2018-04

Networked Undersea Autonomous Sensing and Tracking

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Objectives

- Evaluate capabilities of acoustic vector sensors integrated into distributed platforms in providing bearing estimations for target motion analysis;
- Examine pros and cons of submerged platforms (UUVs) versus buoy systems;
- Evaluate options for acoustic signal processing;
- Evaluate trade-offs between system requirements, specifically power budget, data exfiltration options, and near-real-time reporting capabilities.

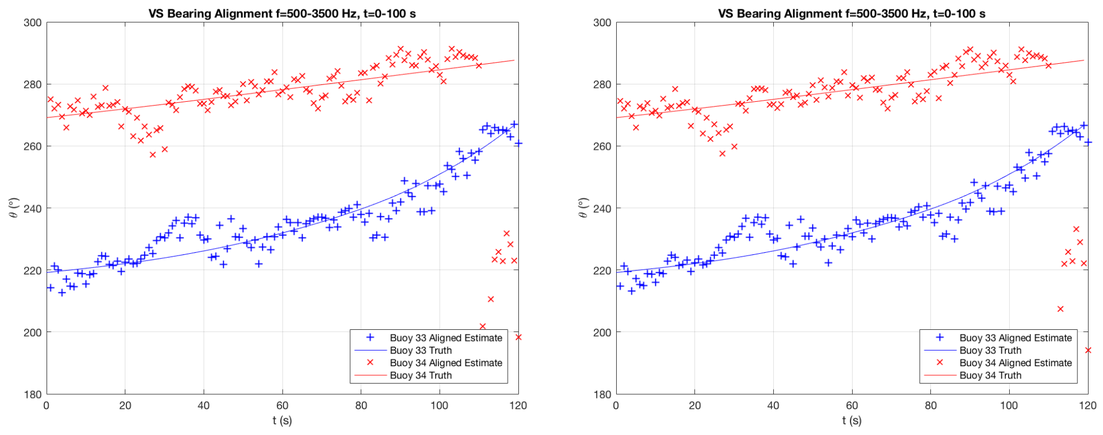
Methodology

- Integrate acoustic vector sensors into multiple distributed platforms, noting DAQ requirements, power limits, weight limits;
- Collect data simultaneously from separate systems during sea trials, first in Monterey Bay and then in Dabob Bay for analysis;
- Utilizing known targets of opportunity, evaluate performance of acoustic vector sensors in estimating target bearing based on various signal processing techniques;
- Perform basic TMA processing to assess the ability of such data to produce accurate tracking data.

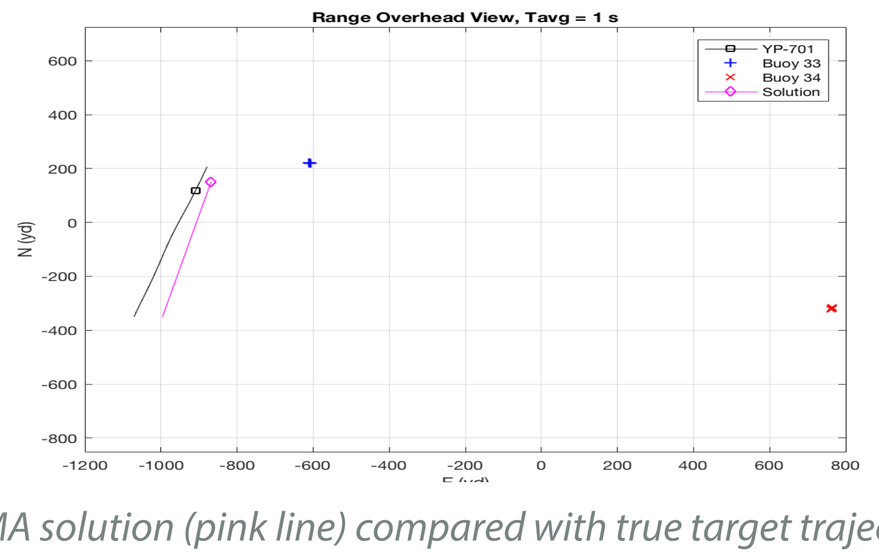
Findings and Conclusions

- Single vector sensors can effectively detect and provide good estimates of target bearing with an SNR of slightly less than 0 dB, providing useful TMA results;
- Both acoustic intensity processing as well as coherent processing produce similar results when only a single sensor is utilized;
- While UUVs provide depth excursions for sensors, they are significantly limited in mission time due to power constraints, and data exfiltration challenges;
- Sensors tethered to gateway buoys provide advantages through improved tracking, improved data exfiltration, and the potential for coherent/semi-coherent processing between distributed systems.

Drifting buoy systems (left) and tethered vector sensor suspended in mount (right) being prepared for deployment in Dabob Bay, Sept 2017.



Comparison of bearing estimates from two separate buoys (red and blue data points) relative to true (red and blue lines) from both acoustic intensity processing (left) and coherent linear processing (right).



Final TMA solution (pink line) compared with true target trajectory (black line) based on bearing estimates from two separate buoys (red and blue crosses)

Future Work

- Evaluate capabilities of such systems for real-time RF transmission of contact/bearing reports to command center for TMA;
- Investigate additional gains achievable by adding additional sensors to each buoy system;
- Investigate potential gains by streaming raw acoustic data over RF to command center for coherent processing between separate buoy systems.

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Topic Sponsor: Office of Naval Research, Code 321MS

NRP Project ID:
NPS-17-N100-A