Possible Two-phase Fluids Projects for AAE 520 in Spring 2005

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1. Scaling of drop tower experiments

Three sizes of the same geometry zero-g fluids experiment should be built and tested in the drop tower. The geometry will be that of a spacecraft propellant tank with a passive surface-tension propellant management device (PMD). Inertial- and viscous-dominated flow regimes scale differently and practical answers for how best to scale this type of experiment can be best had from experience. Thus I wish to gain experience with this project.

2. Cavitation Inception Pressure Measurements

A liquid flowing into the entrance of a spray hole travels on a curved streamline. The pressure on the concave side of the streamline must be lower than the pressure on the convex side. This lower pressure is limited by the vapor pressure, and is found on the surface of the inlet lip, or bluntness. The stagnation pressure for which cavitation begins at the lip is called the `inception pressure'. The inception pressure is known to depend on the amount of bluntness. A simple mathematical model for predicting inception pressure has been developed. It requires some data for comparison, and this experiment will acquire the data in super-sized spray holes with varied and controlled bluntness.

3. Plenum Cross-Flow Effects on Sprays

The plenum is the supply channel upstream of a spray orifice. With no cross flow the flow through the spray hole is largely axisymmetric. With cross flow the flow in the spray hole becomes three-dimensional. Leading to changes in the spray. We have looked at the changes inside the hole, but as yet have not measured changes in the spray. Now we have the proper instrument for making that measurement. We are exploring to find links between upstream of the orifice and downstream in this task.

4. Table-top Zero-G Droplet Wicking Simulator

Future water cycles in human life support in space will often have phase separation needs. The zero-gravity wicking of a droplet on grooved surfaces remains a curious and poorly understood corner of the fluids world. This task will seek to tolerate the tedious nature of density-matched immiscible liquids to try to create a table-top liquid-liquid demonstration of a droplet (in air) wicking on a grooved surface in zero-g.