

## YOLO-IR: Infrared Small Object Detection in High Noise Images

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**Abstract :** Infrared object detection aims at separating small and dim targets from cluttered backgrounds, and its capabilities extend beyond the limits of visible light, making it invaluable in a wide range of applications, such as improving safety, security, efficiency, and functionality. However, existing methods are usually sensitive to the noise of the input infrared image, leading to a decrease in target detection accuracy and an increase in the false alarm rate in high-noise environments. To address this issue, an infrared small target detection algorithm called YOLO-IR is proposed in this paper to improve the robustness to high infrared noise. To address the problem that high noise significantly reduces the clarity and reliability of target features in infrared images, we design a soft-threshold coordinate attention mechanism to improve the model's ability to extract target features and its robustness to noise. Since the noise may overwhelm the local details of the target, resulting in the loss of small target features during depth down-sampling, we propose a deep and shallow feature fusion neck to improve the detection accuracy. In addition, because the generalized Intersection over Union (IoU)-based loss functions may be sensitive to noise and lead to unstable training in high-noise environments, we introduce a Wasserstein-distance based loss function to improve the training of the model. The experimental results show that YOLO-IR achieves a 5.0% improvement in recall and a 6.6% improvement in the F1 score over the existing state-of-the-art model.

**Keywords :** infrared small target detection, high noise, robustness, soft-threshold coordinate attention, feature fusion

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