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Computationally and experimentally assessed base-flow, stability, and sensitivity differences between shear dominated (negligible gravity) and gravity assisted internal condensing flows[1] AMITABH NARAIN, RANJEETH NAIK, SOUMYA MITRA, MICHAEL KIVISALU, Mechanical Engineering, Michigan Technological University, Houghton, MI-49931 — Annular regimes for internal condensing flow are desirable for high heat transfer rates out of a condenser. Predominantly shear driven flows typically occur in horizontal channels (with condensation on the bottom horizontal-surface), zero gravity flows, and in milli-meter to micro-meter scale hydraulic diameter ducts. This talk presents steady and unsteady computational results obtained from the numerical solutions of the full two-dimensional governing equations for annular internal condensing flows in a channel. Results obtained for inclined, horizontal, and zero-gravity cases (with and without surface-tension) bring out the differences between shear driven and gravity assisted/driven flows. The results highlight the differences between steady solutions, their stability, and their noise-sensitivity. It is shown that annular flows are more stable and easily realized for gravity driven or gravity assisted flows than for primarily shear driven flows. Besides stability, extreme-sensitivity of shear driven flows to typically present persistent fluctuations is also demonstrated. This sensitivity is beneficially exploited to achieve significant heat-transfer rate enhancements. The talk also highlights conditions for which surface tension forces become important. The computational results have been validated by good comparisons with condensing flow experimental results for the annular regimes.

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