# Semantic Tolerance Modeling based on Modal Interval Analysis

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**Abstrac**t

A significant amount of research efforts has been given to explore the mathematical basis for 3D dimensional and geometric tolerance representation, analysis, and synthesis. However, engineering semantics is not maintained in these mathematic models. It is hard to interpret calculated numerical results in a meaningful way.

In this paper, a new semantic tolerance modeling scheme based on modal interval is developed to improve interpretability of tolerance modeling. With logical quantifiers, semantic relations between tolerance specifications and implications of tolerance stacking are embedded in the mathematic model. The model captures the semantics of physical property difference between rigid and flexible materials as well as tolerancing intents such as sequence of specification, measurement, and assembly. Compared to traditional methods, the semantic tolerancing allows us to estimate true variation ranges such that feasible and complete solutions can be obtained.