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MODELING ROBUSTNESS AND STRUCTURAL RELIABILITY ANALYSIS

JAMES L. BECK[*], GERHART I. SCHUËLLER[†] AND HÉCTOR A. JENSEN[#]

[*] California Institute of Technology
Mail Code 104-44, Pasadena, CA 91125, USA, jimbeck@its.caltech.edu

[†] LFU, Institute of Engineering Mechanics
Technikerstrasse 13, 6020 Innsbruck, Austria, EU, Mechanik@uibk.ac.at

[#] Univ. Tecnica Federico Santa Maria, Dept. of Civil Engineering
Casilla: 110-V, Av. Los Placeres 401, Valparaiso, Chile, hector.jensen@usm.cl

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ABSTRACT

Robustness in the prediction of structural response is an essential requirement of structural analysis. In other words, any prediction has to satisfy certain tolerance criteria. Deviations in predictions are due to many possible sources, such as uncertainties, variabilities, incomplete model capabilities, etc. It has to be assured that the response quantities do not exceed a certain limit. The specification of these criteria relates to the subject of quality assurance. In order to assess the robustness of the prediction, the relation between the limits of the input and output has to be established. A local information on the robustness could be provided by a sensitivity analysis. In this context, it will be worth noting that there are generally various combinations of different types of inputs producing a single type of output. This way the critical parameters in the input can be identified by suitable computational routines. This may be established by e.g. standard FE procedures combined with search algorithms, etc.

The robustness of the prediction of the structural response is an indispensable prerequisite for assuring the safety of a structure, which may be quantied by its reliability. In this context the robustness and reliability estimation of systems with uncertainties is treated. To quantify the robustness, different methods as well as measures have been proposed. The most widely used procedure for this purpose is based on statistical and probabilistic reasoning including Bayesian analysis. Generally a limited number of simulations (range of 100 are typical) suffices to provide an overview on the structural variability or to reveal unexpected outliers. Alternative methods encompass fuzzy logic, interval arithmetic, possibilistic and info-gap analysis, respectively. Irrespectively of the particular method used, the analyst and designer is provided with additional information which enables him to improve the design and hence the quality of the structural system.