

A Novel Fast Model Predictive Control for Large-Scale Structures

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Abstract

To protect the civil structures from natural hazards, especially for large-scale structures, a novel fast model predictive control (NFMPC) method is presented in this paper. Based on the second-order dynamic equation, a novel explicit expression form of Newmark- β method is first derived, from which the future states can be easily predicted without the computation of the matrix exponential. By applying this explicit expression form into the standard model predictive control (MPC) method, the NFMPC method is developed. Based on the explicit expression form, the optimal control input can be computed by two off-line transient analyses and one on-line transient analysis at every sampling instant on the structure. For no computation of matrix exponential, the off-line computation efficiency of NFMPC is several orders of magnitude higher than that of MPC. And the small amount of on-line computation guarantees the on-line computation efficiency. Furthermore, the use of the Newmark- β method also guarantees the computation accuracy. At last, several typical numerical examples are carried out to verify the validity and high efficiency of NFMPC by the comparison with MPC.

Keywords: Large-scale structures, fast model predictive control, explicit expression form, Newmark- β method, transient analysis.