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On Holmboe's instability for smooth shear and density profiles

ALEXANDROS ALEXAKIS, NCAR — The linear stability of a stratified shear flow for smooth density profiles is studied. This work focuses on the nature of the stability boundaries of flows in which both Kelvin-Helmholtz and Holmboe instabilities are present. For a fixed Richardson number the unstable modes are confined to finite bands between a smallest and a largest marginally unstable wavenumber. The results in this paper indicate that the stability boundary for small wavenumbers is comprised of neutral modes with phase velocity equal to the maximum/minimum wind velocity whereas the other stability boundary, for large wavenumbers, is comprised of singular neutral modes with phase velocity in the range of the velocity shear. We show how these stability boundaries can be evaluated without solving for the growth rate over the entire parameter space as was previously done. The results indicate further that there is a new instability domain that has not been previously noted in the literature. The unstable modes, in this new instability domain, appear for larger values of the Richardson number and are related to the higher harmonics of the internal gravity wave spectrum.

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