GRADUATE STUDENT RESEARCH SEMINAR SERIES (2017)

HARNESSING THE QUASI-ZERO STIFFNESS CHARACTERISTIC FROM FLUIDIC ORIGAMI FOR VIBRATION ISOLATION

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Origami exhibits many unique characteristics that make it desirable for engineers. For example, a stacked origami architecture shows intricate relationships between the geometry of folding and the elastic deformation of constituent sheet materials, which leads to nonlinear properties such as negative Poisson's ratio and multi-stability. Furthermore, such a stacked origami architecture consists of naturally embedded tubes that can be pressurized (aka. fluidic origami) to create adaptive functions such as shape transformation, stiffness control, and recoverable collapse. This research investigates a quasi-zero stiffness (QZS) property from the pressurized fluidic origami cellular solid, and examines how this QZS property can be harnessed for low-frequency base excitation isolation. The QZS property originates from the nonlinear geometric relations between folding and internal volume change, and it is directly correlated to the design parameters of the constituent Miura-Ori sheets. Two different structures are studied to obtain a design guideline for achieving QZS: one is identical stacked Miura-Ori sheets (ismo) and the other is non-identical stacked Miura-Ori sheets (nismo). Further dynamic analyses based on numerical simulation and harmonic balance method (approximation) indicate that the QZS from pressurized fluidic origami can achieve effective base excitation isolation at low frequencies. At the next stage, a more comprehensive amplitude and frequency numerical study will also be presented, and the behavior and efficiency of the nonlinear origami system will be investigated under a broader range of excitation parameters

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