Abstract
- Growing demand for renewable energy has led to the rapid growth of wind turbine installations.
- This growth presents challenges in their inspection and maintenance.
- We present an autonomous inspection system through deep learning which results in higher accuracy, speed, and throughput.
- Ability to inspect blades for faults including erosion, hole, and cracks.

Object Detection Algorithms
- You Only Look Once (YOLO)
  - Created in 2015 with real-time performance in mind.
  - Single stage architecture design.
- Mask Region-Based Convolutional Neural Network (Mask R-CNN)
  - Developed in 2017 to provide accurate and detailed instance segmentation.

Small Wind Turbine Dataset
- Images collected using DJI Mini 3 Pro drone.
- Simulated faults were created on 3 blades of a Primus Wind Power Air Max Turbine.

Results
- Mask R-CNN ResNet50 Backbone
- mAP50: 0.837, mAP50-95: 0.303
- Crack: 0.838, Hole: 0.869, Erosion: 0.805
- YOLOv9 Size E
- mAP50: 0.837, mAP50-95: 0.303
- Crack: 0.838, Hole: 0.867, Erosion: 0.859

Discussion
- Hole features generalized well resulting in mounting hardware detections.
- Light reflections in blades share some crack-like features.

Conclusion
- Results show promising accuracy in blade fault identification.
- Benefits include count of each type of fault, location of the defect relative to image mapping, and size estimation.
- Integration into drone system would allow fully autonomous inspection.

Acknowledgments
- This work is supported by the Office of the Commissioner of Utah System of Higher Education (USHE)-Deep Technology Initiative Grant 20210016UT.
- Authors would like to thank Dr. Afsaneh Minaie for her time advising.