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Unbounded wall flow with free surface waves and horizontal shear
GARY LAPHAM, Maine Maritime Academy, JOHN MCHUGH, Univ of New Hampshire — Free surface waves in the presence of a non-uniform shear flow are treated. The shear flow of interest varies with both the transverse and vertical coordinates, $U(y, z)$. Initial results treat a mean flow varying only with the transverse, $U(y)$. The domain is bounded on one side by a flat rigid vertical wall and is unbounded on the other side. The mean flows considered here are nonzero near the vertical wall and approach zero far from the wall, e.g. $U = e^{-\gamma y}$. The flowfield is treated as inviscid but rotational. Linear solutions are obtained using a nonuniform coordinate transformation that converts the free surface boundary condition into a modified Bessel equation. Velocity components are expanded in modified Bessel functions of the first kind of purely imaginary order. The dispersion relation for steady waves are found with wavespeeds outside the range of U, matching previous results for a flow bounded on both sides. Corresponding eigenvectors show a sequence of wave profiles of increasing complexity near the wall. The wave amplitude approaches zero far from the wall.

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