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MODEL AND BEHAVIOUR OF FORCED DOUBLE-WALLED NANOTUBE OSCILLATORS

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Abstract. In this paper we present a model for gigahertz oscillators comprising two coaxial carbon nanotubes of which the outer tube is fixed and the inner tube is allowed to freely oscillate due to the influences of van der Waals interactions and a sinusoidal forcing term. We examine the oscillatory behaviour predicted by the model, including the influence of forcing field strength and frequency. Neglecting dissipative terms and thermal effects we derive a model which may be solved analytically, region by region, which we use to evolve numerical results for the model, obviating the need to use a numerical ODE solving algorithm. The results for this model show that the induced amplitude and frequency of oscillation are both functions of the forcing field strength and forcing frequency. In the dominant regime, increasing forcing frequency leads to decreasing induced amplitude and increase field strength generally leads to a decrease in the frequency in the principle mode of induced oscillation. We also note that the device can lead to highly ordered behaviour for very special initial condition and forcing parameters. However, we find that small perturbation to these initial conditions may destroy the ordered behaviour.

Keywords. Nonlinear oscillator; Forced motions; Gigahertz oscillator; Carbon nanotube; Mechanics; Chaos.

AMS (MOS) subject classification: 70K40.

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