

Assessing Advanced Computer Vision Techniques in Aerial Imagery: A Case Study on Transmission Tower Identification

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Abstract. Transmission tower inspections are essential for maintaining infrastructure integrity and ensuring the safety of electrical transmission systems. Traditionally, these inspections involve high-altitude assessments by professionals, posing significant risks such as high voltage exposure and falls. To mitigate these hazards, Unmanned Aerial Vehicles (UAVs) have emerged as a safer and more efficient alternative. This study conducts a comparative analysis of the latest YOLO model iterations—YOLOv8, YOLOv8-obb, and YOLOv9—for their efficacy in object detection on transmission tower images captured by UAVs. Additionally, YOLOv8-seg and YOLOv9-seg, integrated with the Segment Anything Model, are evaluated for object segmentation in real-world scenarios. The research's significance lies in addressing practical challenges in aerial inspections of transmission towers. By assessing these advanced technologies' performance, the study aims to provide insights into their effectiveness, limitations, and potential to enhance inspection procedures. The comprehensive examination of YOLO model variations, supported by empirical evidence, offers valuable contributions to improving the safety, efficiency, and accuracy of transmission tower inspections, and identifies future research and development opportunities in this critical infrastructure maintenance domain.

Keywords: Object detection · Image segmentation · Machine Learning · YOLO model · Segment Anything Model · Aerial imagery analysis · Transmission tower inspections.