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Proposed Lecture #2

Title: Nonlinear dynamics in microelectromechanical systems

Abstract: Nonlinear phenomena in microelectromechanical systems (MEMS) are ubiquitous, and stem from a variety of sources. The understanding of these effects is essential for developing accurate device models providing physical insights underpinning performance / robustness optimisation, and may be harnessed to design devices with new principles of operation demonstrating significantly improved performance. This will be illustrated through a number of case studies – (1) the interaction between noise processes and resonator nonlinearities in a feedback oscillator [1], (2) leading to limitations on the output stabilities for resonant accelerometers [2], (3) resonators demonstrating double hysteresis characteristics with competing nonlinear effects [3], (4) the principle of parametric resonance applied to the design of wideband vibration energy harvesters [4], (4) nonlinear modal coupling in standalone micromechanical resonators [5] leading to the generation of (5) phononic frequency combs [6] enabling applications such as the stable tracking of resonant frequencies in physical sensors without the requirements for an external feedback oscillator [7], (6) electrically tuneable parametric mode coupling in electrostatically driven gyroscopic ring resonators [8].

References:

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