The Computational Science & Engineering Picture

- Application
- Analysis
- Computation
Application: Better Devices

I’m On My Way
The Mechanical Cell Phone

[Diagram of the mechanical cell phone showing the components: RF amplifier / preselector, Mixer, IF amplifier / filter, Tuning control, Local Oscillator.]

RF amplifier / preselector → Mixer → IF amplifier / filter

Tuning control → Local Oscillator
A Simple Circuit
An Electromechanical Circuit
Modeling Damping and Radiation

Ingredients:
- Physics: Radiation, thermoelasticity
- Numerics: Structured eigensolvers, model reduction
- Software: HiQLab
Damping: Devil in the Details!

Simulation and lab measurements vs. disk thickness
Application: Resonance and Metastable Behavior
Application: Computer Network Tomography
A Possible Problem
Find and Fix or Route Around?
Linear Algebra of Paths
Application: Detecting Overlapping Communities
Linear Algebraic View

\[ \hat{A} \approx CDC^T \]

- Find dominant subspace for range of \( \hat{A} \)
- Find sparse indicator vector in space (linear programming)
- Deflate and repeat to decompose \( A \)
Application modeling

Analysis

\( \rho \ddot{u} = \nabla \cdot \sigma \)
\( Ax = b \)
\( Ax = \lambda x \)

Algorithms and software

HiQLab, Matscat, ...
Model reduction methods
Structured linear solvers

http://www.cs.cornell.edu/~bindel