Enabling ADCP-Based Turbulence Measurements From a Moving Platform.

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Summary: Assessing the turbulence present in coastal flows is critical to connecting mixing processes to the oceanic structure easily observed by shipboard or autonomous underwater vehicle (AUV)-based sampling. However, commercially available instruments are unable to provide the high sampling and low noise levels needed to adapt to rapidly moving platforms such as a towed-bodies or AUVs. Support from the Rinehart Coastal Research Endowed Fund has allowed us to adapt multipurpose, high-frequency sonar electronics boards, recently developed by WHOI and capable of delivering the sample rates and processing flexibility required, into an instrument package suitable for deployment on a towed body.

Much of the work has been completed successfully and two instruments have been designed, fabricated, and assembled. Thorough testing of the instruments revealed that the high-frequency sonar boards performed well in high scattering environments typical of near-bottom environments, but had issues sampling at such high rates in low scattering environments typical of open ocean conditions. While correcting the issue, a characteristic of the board's design, was beyond the scope of the present work, the instruments can still be utilized in upcoming near-bottom deployments.

Project Background: Recent efforts have enabled sustained, long-term observations of turbulent dissipation from moored, high-resolution acoustic Doppler current profilers (ADCPs). While the results from fixed platforms were useful, the addition of dissipation estimates to hydrographic velocity estimates collected by a small towed-body surveying the water column besides a ship in the inner shelf, or an AUV traveling within the bottom boundary layer near the shelf break front, would greatly add to the dynamical analysis of the conditions present. However, the sampling and noise characteristics of the best sensor commercially available were not conducive to making quality turbulence measurements from a moving platform, and a new purpose-built instrument was required to allow similar levels of success.

Project Tasks: The goal of this proposal was to adapt recently developed specialized acoustic Doppler current profilers (ADCPs) for more general use in mid-water column environments and attached to moving platforms such as towed bodies. Specific tasks were to:

1. Purchase the required hardware (transducer, board, etc.)
2. Design and fabricate transducer heads and self-contained pressure cases systems that would adapt the specialized transducer heads to general uses (Figure 1)
3. Complete the adaptation of the high-frequency sonar electronics boards toward the generalized system.
4. Test the instruments in WHOI test tanks and with dock tests.
5. Prepare the systems for deployment in leveraged ongoing projects.

Results: Two new transducer heads were produced, assembled, and tested (Figure 1). However, during the testing task, both tank and dockside tests revealed that the high-frequency sonar boards performed well in high scattering environments typical of near-bottom environments, but had degraded performance at such high sample rates in low scattering environments typical of open ocean conditions.

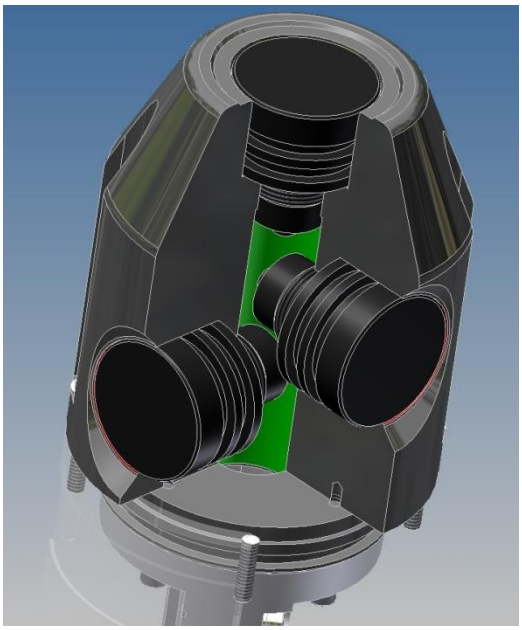

Figure 1: The designed and fabricated transducer head showing the locations of the three transducers with the cut-away.

Future Outlook: Sampling turbulence from a moving platform is more difficult than from a moored or fixed platform. The instrument must sample fast enough, with low enough noise to accurately resolve the individual eddies that account for most of the turbulent energy from a moving platform. This is difficult. The fastest sampling available using commercial instruments is too slow when noise levels are too high. Therefore, the science goals addressed above will have to wait for this issue to be resolved before proceeding further.

Although our project was not a total success, we are grateful for the support from the Rinehart Coastal Research Endowed Fund which allowed us to design two new instruments that can be used in new-bottom deployments.