Conference

Stability and bifurcation analysis of a nonlinear delay equation model for drilling

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Abstract

We study a model for chatter in twist drills derived by Stone and Askari (Dynamical Systems, 2002) in which a linear vibration mode interacts with nonlinear cutting forces. This results in a delay differential equation describing an oscillator that is nonlinear in damping and with cross-terms in the damping and the delay. We perform linear stability analysis of the model and nonlinear analysis of the stability of the primary Hopf bifurcation. The latter is done via the construction, using symbolic algebra, of a two dimensional centre manifold in the infinite dimensional phase space of the delay differential equation. Our analysis shows that the stability of the Hopf bifurcation depends on the type of vibration in question and on the cutting speed.