A Note on Switchable Vibration Absorber Concepts based on Magneto- or Electrorheological Fluid Dampers

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Abstract

To reduce exceeding vibrations in resonance regimes of weakly damped forced excited systems, dry friction based vibration absorber elements can be used, either outside the force flow as *dynamic vibration absorber element* (Figure 1a) or within the force flow as *sequential friction-spring element* (Figure 1b). Such dry friction based concepts offer limiting energy dissipation compared to purely viscous damped element [1, 2].

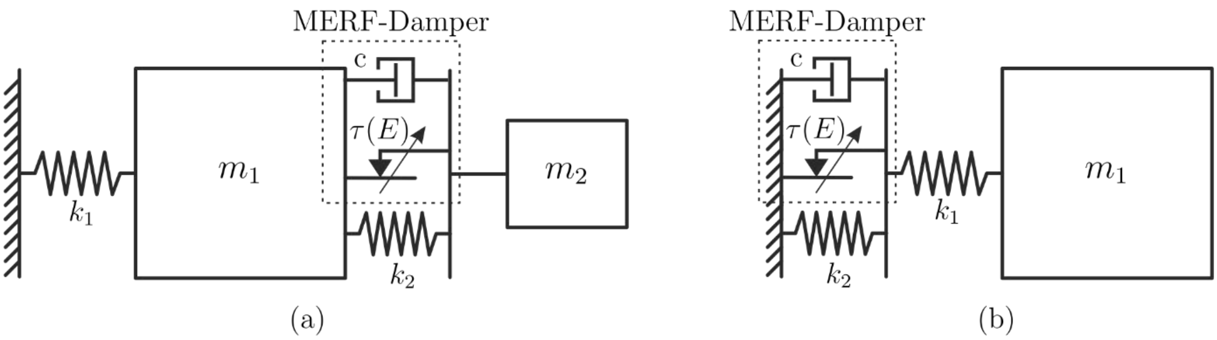

Figure 1. MERF-Damper arrangement as (a) *dynamic vibration absorber element* and (b) *as sequential friction-spring element*

Magneto- or electrorheological fluid dampers, called MERF-dampers, behave in a phenomenological sense roughly as a combination of a viscous damper with a dry-friction element [3], whose friction coefficient is able to be varied. This can be done by changing the fluids yield stress due to changing magnetic or electric field strength. The adaptation of the friction coefficient to the excitation frequency can be helpful to further improve vibration reduction within the resonance regime.

The contribution of this work is the presentation of the principal concept of frequency based switchable vibration absorbers using magneto- or electrorheological fluid systems. This allows to reduce the vibrations by simultaneously reducing the energy dissipation outside the resonance, contrary to e.g. [4]. The objective is to analyze the ability of MERF-dampers to suppress oscillations over a wide range of excitation frequencies in their application as vibration absorbers to a forced excited 1-DOF mass-spring system. Therefore, the two aforementioned vibration absorber concepts are analyzed. In order to describe the system's dynamics, parameter studies are performed by the means of numerical simulations. For a standard parameter set the viscosity as well as the yield stress of the fluids are varied to find the optimal excitation frequency for switching the fluid behavior. Furthermore, the results are compared with the arrangements containing solely dry friction.

The results show that for both arrangements an optimal value of friction or yield stress can be found, yet the MERF alternative offers more flexibility against system changes. The simulations offer insight into the vibrational behavior and damping of an MERF-damper in its application as a vibration absorber.

References

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