The Unbounded Parametric Tolerable Solution Set

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We consider a linear algebraic system $A(p)x = b(q)$, where the elements of the matrix and the right-hand side vector are linear functions of uncertain parameters p, q varying within given intervals $[p]$, $[q]$. The so-called parametric tolerable solution set

$$\Sigma_{tol}(A(p), b(q), [p], [q]) := \{x \in \mathbb{R}^n \mid (\forall p \in [p])(\exists q \in [q])(A(p)x = b(q))\}$$

is studied for unboundedness.

Basing on a characterization of the parametric tolerable solution set as a convex polyhedron, we present necessary and sufficient conditions (in both general and computable forms) for a nonempty parametric tolerable solution set to be unbounded. Every parametric tolerable solution set is represented as a sum of a linear subspace and a bounded convex polyhedron. The latter implies better estimations (outer and inner) for the unbounded parametric tolerable solution set. Numerical examples illustrate the discussed methodology and the solution sets.