Research Proposal:  
Modeling advection and diffusion in microchannels

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1 Introduction

This project will investigate the advection and diffusion of a passive scalar, using a split-step Monte Carlo method. Numerically the implementation of this method is well understood. I have already constructed a working code over the past summer. The experimental geometry is a rectangular pipe with grooves on one wall.

2 Proposed Research

The goals of thesis project are:

1) Model the fluid motion observed in the experiment.
2) Write an effective numerical simulation that captures the mixing induced by the fluid motion observed in experiment.
3) Characterize the mixing analytically and develop mathematical measures of how mixed the fluid is as a function of time or displacement down the pipe.

3 Prior Research

Recirculation in a rectangular pipe induced by surface ridges at oblique angles with respect to the long axis of the pipe. This problem has been investigated experimentally by Ismagilov et al.

Basically they find that the ridges induce a recirculation the effectively mixes the fluid across the pipes cross section.

References