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CONCURRENT TOLERANCE ALLOCATION IN MECHANICAL ASSEMBLIES BY DESING UNDER UNCERTAINTY METHODS

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One of the biggest challenges in the design of products that involve mechanical assemblies of parts is properly controlling the propagation of errors in manufacturing of the pieces in order to ensure assembly functionality. The way to achieve this, is through the control of manufacturing tolerances.

The tolerances represent the ranges of allowable errors to ensure the functionality of a mechanical assembly (depending on quality) at reasonable production costs (cost function). This range of variability allows a direct connection with the uncertainty associated with the process of design and manufacture of a product and its quantification from this relationship , looking for new ways to approach closest to the allocation design tolerances of complex engineering products.[1] The concurrent engineering approach seeks a balanced single set of tolerances for the two functions by simultaneous analysis of the effect of tolerances in both design and manufacturing.[2]

The proposed strategy was to establish a multi-objective optimization problem with two concurrent objective functions: loss of quality and manufacturing cost . The design space is related to the dimensions of the pieces in the assembly and their related variations.
The uncertainty modelling was based on the theory of evidence [3], given that it uses top and bottom for quantifying uncertainty limits , which is similar to the way tolerances are identified in a design.
The method of design optimization under uncertainty based on the robust design optimization (RDO) because this technique seeks the minimization of objective functions and seeks to reduce the sensitivity to uncertainty. [4],[5]. Sensitivity analysis was performed using a method based on the accumulation of tolerances of the root of the sum of squares (RSS) algorithm.

Initial tests were conducted on a set of three pieces controlling the variation of an assembly dimension . Preliminary results show a set of tolerances easier to control with respect to those obtained using traditional techniques or by purely deterministic strategies .

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