Numerical simulations of wave turbulence in vibrating plates

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This work is concerned with numerical simulations of wave turbulence in elastic plates. Nonequilibrium solutions to the kinetic equations, leading to Kolmogorov-Zakharov power spectra, have been previously derived in a theoretical framework for elastic plates satisfying the von Karman equations. Early experimental work however showed discrepancies between the observed data and the theoretical predictions. Here a finite difference code is used to simulate the turbulent regime of a plate vibrating at large amplitudes, hence allowing a computational framework that is closer to the experiments as compared to already published results. Physical boundary conditions are enforced, and the harmonic forcing is pointwise. An energy-conserving time-stepping scheme is used hence allowing for a perfect discrete conservation of energy in the conservative case. Finally, two types of damping laws, independent of the frequency or linear with the frequency, can also be implemented. Undamped simulations are run first to check the numerical results with theoretical predictions. The absence of damping allows to generate an energy cascade up the numerical cutoff frequency (close to the Nyquist frequency). The influence of different geometrical parameters (thickness, initial geometric imperfection, etc) on derived quantities such, for instance, the injected power and the spectral amplitudes is quantified. Relations between these quantities is derived in the form of power laws. Finally, damping is reintroduced in the simulations in order to clearly quantify its influence on the wave turbulence spectra.