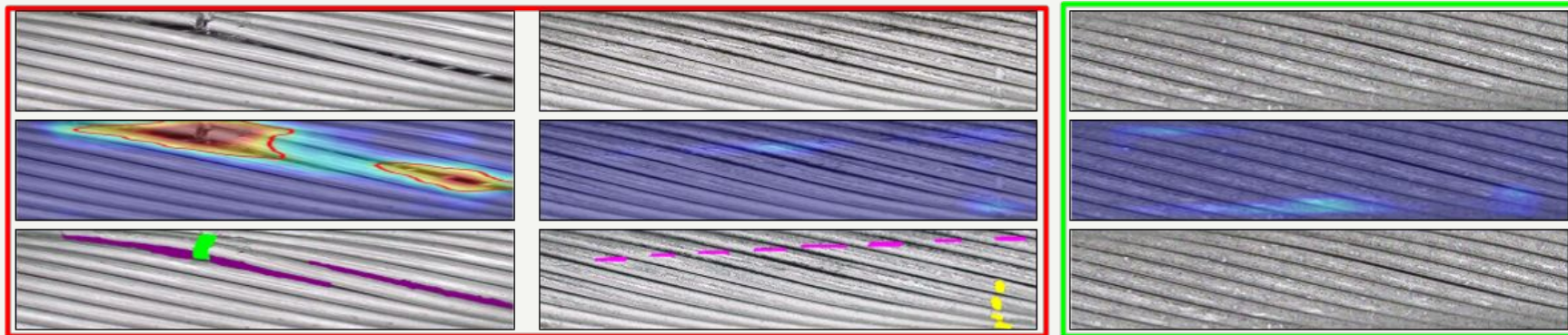
- VLMs show high AUROC and AUPR, indicating strong anomaly detection capabilities. Lower F1 highlights thresholding challenges.
- Enhanced-PatchCore outperforms all VLMs except CogVLM-17B, with limited nominal images, and offers pixel-level evaluation.

VAD across different anomaly types and grades



- More significant anomalies, like bent and broken strands, are easily detected, while lighter anomalies, such as spaced strands and long scratches, are often missed.
- This underscores the need for evaluating multi-grade anomalies.

Anomaly Segmentation



Some anomalies are easily detected (left) whereas others are difficult and are missed (middle).

Contribution and Conclusion

- Introduced CableInspect-AD, a novel anomaly detection dataset created and annotated by domain experts.
- Baseline models show promising results in detecting anomalies but struggle with certain types and grades.
- Highlights the need for new models and the value of CableInspect-AD for the broader anomaly detection community.
- Demonstrates the potential of recent open VLMs for zero-shot anomaly detection with minimal prompt engineering and no image preprocessing.

Thank you!



Code and dataset are available on the project page!