New methods help fill in wave gaps for coastal planning

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The modelling of wave height is important to coastal and ocean engineering. Credit: Theophilos Papadopoulos

Researchers have tested two new methods for calculating and inserting vital missing data into wave models for future coastal and offshore engineering planning.

Led by Curtin University's Department of Spatial Sciences, in conjunction with Landgate and the CRCSI, this collaborative project found that the wavelet cubic spline method and fractal method were both effective in improving interpolation or estimation accuracy for most data

gaps.

However, Dr Xin Liu says more research is needed to better understand the complexities and uncertainties of wave generation.

"The modelling of significant wave height is important to coastal and ocean engineering applications, such as ocean resource management," Dr Liu says.

"It is a necessary component in the design and planning of coastal structures, harbours, waterways and shore protection.

"Many gaps exist in the records and they are not necessarily small. Although a number of previous studies have attempted to fill the gaps in wave height records, most of the interpreted results are not satisfactory.

"Our results indicate that both the wavelet cubic spline method and fractal method show advantages over the cubic spline method, on the average, for the whole dataset."

This was particularly true for medium and large gaps.

The methods were implemented for two case-study areas, Cottesloe and Port Hedland, which were selected because of their distinct wave and coastal features, allowing researchers to evaluate the robustness of the methods for both wave-dominated and tidal regions.

Researchers used the wavelet method to separate the time series of wave height into low and high frequencies for cubic spline interpolation and used the fractal method for larger gaps in order to simulate the whole time series pattern.

These two methods allowed for incorporation of wavelets—small waves

that decay and grow in a limited time—while taking into account the complexity of waves' fractured dimensions.

"Interpolation across gaps in records of significant wave height has always been recognised as a challenging task, even for the time series extension method," Dr Liu says.

"This is due to irregular or unidentifiable development patterns in wave height time series and the various gap sizes in records.

"However the irregular pattern of the time series has two main features: multi-frequencies and self-similarities. These features enable the application of the wavelet and fractal methods."

Dr Liu says future research will investigate other variable parameters contained within the methods and the role of wave climates on method accuracy.

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