The Contradiction Index (CI): A New Metric Combining System Complexity and Robustness for Early Design Stages

For complex and integrated products, companies experience difficulties in achieving a satisfactory and consistent functional performance. When a design has "contradicting" parameter/property requirements it often requires fine tuning with numerous design iterations and complex optimizations to find the "sweet spot" where all functional requirements are fulfilled. This often leads to a lack of robustness, where tight tolerances are required and small defects have knock-on effects throughout the product. In this article we propose the Contradiction Index (CI) to gauge how contradicting the requirements of the different parts are with respect to the different functions. This article provides a step-by-step guide for how to estimate the CI for a design. The method is applied to a case study - the FlexTouch®, a Novo Nordisk insulin injection device. When analyzing the CI for each part, against the number of part design iterations, a positive correlation was found. Furthermore, when correlating the CI against the number of challenging tolerances statistical significance was found ($p=0.01$). It is envisaged that the CI will be a powerful approach to estimate and compare development difficulty and to guide development and design improvements.

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