Scientific Computing Sampler

David Bindel

29 Jun 2017
Cornell CS Scientific Computing Group

Austin Benson  David Bindel

Anil Damle  Charlie Van Loan
The Computational Science & Engineering Picture

**Application**
- MEMS
- Smart grids
- Networks
- Systems

**Analysis**
- Linear algebra
- Approximation theory
- Symmetry + structure
- Optimization

**Computation**
- HPC / cloud
- Simulators
- Solvers
- Frameworks
Resonance and Nonlinear Eigenvalue Problems (NEPs)

\[ T(\lambda)v = 0, \quad T : \mathbb{C} \rightarrow \mathbb{C}^{N \times N} \]
Scalable Kernel-Based Approximation and Optimization

(a) Point data  (b) Exact  (c) Old approx  (d) New approx

\[ \mathcal{L}(\theta|y) = -\frac{1}{2} \left( y^T K(\theta)^{-1} y + \log \det K(\theta) + n \log(2\pi) \right) \]
Asynchronous Parallel Global Optimization

Six-hump camel function
Graph Densities of States
Finding Contingencies in Power Grids
And many others...

To-be-Updated Vertices  
Dependent Vertices  
Unrelated Vertices

(a) Vertex-Oriented Computation  
(b) Block-Oriented Computation