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Preliminary Analysis of using Inertial Mass Damper to mitigate the Cable Vibration

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ABSTRACT
Stay cables used in cable-stayed bridges, are prone to vibration due to their low inherent damping characteristics. Many methods have been implemented in practice to mitigate such vibration. Recently, negative stiffness dampers have gained attention, because of their promising energy dissipation ability. The viscous inertial mass damper (VIMD) has been shown to have similar properties to the negative stiffness dampers. This presentation will try to examine the potential of the VIMD to enhance the damping and mitigate the vibration of stay cables. First, a control-oriented model of VIMD is employed to formulate a system-level model of the cable-VIMD system. The modal characteristics of the system are analyzed, and the optimal damper parameters for the first several modes are determined numerically. The results show that the achievable modal damping ratio can be nearly an order of that of the traditional linear viscous damper; note that the optimal parameters of VIMD are distinct for each mode. These results are further validated through analysis of the cable response due to a sinusoidal excitation at each natural frequency. Finally, a case study is conducted for a cable with a length of 307 m, including the preliminary design of practical damper parameters, modal damping enhancement, and vibration mitigation under wind loads. The results show that the VIMD is promising practical passive damper which possesses much better energy dissipation capacity than the traditional viscous damper for such cable-damper systems.

KEYWORDS: *stay cable; viscous inertial mass damper; passive control; negative stiffness; damping enhancement*