APPLICATION OF THE LATTICE BOLTZMANN MODEL TO ARTERIAL FLOW SIMULATION.

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INTRODUCTION: The dynamics of blood flow in arteries is an important topic. For example, there is a body of evidence to suggest that there is a correlation between the development of atherosclerosis and abnormal wall shear rate[1]. It is often difficult to make these measurements in vivo, thus numerical simulation becomes one of the main investigative tools of these phenomena.

METHODS: The Lattice Boltzmann model (LBM) is used to simulate arterial blood flow through the carotid artery with varying levels of stenosis using a D2Q9 lattice. Two boundary schemes are implemented: the traditional half-way bounce back method[2] and an extrapolation scheme[3], and the results are compared.

RESULTS: The extrapolation scheme is shown to give second order accurate resulted for oscillatory flows. Figure 1 shows the velocity magnitude in an artery with stenosis. The velocity along the cross-section lines A and B is shown in figure 2. The results differ increasingly as the artery width is decreased indicating the importance of the improved wall resolution provided by the extrapolation scheme.

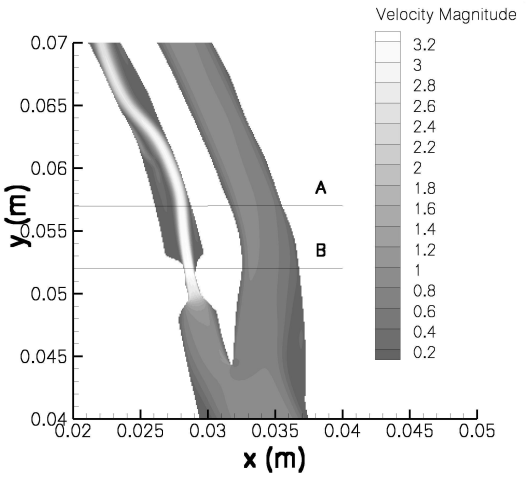

Figure 1: Velocity field magnitude, Carotid artery.

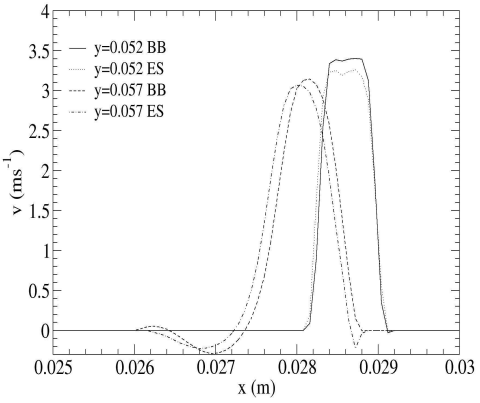

Figure 2: Comparison of velocity profiles across A and B.

DISCUSSION & CONCLUSIONS: The results demonstrate the need to use the improved accuracy of the extrapolation scheme when considering narrow arteries. The resolution of the lattice used in the simulations was 12.5 lattice sites per mm.

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