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Harmonic Detection of ω_0/n Superharmonics in Microcantilevers via Electrostatic Actuation/ Detection J. GAILLARD, J. TAYLOR, G. KESKAR, M. SKOVE, A. RAO, Clemson University — In nonlinear dynamics, mechanical motion can be made up of a complicated mixture of vibrations. In resonating structures, nonlinearities are ubiquitous and more often than not are undesirable. On the other hand, nonlinear dynamics and chaos in electrostatic microelectro-mechanical systems (MEMS) has been shown to be useful for various applications, including secure communications, MEMS filters, and scanning force microscopy. Exploiting these dynamics opens the door for nanoelectro-mechanical systems (NEMS) by providing signals with higher quality factors and better signal-to-background ratios. In cantilever-based MEMS, the nonlinear dynamics usually stem from harmonically forced excitation in which only the second superharmonic has been theorized or detected. Here we measure the nonlinearly modulated charge on a silicon microcantilever up to the seventh superharmonic of the fundamental resonant mode via electrostatic actuation/detection. In agreement with experiment, simulated results reveal that the time dependence of the modulated charge due to the cantilever's motion carries a set of harmonics for each superharmonic of order $\omega 0/n$. We propose that using a system of harmonics and modes of the cantilever increases applications for cantilevered and doubly-clamped microbeams, and that exploiting the nonlinearities in the modulated charge provides a valuable tool for the study of the dynamics in electrostatic transduction.

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