EVALUATION OF MOTION CORRECTED OPEN OCEAN TURBULENCE MEASUREMENT TECHNIQUES

KOMOCSIN, REMY A., VANZWIETEN, JAMES H., NIEVES, ERIC, DALGLEISH, FRASER, AND VUORENKOSKI-DALGLEISH, ANNI

[1]*Komocsin, Remy A., NSF Undergraduate Research Scholar, Florida Atlantic University, Department of Ocean and Mechanical Engineering, 777 Glades Road, Boca Raton, FL, rkomocsin2016@fau.edu*

[2]*VanZwieten, James H., Southeast National Marine Renewable Energy Center, 777 Glades Road, Boca Raton, FL, jvanzwi@fau.edu*

[3]*Nieves, Eric, Florida Atlantic University, Department of Ocean and Mechanical Engineering, 777 Glades Road, Boca Raton, FL, enieves3@fau.edu*

[4]*Dalgleish, Fraser, Harbor Branch Oceanographic Institute, Florida Atlantic University, 5600 US-1, Fort Pierce, FL, fdalglei@fau.edu*

[5]*Vuorenkoski-Dalgleish, Anni, Harbor Branch Oceanographic Institute, Florida Atlantic University, 5600 US-1, Fort Pierce, FL, adalglei@fau.edu*

Future Ocean Current Turbines (OCTs) deployed off the east coast of the US will likely be moored where the water depth exceeds 300 meters and operate 50 to 100 meters below the sea surface. Like any in-stream hydrokinetic turbine, OCTs will be impacted by the local turbulent flow field. For tidal energy sites, turbulence measurements have been made using either bottom mounted Acoustic Doppler Velocimeters (ADVs) [1] or ADVs that are moored to the seafloor using compliant mooring systems [2]. Unfortunately, these techniques are impractical for OCT applications with a solution being to lower the ADV mounted to a Towfish to the proper depth from a surface vessel that is anchored, powered into the prevailing environmental conditions, or drifting. This turbulence measurement technique has some unique challenges that will be discussed on the poster. The challenges include 1) accounting for ADV motions that span a wider spectral range than typical tidal resource measurements when conducting motion correction and 2) accounting for the relative velocity of the ADV through the mean flow field when converting the measurements from spectra that are a function of frequency of encounter to wave number, and then finally to the frequency that would be observed from a stationary sensor. This project evaluates and refines techniques for processing Velocimetry data by first comparing results obtained from algorithms under development at Florida Atlantic University with those obtained using the Doppler Oceanographic Library for pYthoN (DOLfYN) code from the National Renewable Energy Laboratory. Data collected in the Gulf of Mexico are processed and compared in the time and frequency domain, demonstrating the need to account for ADV motions when applying Taylor's Frozen Field Hypothesis. This is highlighted in Figure 1, which compares 1) average flow speed, 2) magnitude of mean relative flow velocity and 3) mean of the sensor speed with respect to mean flow calculated using two different sensing approaches.

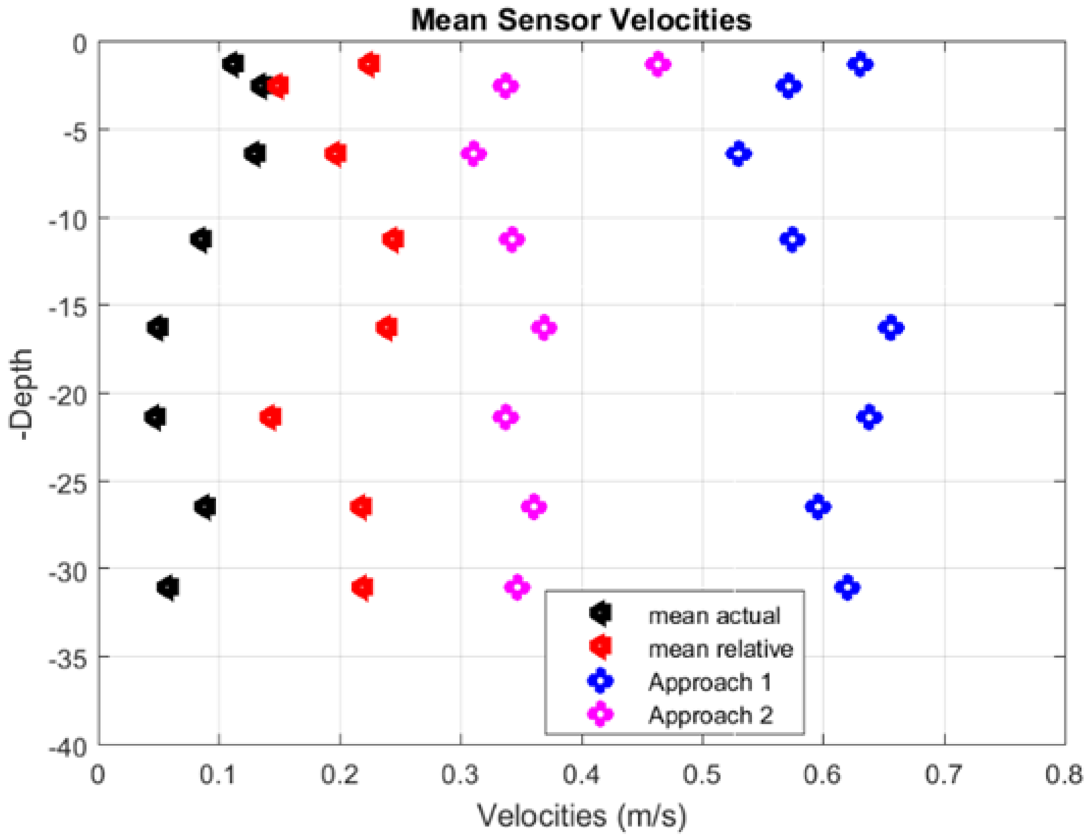

FIGURE 1. CALCULATED AVERAGE SENSOR SPEEDS WITH RESPECT TO MEAN FLOW VELOCITY CALCULATED USING THE TWO DIFFERENT APPROACHES. AVERAGE FLOW SPEEDS WITH RESPECT TO THE EARTH AND THE MAGNITUDE OF THE AVERAGE RELATIVE FLOW VELOCITY ARE PRESENTED FOR COMPARISON.

ACKNOWLEDGEMENTS

This work was funded by the National Science Foundation LEARN™ grant NSF DUE#1524601 (PIs: Dan Meeroff and Donna Chamely-Wikk). It was also funded by the US Department of Energy's Water Power Program through award DE-EE0004200. It was also supported by the Office of Naval Research, grant award number: N00014-15-1-2608 (PIs: Fraser Dalgleish and Anni Vuorenkoski-Dalgleish).

REFERENCES

[1] J. Thomson, B. Polagye, V. Durgesh and M. C. Richmond, "Measurements of turbulence at two tidal energy sites in Puget Sound, WA," J. Oceanic Eng., vol. 37, no. 3, 2012, pp. 363-374.

[2] J. Thomson, L. Kilcher, M. Richmond, J. Talbert, A. deKlerl, B. Polagye, M. Guerra and R. Cienfuegos, "Tidal turbulence spectra from a compliant mooring," Proc of 1st Marine Energy Technology Symp., Washington, D.C., 2013.