Topology Optimization Based on an Approximate Model of a 2D Link Mechanism Derived from Generalized Continuum Mechanics

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Abstract

This study presents a topology optimization method for synthesizing multi-input and multi-output link mechanisms. Traditional approaches rely on intuition, limiting complexity. Using micropolar elasticity, which independently defines bending and tensile stiffness, we model links and joints with distinct elastic properties. This allows accurate approximation of link mechanisms within a multi-material topology optimization framework. The optimization minimizes displacement errors and strain energy, ensuring desired motion with appropriate degrees of freedom. Numerical examples demonstrate successful designs of multi-output and multi-input slider-crank mechanisms, showcasing the method's potential for lightweight, robust solutions. This work enables advanced mechanism synthesis and offers avenues for experimental validation.

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