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Planar, free oscillations of a cylindrical fluid filament RATUL DASGUPTA, PALAS KUMAR FARSOIYA, Dept. Chemical Engineering, IIT Bombay — A viscous cylindrical fluid filament of infinite axial extent is immersed in another viscous fluid at rest. We perturb the circular cross section of the filament with an azimuthal Fourier mode ($\exp(im\theta)$ with wavenumber m real). Under/over damped free oscillations occur due to surface tension and we study these theoretically and through DNS. In the invisicd, irrotational approximation the dispersion relation for these oscillations was first obtained by Rayleigh (Proc. Roy. Soc. Lond., 29, 71, 1879) ignoring the inertia of the ambient fluid. Fyfe et. al. (J. Comp. Phys., 76,349-384 1988) subsequently included the inertia of the ambient fluid to the dispersion relation. We study the viscous correction to this relation, including viscosity of both the fluids. Unlike the inviscid dispersion relation which is an algebraic equation, the viscous dispersion relation turns out to be a transcendental equation. We study the roots of this equation on the complex frequency plane. In addition to the discrete spectrum, the viscous problem also has a continuous spectrum. The solution to the initial value problem which includes both, will be presented. Comparisons of analytical results with DNS results obtained from an in house developed VOF code, will be discussed.

Ratul Dasgupta
Dept. Chemical Engineering, IIT Bombay

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