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**Phase-Resolved Ocean Waves Prediction via Machine Learning**
FAZLOLAH MOHAGHEGH, University of California-Los Angeles, MOHAMMAD-REZA ALAM, University of California-Berkeley, JAYATHI MURTHY, University of California-Los Angeles — Phase-resolved prediction of ocean waves is one of the most important outstanding problems in ocean science and engineering. With an accurate prediction of ocean surface height, extreme events such as rogue waves can be braced for, or entirely avoided (e.g. via rerouting of ocean vessels); ocean wave harnessing devices can tune up in real-time to take the most energy out of incoming waves; and the final destination of passive floating particles (e.g. pollutants) can be precisely determined. The problem, however, is very complex because equations that govern the waves evolution are nonlinear; hence even inferring wave components that make up a given surface is already a difficult task. Here we show that a Convolutional Recurrent Neural Network (CRNN) has a strong potential to efficiently make real-time prediction of nonlinear non-breaking ocean waves. We use extensive direct simulation of nonlinear ocean waves to train and then test our proposed CRNN-based methodology. Each input node in our CRNN is composed of the discretized surface elevation in a given spatial domain at a specific time. The network takes a time-window of input nodes, and outputs the spatiotemporal prediction of surface waves. Accuracy, reliability and limitations of the proposed methodology are discussed.

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