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Direct numerical simulations of gas-liquid annular flows in horizontal pipes: predictions of film height and mechanisms for film sustainment[1] JEREMY MCCASLIN, OLIVIER DESJARDINS, Cornell University — Direct Steam Generation (DSG), a technology that uses parabolic solar reflectors to generate steam from water flowing through horizontal pipes located at the focal points of the reflectors, often requires an annular pipe flow in which the liquid is distributed as a thin film around the circumference of the pipe. The distribution of the gas-liquid interface for such flows (i.e. the thickness of the liquid film and the measure of liquid droplets entrained in the gas core) can have ramifications for both the optimized operation and economical design of DSG loops. In this work, a conservative finite difference scheme is used in conjunction with a state-of-the-art discontinuous Galerkin conservative level set methodology to simulate periodic sections of such flows. Under the assumption of a gas core-dominated flow, dimensional analysis suggests a theoretical basis that is presented for the prediction of flow "annularity" (i.e. contiguousness of the liquid film). Mechanisms for film sustainment such as wave propagation up the pipe walls and droplet entrainment and deposition are also numerically investigated for a variety of annular flows.

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