Which Method for Solution of the System of Interval Equations Should we Choose?

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Abstract

In many real world situations we do not know the exact values of the parameters p_i of the system. Very often we know only upper and lower bounds of the measurement errors Δ_i. In this case parameters p_i belong to appropriate intervals $[p_i - \Delta_i, p_i + \Delta_i]$. Many engineering problems can be described by the system of parameter dependent system of equations in the form $A(p)u = b(p)$ where p is a vector of uncertain parameters. Solution of the system can be defined as the following set $\{u : A(p)u = b(p), p \in \mathbf{p}\}$ or as the smallest multidimensional interval that contains this solution set where $\mathbf{p}$ is a multidimensional interval that contains all possible values of the uncertain parameters $(p_1, ..., p_m) = p$.
In this presentation several methods for solutions of such equations will be given. The most straightforward approach is based on direct application of existing optimization methods. In order to get the solution with guaranteed accuracy it is possible to apply special methods based on the interval arithmetic. It is also possible to apply the theory of perturbation numbers. Presented method can be applied for the solution of a different engineering or scientific problems. By comparing computational complexity, accuracy, domain of application it is possible to choose an optimal method for the solution of particular problem. It this talk several engineering applications as well as overview of the computational methods will be presented.