Control Strategies and Modeling Challenges in Magnetorheological Elastomer Applications: A Review

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ABSTRACT – Magnetorheological elastomers (MREs) exhibit field-dependent mechanical properties that can be rapidly and reversibly tuned under external magnetic stimuli. This unique capability has driven significant research interest in their application to adaptive engineering systems, including vibration isolation, adaptive suspension, medical devices, and seismic mitigation. However, practical implementation remains challenging due to the need for accurate modeling and effective control system strategies that can reliably transform MRE material behavior into desired system performance. This article provides a concise yet comprehensive perspective on the development of modeling and control system strategies for the implementation of MRE based devices. It also reviews a wide range of MRE applications and highlights the integration of MRE models into control systems as a supplementary means of enhancing device performance, thereby strengthening understanding, guiding design considerations, and encouraging further research toward the effective deployment of MREs in real-world applications.