Effects of quadratic and cubic nonlinearities on a perfectly tuned parametric amplifier - DTU Orbit (10/12/2018)

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We consider the performance of a parametric amplifier with perfect tuning (two-to-one ratio between the parametric and direct excitation frequencies) and quadratic and cubic nonlinearities. A forced Duffing–Mathieu equation with appended quadratic nonlinearity is considered as the model system, and approximate analytical steady-state solutions and corresponding stabilities are obtained by the method of varying amplitudes. Some general effects of pure quadratic, and mixed quadratic and cubic nonlinearities on parametric amplification are shown. In particular, the effects of mixed quadratic and cubic nonlinearities may generate additional amplitude–frequency solutions. In this case an increased response and a more phase sensitive amplitude (phase between excitation frequencies) is obtained, as compared to the case with either pure quadratic or cubic nonlinearity. Furthermore, jumps and bi-stability in the amplitude–phase characteristics are predicted, supporting previously reported experimental observations.