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Non Trivial Effect of Strong High-Frequency Excitation on a Nonlinear Controlled System

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Nontrivial effects of high-frequency excitation on mechanical uncontrolled systems have been investigated intensively in the last decade. Some of these effects are usually used in controlled systems in form of dither to smoothen out undesired friction and hysteresis. However the level of damping due to control is usually high compared to uncontrolled systems. A standard optimal controller for a standard nonlinear system (a movable cart used to balance a pendulum vertically) is shown to exhibit pronounced bias error in presence of HF-excitation. The bias increases with increased excitation intensity, but it also increases with the increased control power. Analytic prediction for the bias shows, the interaction between fast excitation and strong damping terms in the control system to be the cause of the permanent control error. A “slow observer” ignoring fast motions is shown to be the simplest way to avoid the undesired bias in the considered particular system.

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