2022_28_Civil_Eng_Callaghan: Using Digital Imaging to Study Wind-Driven Laboratory and Ocean Waves with a Focus on the Development of Wave Breaking

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When the wind blows over the ocean surface the transfer of momentum and energy from the atmosphere to the ocean drives the generation of ocean waves. The transfer of momentum and energy leads to the continued development of the wave field until a steady state is achieved when the net transfer reaches zero. A necessary process that leads to the attainment of this steady state is energy dissipation by breaking waves. Characterising the development of (i) the wave field in general and (ii) individual waves in particular, to the point of breaking is key to understanding and predicting the occurrence of wave breaking. This characterisation is ideally done with measurements that can return time-evolving spatial information of the wave field across scales of several dominant wavelengths, and digital imaging is the ideal tool with which to accomplish this.

This project will use digital imaging techniques to characterise the temporal evolution of individual wind-driven waves in the laboratory and field. In the laboratory, you will use a dedicated wind-wave channel and a suite of time-synchronised digital cameras and LED lighting to image waves in scaled random sea-states. The data generated will be used to provide a novel and complete view of the evolution to breaking of individual waves in a combination of different sea states and wind conditions. The sea states in the laboratory can be precisely generated, controlled and repeated with the state of the art wave-making facilities in the Hydrodynamics Laboratory at Imperial College London. To complement the deterministic laboratory wave measurements, observations of wind-driven waves will be collected using a state of the art stereovision system currently installed on an oceanographic platform in the Adriatic Sea. Uniquely, the stereovision system is capable of producing 3-D maps of the surface wave field to provide detailed information on wave shape. While the laboratory data will be representative of unidirectional sea states, the field observations will be of waves that are directionally-spread, with the laboratory data providing a simplified representation of the real field conditions. Applications of the work are wide span the fields of Civil Engineering, Physical Oceanography, Air-Sea Exchange and Climate Science.

Suitable candidates will have a strong curiosity about the ocean waves which is supported by a suitable academic background in Physics, Mathematics, Oceanography or another numerate background. The successful candidate can expect to gain extensive experience in digital image acquisition and processing, wave physics and data analysis.

Please email Dr. Callaghan (a.callaghan@imperial.ac.uk) for further information.

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