ON THE USE OF MACHINE LEARNING FOR VIBRATION CONTROL PURPOSES: BENEFITS AND CHALLENGES

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The application of data science and machine learning has significantly expanded the potential for advanced design of engineering structures. To highlight the beneficial use of machine learning methodologies, this research first provides a summary of the author's results related to structural design, specifically targeting objectives centered on vibration control. The focus is on a base excited metastructure that incorporates periodically arranged external units, each containing internal oscillators that act as vibration resonators. The initial design of the metastructure aimed to reduce vibrations around the first structural resonance was characterized by uniformity, with all resonators being identical.

To achieve the efficient vibration attenuation around the second resonance, while also addressing higher resonances simultaneously, a machine learning methodology was utilized. Various optimality criteria led to different shapes and distribution solutions for the vibration resonators. The redesigned metastructures, developed in accordance with these criteria, were produced using 3D printing technology, and their improved vibration mitigation performance is validated experimentally. Besides pointing out the exploited beneficial effects of the applied machine learning techniques, certain challenges and potential issues brough into bear by systems' dynamics are discussed as well, both specifically for this study but also for vibration control, in general.