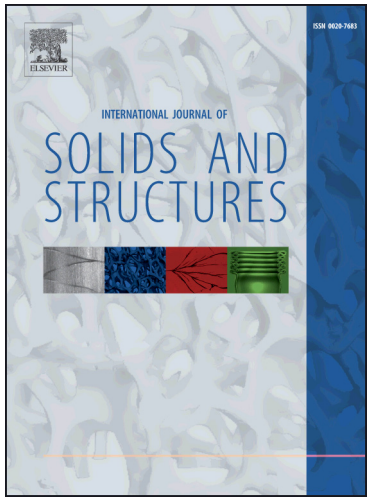

Efficient Bounds for the Monte Carlo – Neumann Solution of Stochastic Thermo-Elasticity Problems

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Efficient Bounds for the Monte Carlo – Neumann Solution of Stochastic Thermo-Elasticity Problems

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Abstract: The numerical solution of stochastic thermo-elasticity problems can be computationally demanding. In this article, a well-known property of the Neumann series is explored in order to derive lower and upper bounds for expected value and second order moment of the stochastic temperature and displacement responses. Uncertainties in axial stiffness and conductivity are represented as parameterized stochastic processes. Monte Carlo simulation is employed to obtain a few samples of the stochastic temperature and displacement fields, from which lower and upper bounds of expected value and second order moment are computed. The proposed methodology is applied to two linear one-dimensional thermo-elastic example problems. It is shown that accurate and efficient bounds can be obtained, for a proper choice of operator norm, with as few as one or two terms in the Neumann expansion. The Monte Carlo – Neumann bounding scheme proposed herein is shown to be an efficient alternative for the solution of stochastic thermo-elasticity problems.

keywords: Neumann series; Monte Carlo simulation; thermo-elasticity; stochastic processes.

1. INTRODUCTION

The last few decades have witnessed tremendous developments in the modeling of mechanical and structural systems, due to advances in computational mechanics. Numerical methods such as finite elements, finite difference, boundary elements, etc., have reached broad acceptability and wide