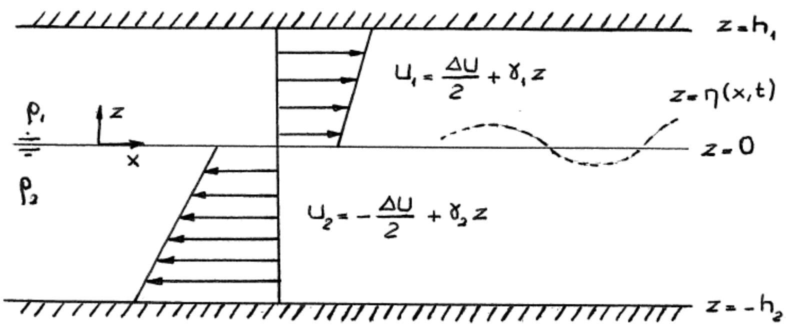
1. Find the dispersion relation and analyze the stability of the flow shown below:



Include the effect of surface tension at the interface between the two immiscible fluids of densities $\rho_1 \& \rho_2$ and assume inviscid motion.

Discuss the effects of the bulk shear (i.e. $\gamma_1 \& \gamma_2$) and the interfacial shear (i.e. ΔU) on the stability.

Consider the limits ($\gamma_1 = \gamma_2$, $\gamma_1 = \gamma_2 = 0$, $\Delta U = 0$) and identify stabilizing and destabilizing effects.

<u>Note</u> that as $h_1 \to \infty$ and $h_2 \to \infty$ with $\gamma_1 = \gamma_2 = 0$, the problem reduces to Kelvin-Helmholtz instability case. So you may compare your work with Drazin & Reid, Chap. 1 and Prob. 1.4. (see also Chandrasekhar, Chap. 11)

2. (Bonus Problem) Modify the Matlab code p40.m* that solves the Orr-Sommerfeld eigenvalue problem for the critical temporal frequency ω (just linearly unstable) in the normal mode analysis $\exp(i(kx - \omega t))$ for given Reynolds number $Re = 5772$ and wavenumber $k = 1.02 \approx 1$ to compute the critical spatial wavenumber k for given $Re = 5772$ and frequency $\omega = 0.26943$ as a spatial stability problem using the Companion Matrix Method presented in **. Compare your result with Table 3 in **.

*See Course webpage

**Bridges, T. J. and Morris, P. J., *Differential Eigenvalue Problems in Which the Parameter Appears Nonlinearly*, J. Comp. Phys. 55, 437-460 (1984). (provided in Course webpage)