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Optimum Design of Hybrid (Metal-Composite) Mechanical Power Transmission System under Uncertainty by Convex Modelling

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Abstract : The design models dealing with flawless composite structures are in abundance, where the mechanical properties of composite structures are assumed to be known a priori. However, if the worst case scenario is assumed, where material defects combined with processing anomalies in composite structures are expected, a different solution is attained. Furthermore, if the system being designed combines in series hybrid elements, individually affected by material constant variations, it implies that a different approach needs to be taken. In the body of literature, there is a compendium of research that investigates different modes of failure affecting hybrid metal-composite structures. It covers areas pertaining to the failure of the hybrid joints, structural deformation, transverse displacement, the suppression of vibration and noise. In the present study a system employing a combination of two or more hybrid power transmitting elements will be explored for the least favourable dynamic loads as well as weight minimization, subject to uncertain material properties. Elastic constants are assumed to be uncertain-but-bounded quantities varying slightly around their nominal values where the solution is determined using convex models of uncertainty. Convex analysis of the problem leads to the computation of the least favourable solution and ultimately to a robust design. This approach contrasts with a deterministic analysis where the average values of elastic constants are employed in the calculations, neglecting the variations in the material properties.

Keywords : convex modelling, hybrid, metal-composite, robust design
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