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Experiments and non-parallel theory on the natural break-up of freely falling Newtonian liquid jets[1] PAULA CONSOLI-LIZZI, WILFRIED COENEN, ALEJANDRO SEVILLA, Dept. Ingeniería Térmica y de Fluidos, Universidad Carlos III de Madrid, Spain — The capillary break-up of liquid jets issuing from a needle at a constant flow rate is studied experimentally and theoretically. In particular, we focus on globally stable jets of a Newtonian liquid that are strongly stretched by gravity, so that the region close to the injector is highly non-parallel. In this regime, the use of parallel linear stability theory, based on a local dispersion relation between the frequency and the wavelength of travelling-wave disturbances, is questionable. We therefore propose a global linear frequency response analysis based on a one-dimensional formulation of the mass and momentum equations. Our model reveals that perturbations present large damping in the initial region of strong axial stretching, followed by a growth that eventually causes the break-up of the jet. Besides the break-up length, our model also allows for the prediction of the most amplified frequency. The theoretical predictions are compared with experimental observations, that comprise the natural break-up of stretched jets for a wide range of liquid viscosities, injector radii and flow rates.

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