Dependency Problem in the Modeling of Beams with Uncertain Parameters

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The Euler-Bernoulli beam is one of the most popular mathematical model of civil engineering structures (bridges, towers, buildings etc.). In many cases we do not know exact values of the parameters (material characteristics, geometrical parameters, loads). Sometimes it is hard to get probabilistic characteristics. In such situations interval and set-valued models can be applied. From mathematical point of view truss and frame structures can be described by the system of differential equations on manifolds. A set-valued solution of the beam equation can be defined in the following way

$$\mathbf{w}(x)=\left\{w(x):\frac{d^2}{dx^2}\left(E(x)J(x)\frac{d^2w(x)}{dx^2}\right)=q(x),E(x)\in\mathbf{E}(x),q(x)\in\mathbf{q}(x),w\in V\right\}.$$

For the problems with complex geometry it is hard to get the exact solution set-valued $\mathbf{w}(x)$. In order to get the solution different numerical methods can be applied (for example the Finite Element Method). The accuracy of the results depends on the discretization process. The discretization process require appropriate changes in the definition of the solution set. In this presentation relations between discretization process and the set-valued solution $\mathbf{w}(x)$ of the problem will be presented.