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Summary of the Ph.D. Dissertation

Repetitive control (RC) has been used in various industrial applications. The aim of RC is to asymptotically track/reject periodic references/disturbances. Typically, these signals are of known fundamental period but unknown amplitudes and phase. A main focus of the dissertation is the robustness of RC schemes to plant model uncertainty. In particular, the trade-offs and limitations imposed by robustness requirements on steady state disturbance response and transient performance are investigated. Controller designs and implementations are also considered.

In the dissertation, robustness is measured using the gap metric. A linear control approach to RC is first investigated. An expression for the optimal gap metric robustness margin subject to the requirement of asymptotic rejection of periodic disturbances is derived. This shows the interaction between robustness and RC requirements. As a complement to this, the optimal achievable steady state attenuation for a prescribed robustness level is also given. For the transient state, a *power-energy induced measure* is defined. This measure describes the energy of the worst transient output corresponding to periodic inputs with unit power. The relation between this transient measure and robustness is examined. A CD player control design problem is considered both theoretically and experimentally. Two design approaches are considered, one of which is implemented in real-time on a CD player experimental rig. Finally, the dissertation considers nonlinear RC. It is pointed out that complete asymptotic rejection of a periodic disturbance is not achievable robustly with a linear controller in the case that the periodic signal has infinitely many non-zero harmonics. It is shown that nonlinear control can achieve robust asymptotic disturbance rejection for a specific waveform, e.g. for a triangular waveform disturbance.