Attention Modules Improve Efficient Anomaly Localization for Industrial Inspection in the Wild

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Hypothesis

Attention modules can boost anomaly detection methods in the wild, not just image-wise as shown in [1], but also pixel-wise, increasing the model's anomaly localization capabilities.

Proposed approach: Attention modules

- Figure 1 shows the proposed combination of attention modules with EfficientAD to expand its application to anomaly detection and localization in the wild.
- For the other method, SimpleNet, we combine its backbone, ResNet-18, with attention blocks by placing them in the non-identity branch of each residual module, making the attention operations act before the summation with the identity branch, producing RN18-SENet and RN18-CBAM.

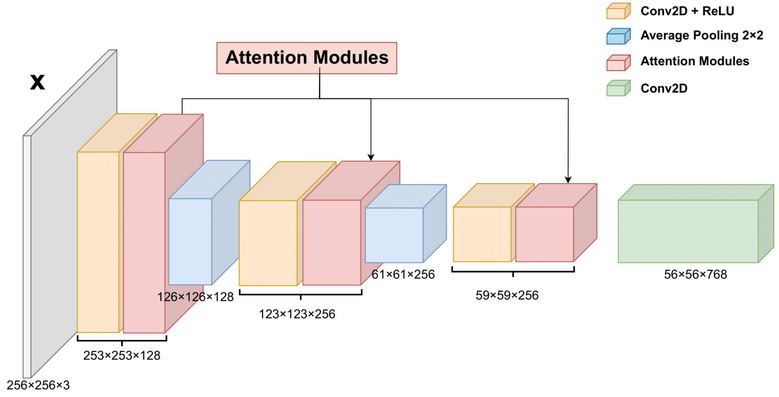
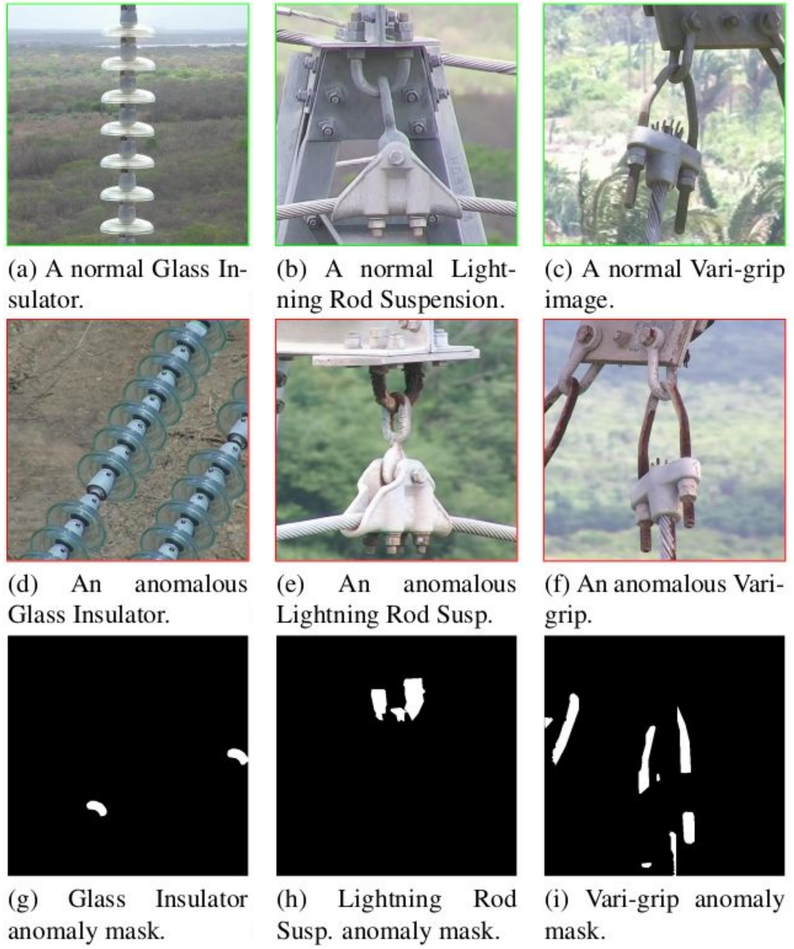


Figure 1. Attention-enhanced EfficientAD. The network architecture of the proposed version of EfficientAD's student network.

InsPLAD-seg dataset:

Proposed dataset: InsPLAD-seg



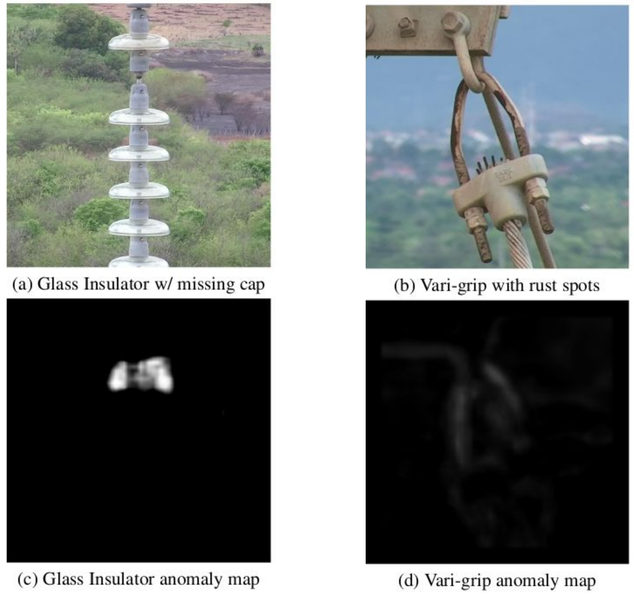
(a) A normal Glass Insulator. (b) A normal Lightning Rod Suspension. (c) A normal Vari-grip image.

(d) An anomalous Glass Insulator. (e) An anomalous Lightning Rod Susp. (f) An anomalous Vari-grip.

(g) Glass Insulator anomaly mask. (h) Lightning Rod Susp. anomaly mask. (i) Vari-grip anomaly mask.

Figure 2. Samples of normal and anomalous objects from InsPLAD-seg, with their respective defect masks for the anomalous ones.

Results



(a) Glass Insulator w/ missing cap (b) Vari-grip with rust spots

(c) Glass Insulator anomaly map (d) Vari-grip anomaly map

Figure 3. Anomalous objects (inputs) with their respective predicted anomaly masks (outputs).

Category	SimpleNet (RN18)	SimpleNet (RN18-SENet)	SimpleNet (RN18-CBAM)	EfficientAD (RN18)	EfficientAD (RN18-SENet)	EfficientAD (RN18-CBAM)
Glass Insulator (missing cap)	58.20	59.40	53.50	49.48	58.50	50.20
Lightning Rod Suspension (corrosion)	59.46	54.44	70.10	43.74	42.01	44.65
Vari-Grip (corrosion)	62.80	52.20	60.00	49.45	46.45	47.91
Average AUROC	<u>60.13</u>	55.35	**61.20**	47.56	**48.99**	<u>47.59</u>

Table 1. AUPRO (pixel-level). Bold: best average results. Underlined: the second-best results

Contributions

- We propose InsPLAD-seg, which is, to the best of our knowledge, the first real-world dataset for industrial inspection in the wild with pixel-level annotations.
- We show that combining attention modules with real-time state-of-the-art anomaly detection methods improves anomaly detection (image-level) and localization (pixel-level) in the wild.