Analysis of Truss Structures with Uncertainties: from Experimental Data to Analytical Responses

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Abstract

In recent years, it has been recognized that the analysis of structural systems should take into account all the relevant uncertainties present in the analyzed problem.

Uncertainties associated with an engineering problem, due to the different sources, can be divided into two main groups: random uncertainties and epistemic uncertainties. The random uncertainties are completely characterized through the knowledge of the full set of its statistics or through the knowledge of its probability density function (PDF). It is well known that the probabilistic approaches give reliable results only when sufficient experimental data are available to define the PDF of the fluctuating properties.

Generally, it is assumed that the probabilistic distribution of data is given. On the contrary in this paper, starting from elastic modulus data obtained from tensile tests on several steel bars performed in the Laboratory of structures and materials of the Department of Engineering (University of Messina), the PDF of elastic modulus of the material is determined by the maximum entropy approach proposed by Alibrandi and Ricciardi (2008). Then the stochastic structural response of truss structures is derived in explicit approximate form by applying the Rational Series Expansion method recently proposed by Muscolino and Sofi (2013). The analytical results are compared with the ones obtained by applying the Monte Carlo Simulation.

References

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