

Can Oscillatory Convection Accelerate Signal Propagation in Simple Epithelium?

M. Nebyla¹, M. Pribyl¹

¹Institute of Chemical Technology, Prague, Department of Chemical Engineering, Prague, Czech Republic

Abstract

Introduction

We introduce a mathematical model of signal transmission in simple epithelial layers. The mathematical model consists of reaction-transport equations for extracellular ligands, cellular receptors, ligand-receptor complexes and a ligand releasing protease. We consider diffusion and nonstationary convective transport of protein ligands in the extracellular space.

The use of COMSOL Multiphysics®

The study was carried out using combination of COMSOL Multiphysics® and MATLAB®. We will show that the oscillatory flow with the zero time-averaged flow rate accelerates the signal transmission in a large range of frequencies. The obtained nonmonotoneous frequency dependencies of the signal propagation velocity will be explained by means of asymptotic solutions. The obtained findings can be useful in bone or vascular tissue engineering.