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Considerations and Optimization of Time-Resolved PIV Measurements near Complex Wind-Generated Air-Water Wave Interface

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Time Resolved PIV measurements are applied on both sides of air-water interface in order to study the coupling between air and fluid motion. The multi-scale and 3-dimensional nature of the wave structure poses several unique considerations to generate optimal-quality data very near the fluid interface. High resolution and dynamic range in space and time are required to resolve relevant flow scales along a complex and ever-changing interface. Characterizing the two-way coupling across the air-water interface provide unique challenges for optical measurement techniques. Approaches to obtain near-boundary measurement on both sides of interface are discussed, including optimal flow seeding procedures, illumination, data analysis, and interface tracking. Techniques are applied to the IIHR Boundary-Layer Wind-Wave Tunnel and example results presented for both sides of the interface. The facility combines a 30m long recirculating water channel with an open-return boundary layer wind tunnel, allowing for the study of boundary layer turbulence interacting with a wind-driven wave field.

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