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A self-saturating mechanical oscillator with linear feedback

CHANGYAO CHEN, Argonne National Lab, DAMIAN ZANETTE, Centro Atmico Bariloche, DAVID CZAPLEWSKI, JEFFREY GUEST, DANIEL LOPEZ, Argonne National Lab — Oscillators, opposed to resonators, produce a prescribed periodic signal without any external frequency reference. In order to maintain stable oscillations, there needs to be an amplitude limiting mechanism, which is usually realized by saturating at least one of the sustaining amplifiers. Here we demonstrate a simple oscillator structure that solely relies on the nonlinearity inherent to the constituent mechanical resonator to limit the oscillating amplitude, while the performance of the feedback loop remains in the linear regime. To validate the model, we experimentally demonstrate the principle using a non-linear silicon microelectromechanical (MEMS) resonator, and perform comprehensive characterizations that agree well with the theoretical predictions.

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