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Fourier Synthesis and Robust Control of Quantum Dynamics[1]

NAVIN KHANEJA, Harvard University

The problem of manipulating quantum systems with uncertainities or inhomogeneties in parameters governing the system dynamics is ubiquitous in spectroscopy, metrology and quantum information processing. Typical settings include resonance offsets, inhomogeneties in strength of excitation field, time dependent noise, adressing errors etc. There is widespread use of adiabatic and composite pulses to compensate for these inhomogeneties. In this talk we describe the mathematical aspects of quantum dynamics that make such compensation possible. We analyze what kind of errors can and cannot be corrected. Finally we describe Fourier synthesis methods for design of compensating pulse sequences. Applications of these ideas to NMR spectroscopy in inhomogeneous static and radio-frequency fields are discussed.