

A Stokes Optimal Control Model of Determining Cellular Interaction Forces during Gastrulation

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Abstract : An optimal control system model is proposed for the cell flow in the process of chick embryo gastrulation in this paper. The target is to determine the cellular interaction forces which are hard to measure. This paper will take an approach to investigate the forces with the idea of the inverse problem. By choosing the forces as the control variable and regarding the cell flow as Stokes fluid, an objective functional will be established to match the numerical result of cell velocity with the experimental data. So that the forces could be determined by minimizing the objective functional. The Lagrange multiplier method is utilized to derive the state and adjoint equations consisting the optimal control system, which specifies the first-order necessary conditions. Finite element method is used to discretize and approximate equations. A conjugate gradient algorithm is given for solving the minimum solution of the system and determine the forces.

Keywords : optimal control model, Stokes equation, conjugate gradient method, finite element method, chick embryo gastrulation

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