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A weakly nonlinear model with exact coefficients for the fluttering and spiraling motions of buoyancy-driven bodies JACQUES MAGNAUDET, CNRS/IMFT, JOEL TCHOUFAG, DAVID FABRE, IMFT — Gravity/buoyancy-driven bodies moving in a slightly viscous fluid frequently follow fluttering or helical paths. Current models of such systems are largely empirical and fail to predict several of the key features of their evolution, especially close to the onset of path instability. Using a weakly nonlinear expansion of the full set of governing equations, we derive a new generic reduced-order model of this class of phenomena based on a pair of amplitude equations with exact coefficients that drive the evolution of the first pair of unstable modes. We show that the predictions of this model for the style (eg. fluttering or spiraling) and characteristics (eg. frequency and maximum inclination angle) of path oscillations compare well with various recent data for both solid disks and air bubbles.

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