Efficient parametric amplification in micro-resonators with integrated piezoelectric actuation and sensing capabilities

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We report, in this work, on unprecedented levels of parametric amplification in microelectromechanical resonators, operated in air, with integrated piezoelectric actuation and sensing capabilities. The method relies on an analytical/numerical understanding of the influence of geometrical nonlinearities inherent to the bridge-like configuration of the resonators. We provide analytical formulae to predict the performances of the parametric amplifier below the nonlinearity threshold, in terms of gain and quality factor (Q) enhancement. The analysis explains how to overcome this nonlinearity threshold by controlling the drive signals. It predicts that in theory, any Q-factor enhancement can be achieved. Experimental validation demonstrates a Q-factor enhancement by up to a factor 14 in air.

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