제진장치의 최적제어기 설계

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Design of Optimal Controller for Vibration Isolator

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In this study, an optimal controller design based on Model Predictive Control (MPC) method for a conventional vibration isolator will be discussed. This isolator modelling is a one degree of freedom vibration isolator composed of mass, spring, damper and actuator mechanism. MPC models predict the change in the dependent variables of the modeled system that will be caused by changes in the independent variables. In this study process, dependent variables that can be adjusted by the controller are either displacement and velocity of mass, or the control input force etc. Independent variables that can not be adjusted by the controller are used as disturbances. MPC uses the current plant measurements-displacement of isolator's mass, the current dynamic state of the process, the MPC models, and the process variable targets to calculate future changes in the independent variables. These changes are calculated to hold the dependent variables close to target while honoring constraints on both independent and dependent variables. The Receding horizon control technique is applied for optimization control. An optimization cost function J over the receding prediction horizon is formulated to calculate the optimum control input. Some analysis result will be also introduced to verify the effectiveness of control procedure.

Model discrete-time State-Space equation (sampling time = 0.02 seconds)

$$\begin{cases} x(k+1) = \begin{bmatrix} 0.9583 & -3.9429 \\ 0.0197 & 0.9603 \end{bmatrix} x(k) + \begin{bmatrix} 0.0197 \\ 0.0002 \end{bmatrix} f \\ X\_f = [0 \;\; 1]\, x(k) \end{cases} \quad (1)$$

Constraint in the output: $-8 \le X\_f \le 8$ (mm). Constraints in the input: $-300 \le f \le 300$ (N), $-6 \le \triangle f \le 6$ (mm)

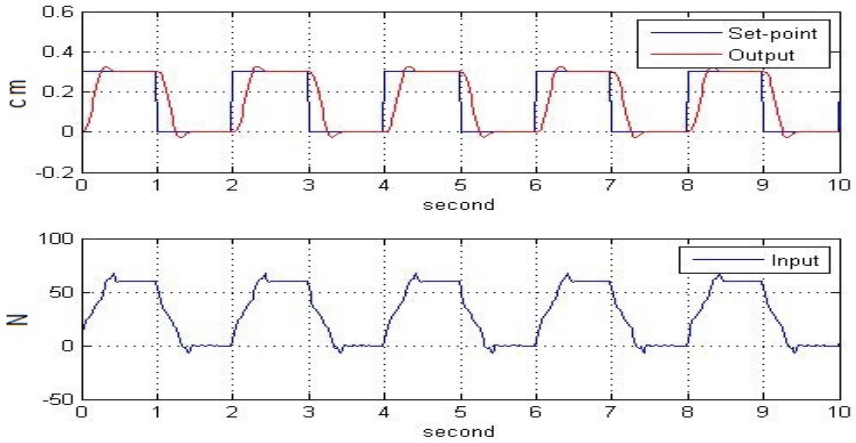

Fig. 1 Simulation results are shown out in Fig. 1.

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References

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