

ORNL data post-processing methods for ADV and ADCP measurement at marine and hydrokinetic sites

measurement at marine and hydrokinetic sites

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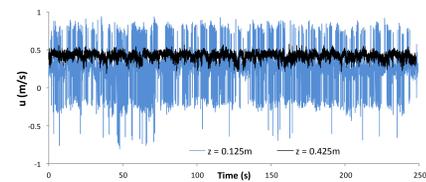
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1. BACKGROUND

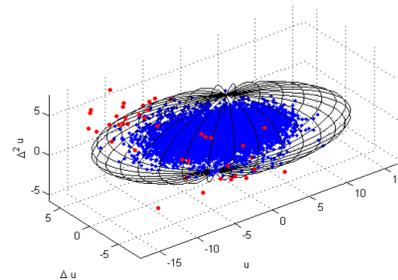
- Velocity and turbulence information is crucial for:
 - Marine and hydrokinetic (MHK) energy resource assessment
 - Evaluating environmental impacts of MHK technologies
 - Model development and validation
- Acoustic Doppler velocimeters (ADV) and Acoustic Doppler current profilers (ADCP) need data QA/QC and to output relevant information to estimate:
 - Power quantity & availability
 - Ultimate and fatigue loads
 - Wake flow recovery
 - Installation conditions

2. ORNL DATA POST-PROCESSING CODES

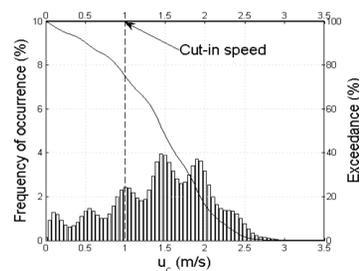
- Developed in Matlab
- Input: instantaneous velocity timeseries in ASCII format
- Noise filtering methods: Phase-spaced thresholding, Modified Phase-spaced thresholding, Correlation filter
- Output includes:
 - Noise-filtered instantaneous velocity data
 - Velocity, power and load timeseries and histograms
 - Reynolds stresses
 - Spectral energy densities



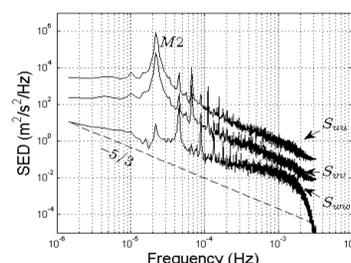
Velocity timeseries



PST algorithm



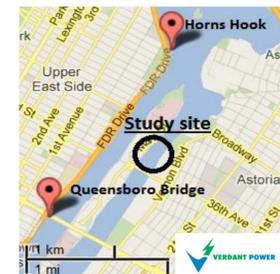
Power density histogram



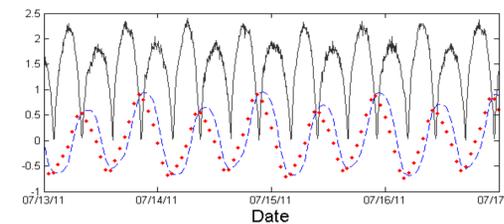
Low frequency spectra

3. EXAMPLES OF APPLICATION

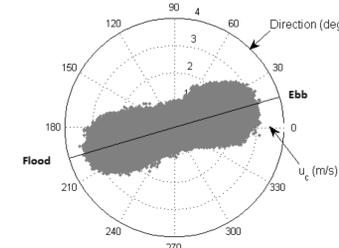
- Resource assessment and loading estimation at a tidal energy site in East River, NY



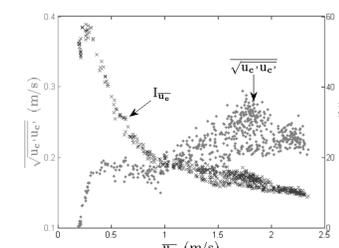
Site and NOAA gages locations



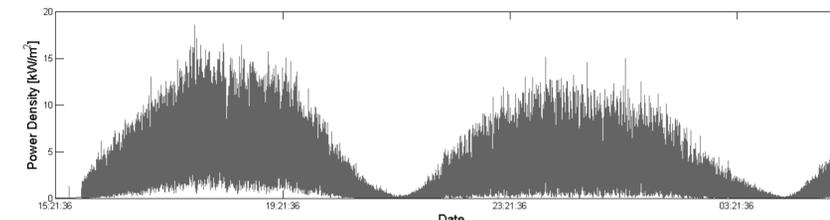
Hub height velocity and water level measurements



Hub-height velocity directions

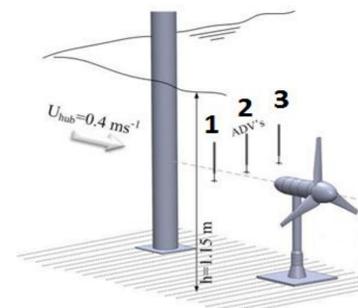


Turbulence levels



Power density variation over 14 hours

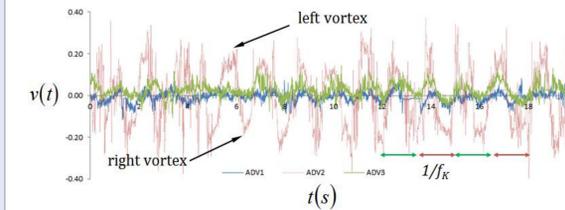
- Scale model testing (reference turbine, vortex shedding characterization, wake flow recovery, thrust calculation)



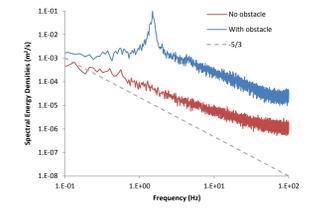
Measurement setting for vortex shedding characterization



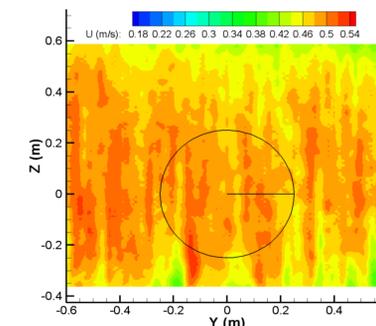
St. Anthony Falls Main Channel Facility



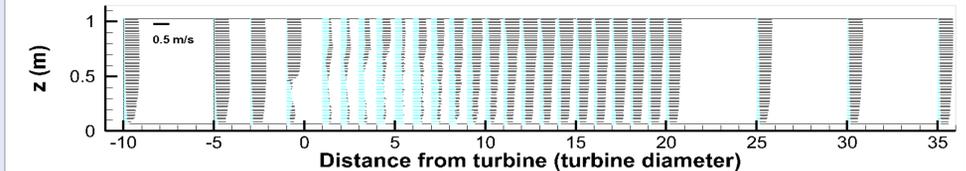
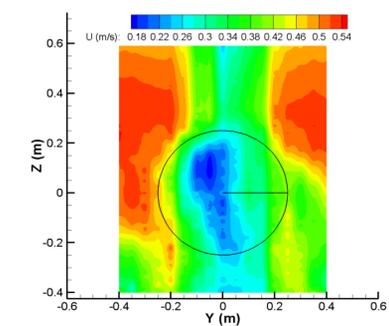
Lateral velocity timeseries of the right, mid and left ADVs



Spectral energy densities of the lateral velocity - with and without obstacles



Streamwise velocity at upstream (left) and downstream (right) of the turbine model – thrust calculation



Velocity and turbulence intensity at various distances from MHK scaled turbine model – wake flow recovery

5. REFERENCES

- Neary, V.S., Gunawan, B., Polagye, B., Thomson, J., Richmond, M.C., Durgesh, V., Muste, M. and Fontaine, A. (2011). Field measurements for MHK site development: Best practices manual ORNL/TML-2011/419.
- Gunawan, B., Neary, V.S. and McNutt, J.R. (2011) ORNL ADV post-processing guide and MATLAB algorithms for MHK site flow and turbulence analysis. ORNL/TML-2011/338.
- Gunawan, B. and Neary, V.S. (2011) ORNL ADCP post-processing guide and MATLAB algorithms for MHK site flow and turbulence analysis. ORNL/TML-2011/404.

6. ACKNOWLEDGEMENTS

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7. POINT OF CONTACT

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