UNIVERSITY RESEARCH GRANT APPLICATION PROPOSAL

PART A: SUMMARIES OF PROJECT REQUEST

1. PROFESSIONAL SUMMARY

The main objective of this research is to develop and study numerical methods for nonlinear reaction-diffusion systems. The coupled systems of parabolic partial differential equations (PDEs) have a wide variety of applications, such as models for pattern formation in morphogenesis, for prey-predator and other ecological systems, for conductions in nerves, for chemical kinetic reaction, etc. The nonlinear PDE systems usually possess *traveling wave solutions*, whose long-term behavior is difficult to simulate and approximate. A successful numerical method for these very challenging problems requires stability and reliability with respect to a small perturbation at the *wave front*, which is significantly important for both scientific applications and mathematical theory development.

An innovative numerical approach has been developed for linear reaction-diffusion equations in the PI's previous University Research Grant (URG) projects. The method couples the least-squares finite element method (LSFEM) with the local discontinuous Galerkin (LDG) method, which inherits many desirable properties of both methods. In particular, the LDG LSFEM is robust and stable to singular perturbations. It is also very effective and efficient, which has optimal convergence rates. Therefore, it is nature to extend the method for nonlinear problems. The PI has conducted some computational experiments. The results are encouraging and promising.