Two-Phase Flow Distribution Modeling and Stability Analysis

Tijs Van Oevelen, Justin A. Weibel, Suresh V. Garimella
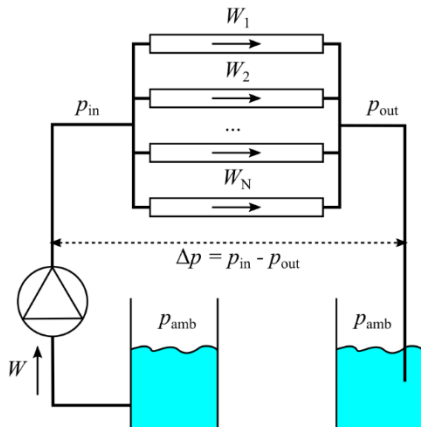
Objective

Develop predictive model for flow rate distribution in parallel channels of two-phase heat sinks

Motivation

Non-uniform flow distributions lead to reduced and non-uniform cooling performance
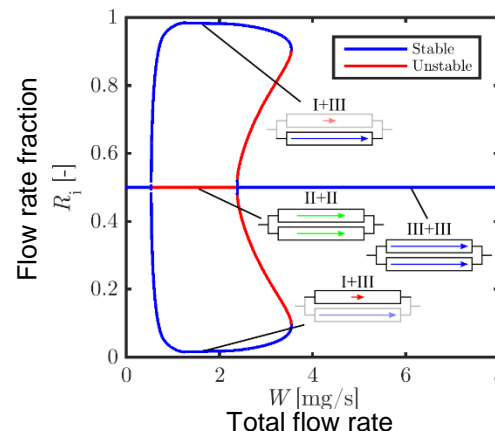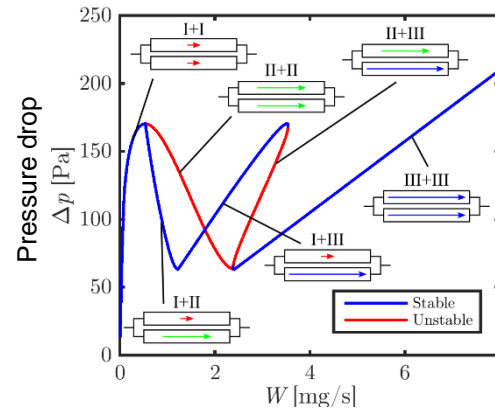
Methodology

- Simulation of individual channels and pump in parallel flow network
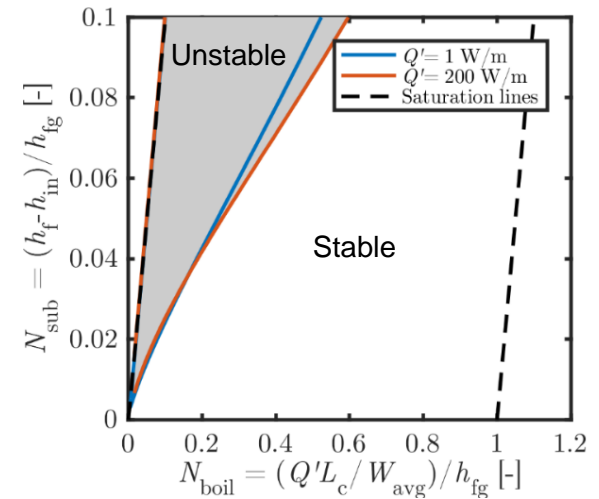- Stability analysis of steady operating points

Two Channels

- Flow distribution is not unique
- Uniform flow distribution is unstable for a range of flow rates (II+II); in this range, the stable flow distribution is very non-uniform (I+III)

Stability Map

- Stability of uniform flow distribution: dependence on inlet subcooling and heat flux

Reference

Van Oevelen, Weibel, Garimella, "Predicting Two-Phase Flow Distribution and Stability in Systems with Many Parallel Heated Channels," Int. J. Heat Mass Transfer 107, 557-571, 2017.