Applications of sensitivity analysis for modelling of structures with uncertain parameters

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Abstract

Solutions of engineering problems **q** depends on many parameters **h**, some of them are uncertain. In paper [1] were shown conjunctions between fuzzy and random sets. When parameters **h** are modelled by random sets then parameters **q** are also random sets. In calculation random sets model can be transformed to fuzzy sets model [1]. Using α-cut method equation with fuzzy parameters can be transformed to equation with interval parameters. The problem of finding exact range of function $q_i(...,h_j,...)$ when $h_j \in \left[h_j\right]_\alpha = \left[h_j^-, h_j^+\right]_\alpha \subset R$ is NP-hard [4]. When functions $q_i(...,h_j,...)$ are monotone then extreme values of $q_i(...,h_j,...)$ can be calculated using only endpoints of the intervals $\left\lfloor h_j \right\rfloor_\alpha$ [4]. Sometimes relation between **q** and **h** is given in the following form

$$\mathbf{F}(\mathbf{q},\mathbf{h}) = \mathbf{0}, \tag{1}$$

where $\mathbf{F}: R^n \times R^m \to R^n$. It can be shown that if some special Jacobian matrices are regular then the functions $q_i(...,h_j,...)$ are monotone [4]. In other cases monotonicity tests can be done using sensitivity analysis methods [2] in some point in the given intervals $\left\lfloor h_j \right\rfloor_\alpha$. From interval solutions $\left[q_i\right]_\alpha$ we can obtain fuzzy solutions. From fuzzy numbers we can calculate upper and lower probability [1] of the solutions of the given problem. Examples of applications of this method will be presented on the conference.

Keywords: interval arithmetic, fuzzy sets, random sets, uncertain parameters

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