SAS-Based Underwater Target Localization Using Hybrid Quantum Machine Learning

2026 Quantum Machine Learning REU Program

Maryam Gorgees, David Ramirez, Professor Andreas Spanias, Dr. Glen Uehara

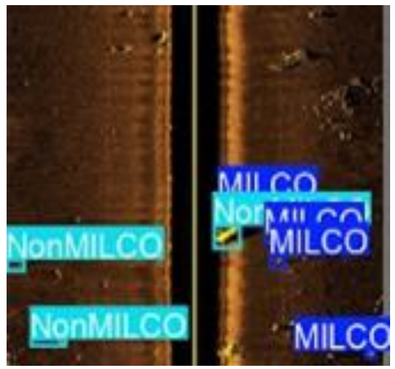
SenSIP Center, School of ECEE, Arizona State University

GLENDALE COMMUNITY COLLEGE

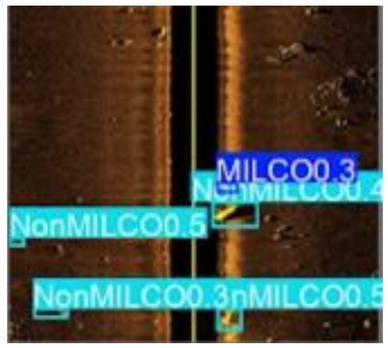
RESEARCH OBJECTIVES

- Detect and classify objects in Underwater Synthetic Sonar images using instance segmentation
- Implement a Variational Quantum Classifier to distinguish between MILCO vs NonMILCO
- Design and embed an Amazon Braket Quantum Circuit

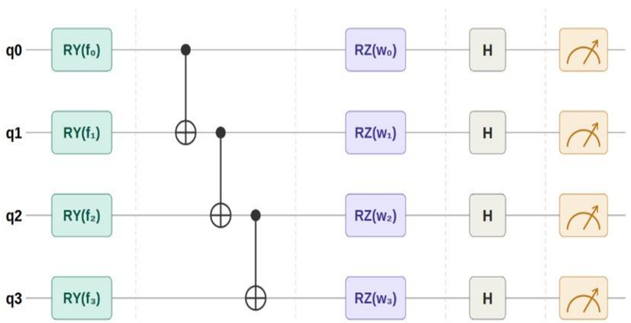
Actual



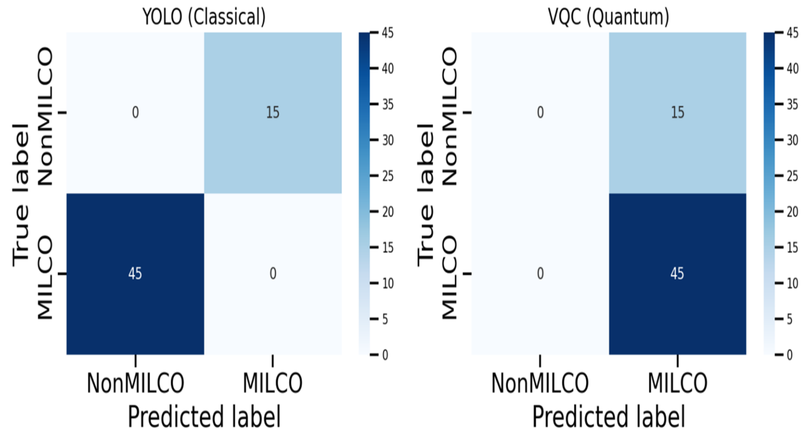
Predicted



- A 4-qubit circuit takes in 4 features (width, height, area, aspect ratio) and uses angle encoding to classify each detection



PRELIMINARY RESULTS



Confusion Matrices showing YOLO vs VQC results

- YOLO detections predicted MILCO on the mines in the Santos sonar dataset at around 45% recall and an mAP50 of 31.7%
- VQC replicates classical results with 910 images

REFERENCES

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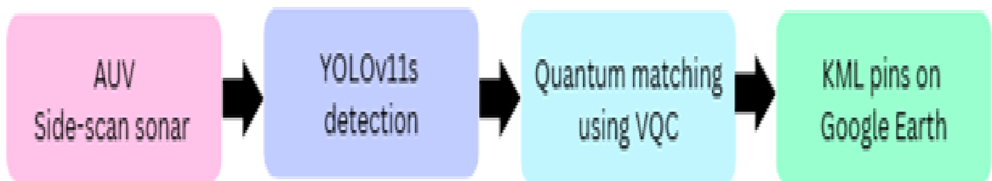
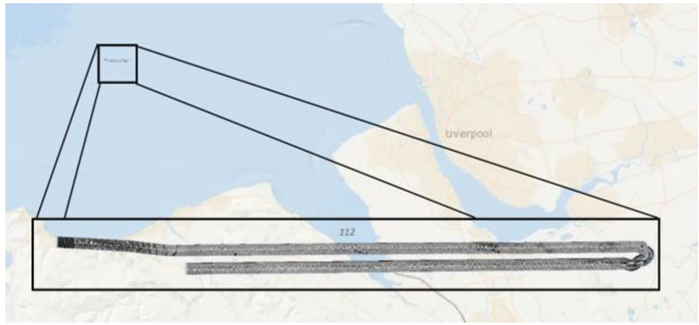


CONCLUSION

- Autonomous seafloor localization through instance segmentation improves object characterization using AWS Quantum circuits
- Future integration include segmentation and real-life coordinate pin-point on Google Earth map



Geoswath data collected from Gavia AUV shows its path near the Liverpool area

NEXT STEPS

- Instead of vague bounding boxes, the use of segmentation will give us a precise object shape
- Add LLM-generated survey reports from detection data
- VQC classification is the active research direction
- Validate classical vs quantum localization accuracy on noisy sonar imagery

Ira A. Fulton Schools of Engineering
ARIZONA STATE UNIVERSITY

Sensor Signal and Information Processing Center
https://sensip.asu.edu

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