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CHARACTERIZATION OF SMART FLUID DAMPERS USING RESTORING FORCE SURFACE METHOD BASED ON ACCELERATION FEEDBACK

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Summary: The restoring force surface (RFS) method of nonlinear system characterization requires the simultaneous input of displacement, velocity and acceleration signals. A practical technique requires that only one of these quantities can be measured and estimate the others by numerical integration and/or differentiation. Up to now, the prediction of the damper force using RFS has been done before based on displacement and velocity measurements but these two input signals require expensive hardware equipment. The magnetorheological (MR) damper is one of the most famous smart fluid industrial applications because it has many advantages such as mechanical simplicity, high dynamic range, low power requirements, large force capacity and robustness.

This paper introduces a precise selection of data input to the restoring force surface to predict the damping force of MR dampers. An RFS method for predicting the MR damper force based on acceleration feedback is investigated due to the advantages of the accelerometers. It consists of a two dimensional interpolation using Chebyshev orthogonal polynomial functions to identify the damping force as a function of the velocity, acceleration and input voltage. The identification and its validation are done based on simulated data generated by a theoretical model of an MR damper. Validation data sets representing a wide range of operating conditions of the MR damper show that the usage of RFS to predict the damping force for known velocity and acceleration is reasonably accurate compared to the prediction based on displacement and velocity.