Title: Analysis and modeling of Capillary Fluid Statics in Microchannels with Gravity

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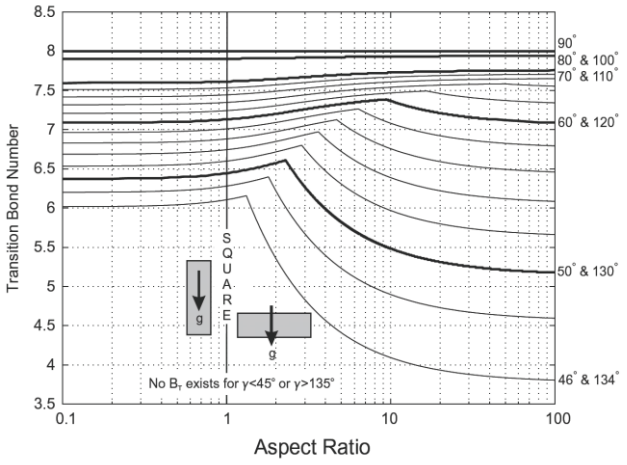
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I. Abstract Body

The existence and stability of solutions for capillary liquid volumes in channels are of interest to many. Recent original analysis[1], an extension of the classical Concus-Finn critical wetting analysis, provides a means to determine, for any closed channel cross section, when liquid properties will cause pooling of liquid on the bottom and the channel, as in large pipes, or when the liquid will completely span the cross section, blocking off the two ends of the channel. Application to rectangular cross section channels answers the pooling vs. plugging question for all rectangular channels and all contact angle liquids[2].

In additional to analytical work, while computational fluids dynamics modelling is a vital tool in use by many, the complementary Surface Evolver tool can rapidly produce a wealth of modelling results to both determine stability of capillary surfaces and illustrate for the researcher features such as the extent of the surface in the channel, the area of highly-curved free surfaces, impact of multiple free surfaces on stability, local and global minimum energy states, and similar. Even in small channels where Bond umber is small, the effect of gravity in breaking the symmetry of the geometry may be important. Examples from channels and porous media are presented.

II. Image: from reference [2]



III. References:

1 Manning, R.E., Collicott, S.H., and Finn, R. "Occlusion criteria in tubes under transverse body forces," *Journal of Fluid Mechanics*. 682: 397-414. DOI: 10.1017/jfm.2011.230

2 Manning, R. E. and Collicott, S.H., "Existence of static capillary plugs in horizontal rectangular cylinders," *Microfluidics and Nanofluidics*. 19: 1159-1168. DOI: 10.1007/s10404-015-1632-y

IV. Biography:

Steven H. Collicott is in his 28th year as a Professor in the School of Aeronautics and Astronautics at Purdue University and is now also the Associate Head for Engagement. His research focuses on capillary fluid physics in spaceflight and on Earth. He consulted on the design of the successful Vane-Gap payloads in the International Space Station, has flown nearly 40 parabolic flight experiments and 10 commercial sub-orbital rocket experiments. He chairs the Sub-Orbital Advisory Group of the Commercial Spaceflight Federation and serves on the Science and Technology Advisory Panel for CASIS.

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