

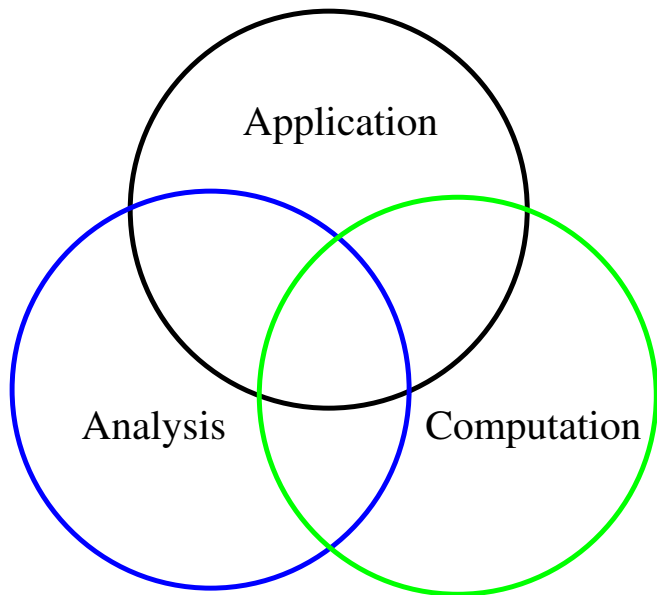
A CSE Sampler

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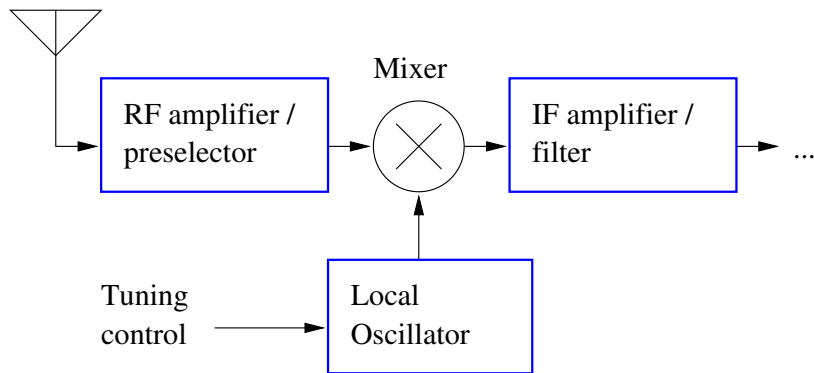
The Computational Science & Engineering Picture



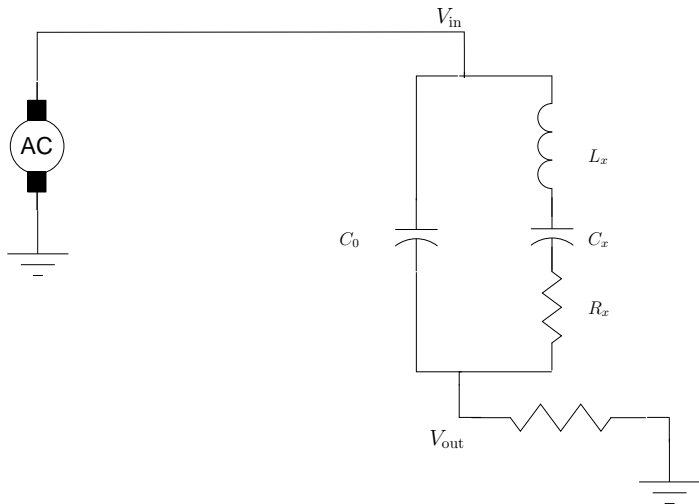
Application: Better Devices



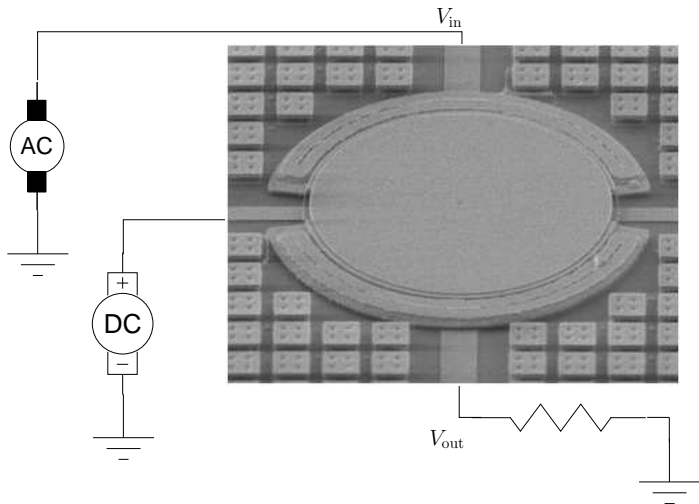
The Mechanical Cell Phone



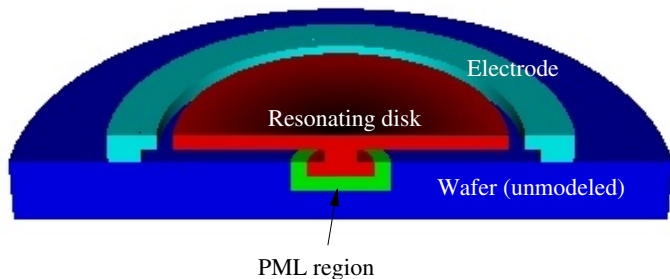
A Simple Circuit



An Electromechanical Circuit



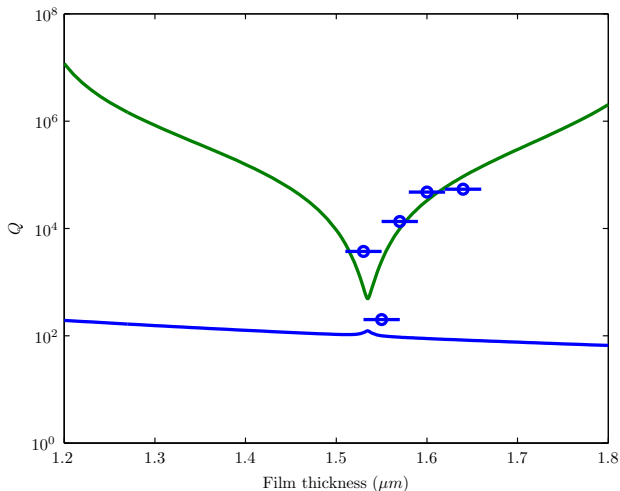
Modeling Damping and Radiation



Ingredients:

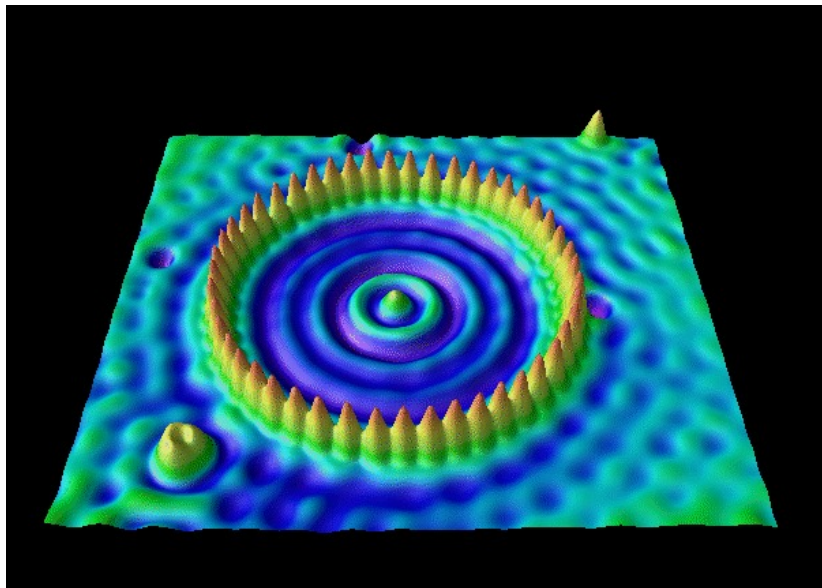
- ▶ Physics: Radiation, thermoelasticity
- ▶ Numerics: Structured eigensolvers, model reduction
- ▶ Software: HiQLab

Damping: Devil in the Details!

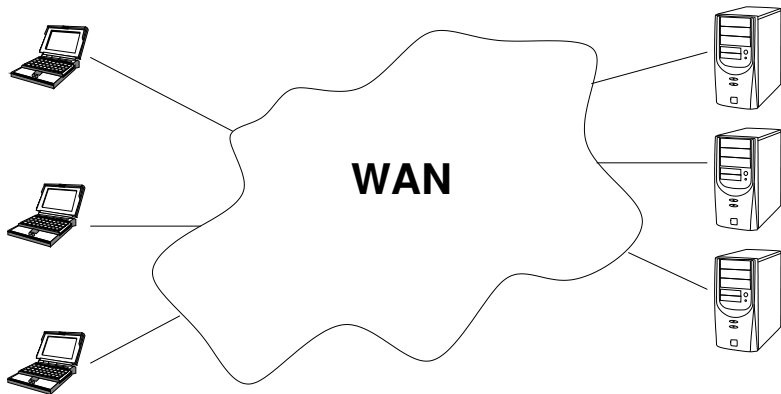


Simulation and lab measurements vs. disk thickness

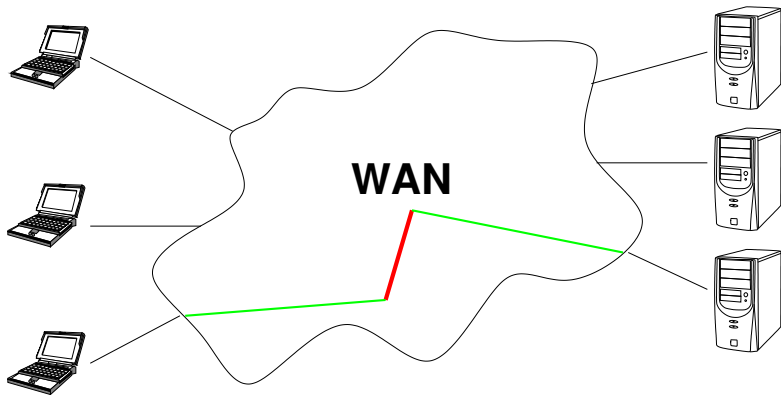
Application: Resonance and Metastable Behavior



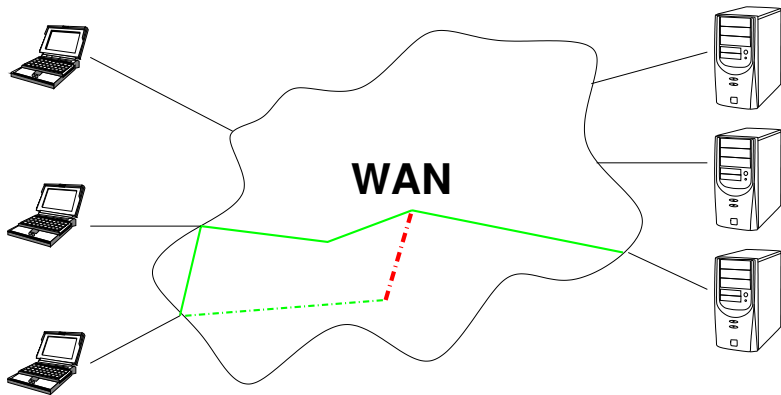
Application: Computer Network Tomography



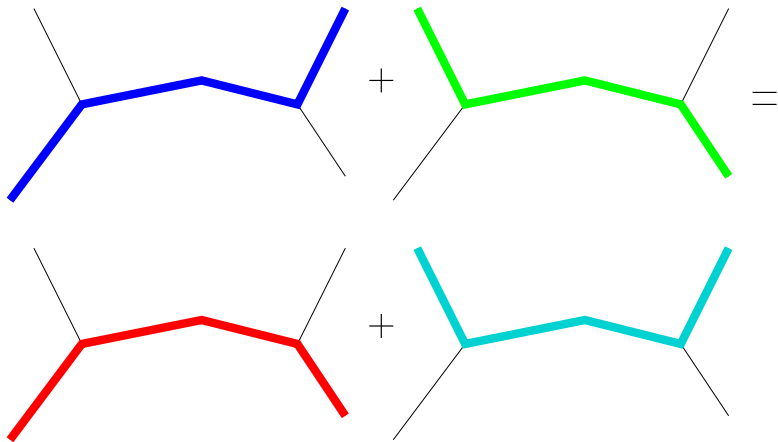
A Possible Problem



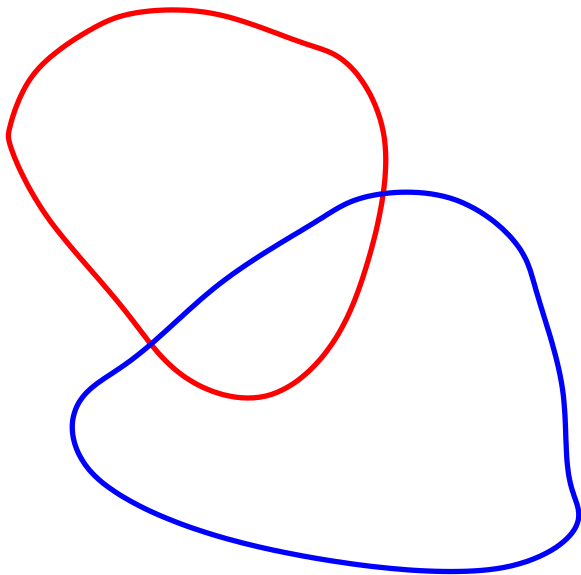
Find and Fix or Route Around?



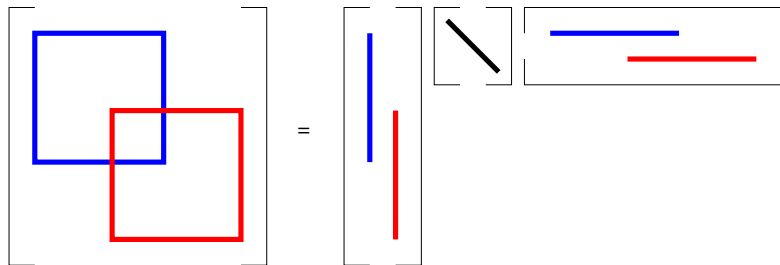
Linear Algebra of Paths



Application: Detecting Overlapping Communities

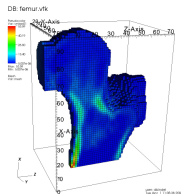
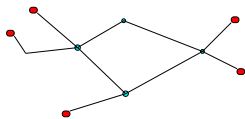
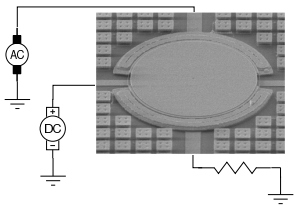


Linear Algebraic View



$$\hat{A} \approx CDC^T$$

- ▶ 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>