Interdisciplinary Research

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Interdisciplinary Research

Interdisciplinarity is a type of academic collaboration in which specialists drawn from two or more academic disciplines work together in pursuit of common goals

--Wikipedia

A well-chosen interdisciplinary research project should offer challenging research problems for each member of the team.

Why do it?

- Some high-impact research can only be accomplished by drawing on several areas of expertise

- Rich source of challenging research problems

- Build connections from your Department to the rest of the University

Some Personal Examples
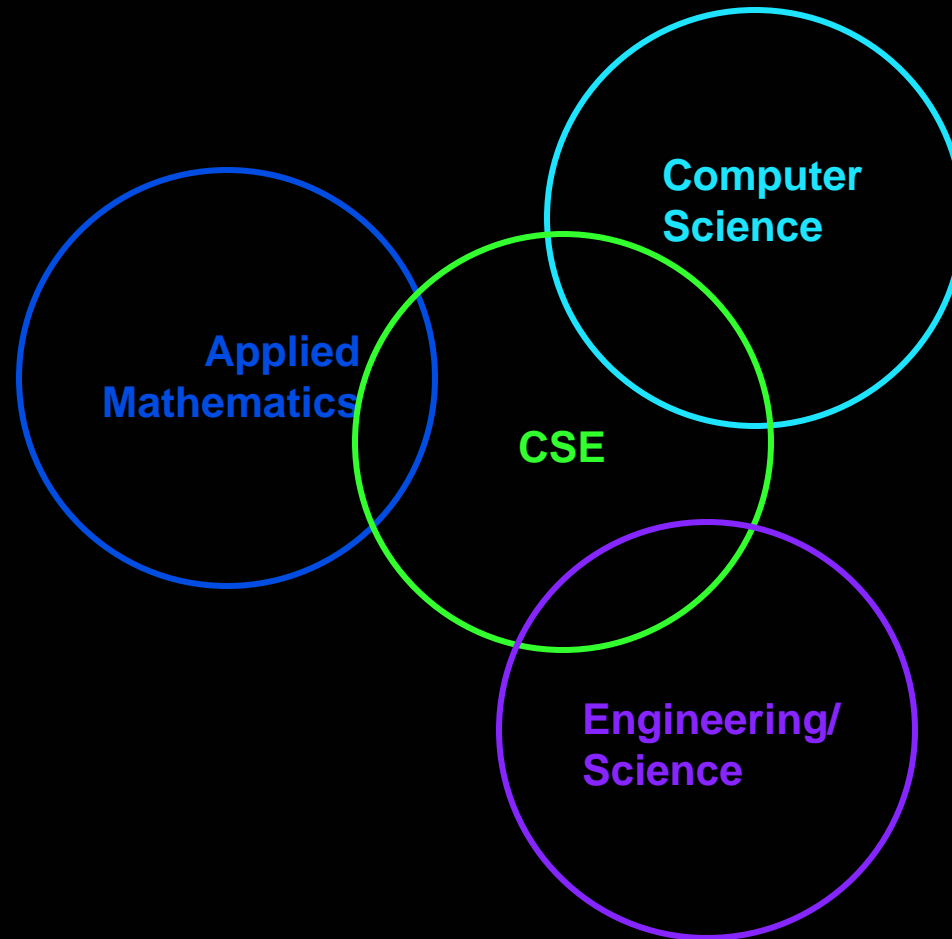
Solar Power Plant Design

Collaboration with Bill Winters, SNLL Engineering group, early 1980's

Computational research issues:
A class of differential-algebraic equations (DAE) that nobody at the time knew how to solve. Spawned a new research area, hundreds of papers, books, software. Software went on to solve thousands of problems from wide range of science and engineering.

Copper Electrodeposition

Current collaboration with Richard Alkire, Dept. of Chemical Engineering, UIUC

| ○	Cu^{2+}	■	Cu	Ⓐ	Adsorbed Additive
●	Cu^+	Ⓐ	Additive	Ⓓ	Debris
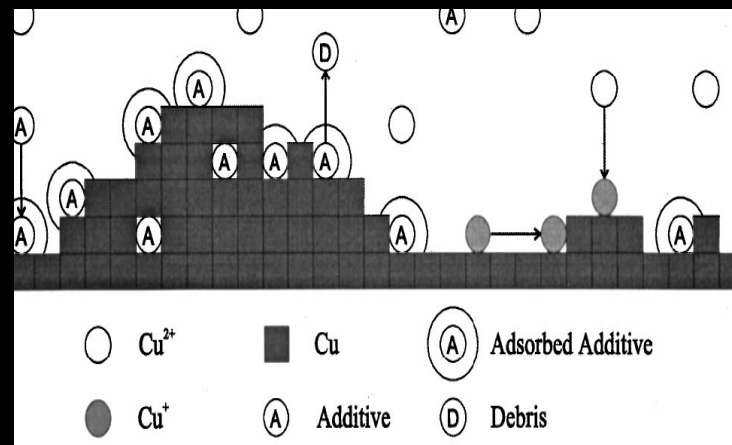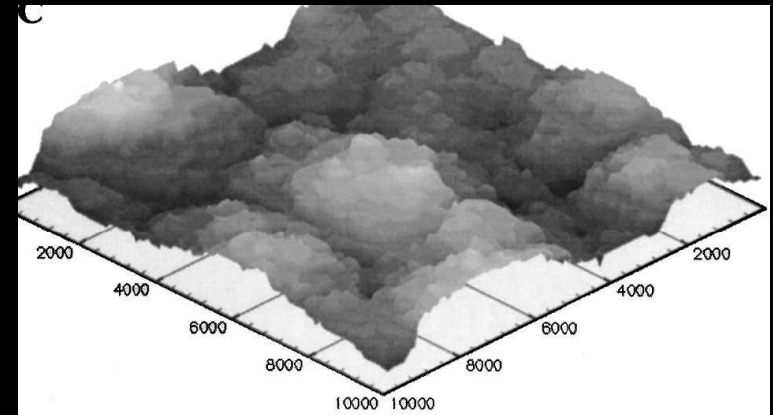
Computational research issues:
• Multiscale Monte-Carlo/PDE
• Huge consumer of computer time

Systems Biology

In the heat-shock response in E. Coli, an estimated 20 - 30 sigma-32 molecules per cell play a key role in sensing the state of the cell and in regulating the production of heat shock proteins. The system cannot be simulated at the fully stochastic level due to:

- Multiple time scales (stiffness)
- The presence of exceedingly large numbers of molecules that must be accounted for in discrete stochastic simulation

Regulation of Heat-Shock Response

Collaborations: Mustafa Khammash (ME), Frank Doyle (ChemE), John Doyle (CDS Caltech), Ken Kosik (Neuroscience), Peggy Cotter (Cellular Biology), Roger Nisbet (Ecology)
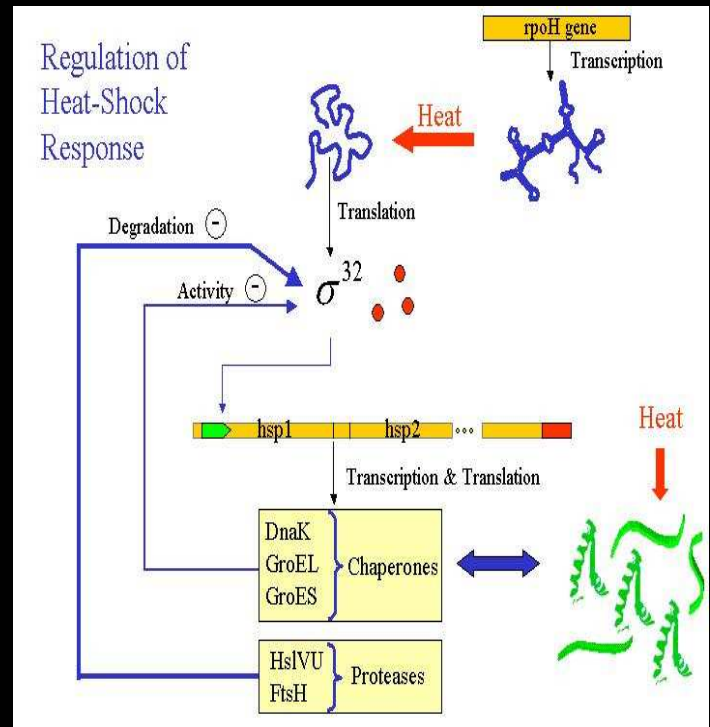
Why build software tools?

- Fosters interdisciplinary collaboration
- Enables theory and algorithm research to make an impact
- The software brings ever more challenging problems to your attention, suggesting new, high-impact areas of research

Creating a Supportive Environment in Academia

- Joint appointments
- Encourage and support collaborative proposal efforts
- Track interdisciplinary funding and reward faculty same as disciplinary funding
- Salary, promotion and tenure: reward excellent research, not just excellent disciplinary research
- Create and support interdisciplinary education programs

UCSB IGERT Program in CSE

**NSF IGERT: Integrative Graduate Education Research Traineeship program**

PhD Program, 2 years guaranteed support

Departments:
- Chemical Engineering, Computer Science, Mathematics, Mechanical Engineering

Research: Focus on multiscale problems. Students and faculty work in interdisciplinary teams. Theses are jointly supervised from two Departments.
- Complex Fluids and Computational Materials
- Microscale Engineering
- Computational Systems Biology
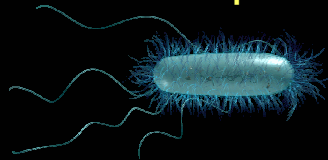
Internship

UCSB IGERT Program in CSE

Interdisciplinary research teams - *building research teams from the ground up*

- Modeled after interdisciplinary research teams in Laboratories and industry.

- Spawns new interdisciplinary research collaborations and strengthens existing ones.

- Exciting, collaborative environment attracts students, postdocs and faculty who may not even be directly funded by the Program.