

Projected Finite Element Method on Evolving Surfaces

Necibe Tuncer

necibe-tuncer@utulsa.edu

Department of Mathematics, KEP U359, University of Tulsa, Tulsa, OK, 74104.

This talk presents a robust, efficient and accurate numerical method for solving reaction-diffusion systems on stationary and evolving spheroidal surfaces. These surfaces are the deformation of sphere such as ellipsoids, dumbbell, and hearth-shape surface. Reaction-diffusion models are routinely used in the areas of developmental biology, cancer research, wound healing, tissue regeneration, and cell motility. The advantages of the “projected” finite element method is that it is easy to implement and that it provides a conforming finite element discretization which is “logically” rectangular. To demonstrate the robustness, applicability and generality of this numerical method, we present solutions of reaction-diffusion systems on various stationary and evolving surfaces. We show that the method preserves positivity of the solutions of reaction-diffusion equations which is not true for the Galerkin type methods. We conclude that surface geometry plays a pivotal role in pattern formation. For a fixed set of model parameter values, different surfaces give rise to different pattern generation sequences of either spots or stripes or a combination (observed as circular spot-stripe patterns). These results clearly demonstrate the need to carry out detailed theoretical analytical studies to understand how surface geometry and curvature influence pattern formation on complex surfaces.

