(A) Project Summary

Title: Dynamics in Many Dimensions
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This IGERT program addresses the grand challenge of nonlinear science: Explore experimentally and describe theoretically the dynamics of high-dimensional nonlinear, noisy systems. The program will foster applications of the methods thus developed to problems in engineering and biosciences.

Intellectual Merit: Nonlinear science deals with systems whose behavior cannot be understood by knowing how separate components behave in isolation: a nonlinear system is not simply a sum of its parts. By identifying features that are common to widely different systems, advances in nonlinear science continue to have a fundamental impact on many disciplines in the natural sciences, and engineering. In particular, one of the central questions driving the research of the GaTech faculty on this IGERT is: "How do high-dimensional unstable coherent structures manage to be so recognizable in a world so noisy?"

Addressing the challenge of high-dimensional dynamics requires training in the tools and methods of nonlinear science, a training that bridges traditional departmental boundaries. We propose the creation of an integrated, cross-disciplinary graduate training program which emphasizes of fundamental concepts common to a broad range of research areas in science and engineering. The IGERT program provides here the kind of PhD support not available from individual grants, but vitally important to initiating, stimulating and sustaining cross-disciplinary research, kind of research that is essential to making progress in this field.

The core program includes, as a key component, an intensive course in which graduate student teams investigate a topic guided by two faculty members with complementary perspectives. The main objective is to equip the student with the common toolkit of nonlinear science, train her to address different disciplinary problems, and develop initial communication skills necessary for interdisciplinary research. This early research experience is followed by a thesis on a different topic; for IGERT supported Fellows the thesis research is co-advised and cross-disciplinary.

Broader Impact: Our goal is to prepare graduate students for today's rapidly evolving professional environment. Complementing this core will be a broad range of IGERT activities: interdepartmental research seminars, student-run seminars, shared common space, annual retreats, regional workshops, international nonlinear summer schools, and a visiting scientist program. Internships at sister institutions will provide additional training experience and opportunities at both academic and industrial sites, domestic and abroad. Together these components offer a stimulating and diverse graduate experience with emphasis on the importance of cross-disciplinary thinking and communication skills. The outreach initiatives include undergraduate research participation by students of Atlanta area minority colleges and the establishment of a web-based graduate course on nonlinear dynamics suitable for distance learning.