Parameter identification of periodical signals: Application to measurement and analysis of ocean wave forces

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Abstract

This article presents an approach based on state observers to identify the parameters of an unknown periodic force exerted on a mechanical system. This approach comprises two stages and can be executed in real time by using only displacement measurements. The first stage goal is the estimation of the coefficients of a Fourier series that approximates the periodic force. From the estimated coefficients, the phase and the amplitude of the signal can be simultaneously computed; and from the estimated force, in a second stage, the frequencies of the signal can be estimated. To perform the tasks at each stage, two state observers were designed. To show the applicability of the proposed approach, the reconstruction of a wave force affecting a marine structure as well as the computation of the amplitude and phase of its spectral components was taken as case of study. The performance of the state observer was examined by means of simulations and off-line tests carried out with experimental data. Such data were obtained by executing laboratory tests and measuring waves in the Caribbean sea.

Keywords