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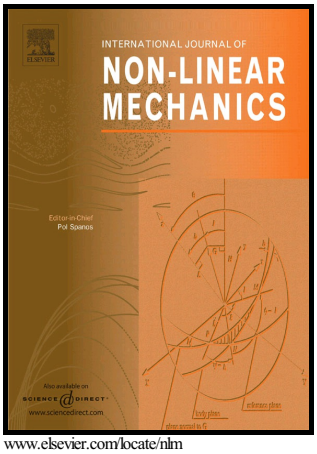

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Cross-correlation and cross-power spectral density representation by complex spectral moments

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Abstract

A new approach to provide a complete characterization of normal multivariate stochastic vector processes is presented in this paper. Such proposed method is based on the evaluation of the complex spectral moments of the processes. These quantities are strictly related to the Mellin transform and they are the generalization of the integer-order spectral moments introduced by Vanmarcke.

The knowledge of the complex spectral moments permits to obtain the power spectral densities and their cross counterpart by a complex series expansions. Moreover, with just the aid of some mathematical properties the complex fractional moments permit to obtain also the correlation and cross-correlation functions, providing a complete characterization of the multivariate stochastic vector processes.

Some numerical applications are reported in order to show the capabilities of this method. In particular, the examples regard two dimensional linear oscillators forced by Gaussian white noise, the characterization of the wind velocity field, and the stochastic response analysis of vibro-impact system under Gaussian white noise.

Keywords: Complex Spectral Moments, Mellin transform, Cross-Correlation, Cross Power Spectral Density

1. Introduction

In several structural dynamics problems the external agencies are often modeled as stochastic processes, e.g. ocean waves, earthquake excitation, wind velocity field, random vibration in mechanical devices, etc.[1, 2]. This approach to represent the real input in the structures implies that the responses of structural systems are stochastic processes too. The probabilistic characterization of such processes represents an important branch in the stochastic mechanics for the reliability analysis.

Several structural mechanical problems involve the stochastic analysis of structure under Gaussian processes. In such cases, a widespread way to get their stochastic characterization is given by two determin-

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