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Dynamics and control of self-excited system under parametric or external excitations and time delay

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Abstract: Self-excited vibrations which may occur in many mechanical systems are well known and deeply studied in the literature. However, the phenomena typical for this type of vibrations may change if they interact with different vibrations which may occur at the same time. Classical examples are vortex–induced vibrations occurring owing to fluid flow, which may interact with vibrations generated by different mechanisms, such as parametric excitation or external loading. One of the important effect of such interactions is quasi-periodic oscillation composed of at least two incommensurate frequencies which near the resonance zones bifurcates into periodic one via Hopf bifurcation of the second kind. Then, the so called frequency locking phenomenon is observed. The self-excitation frequency is locked by parametric or external excitation and large periodic oscillations arise. Dynamics of the system can be controlled by added time delay input. The goal of this paper is to study analytical model of a self-excited oscillator driven by parametric or external excitation with added time delay signal which is treated as an input supplied from the controller. The influence of time delay on bifurcation scenario and vibration control will be demonstrated analytically by the multiple time scale method applied to time delayed system and also numerically by direct numerical simulations of the original delayed ordinary differential equations.

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