Mining Recommendation Spaces for Algorithms
(joint work with Calvin J. Ribbens)

Case Study: Comparison of Direct and Iterative Solvers

gmres vs. direct on nearly singular problems

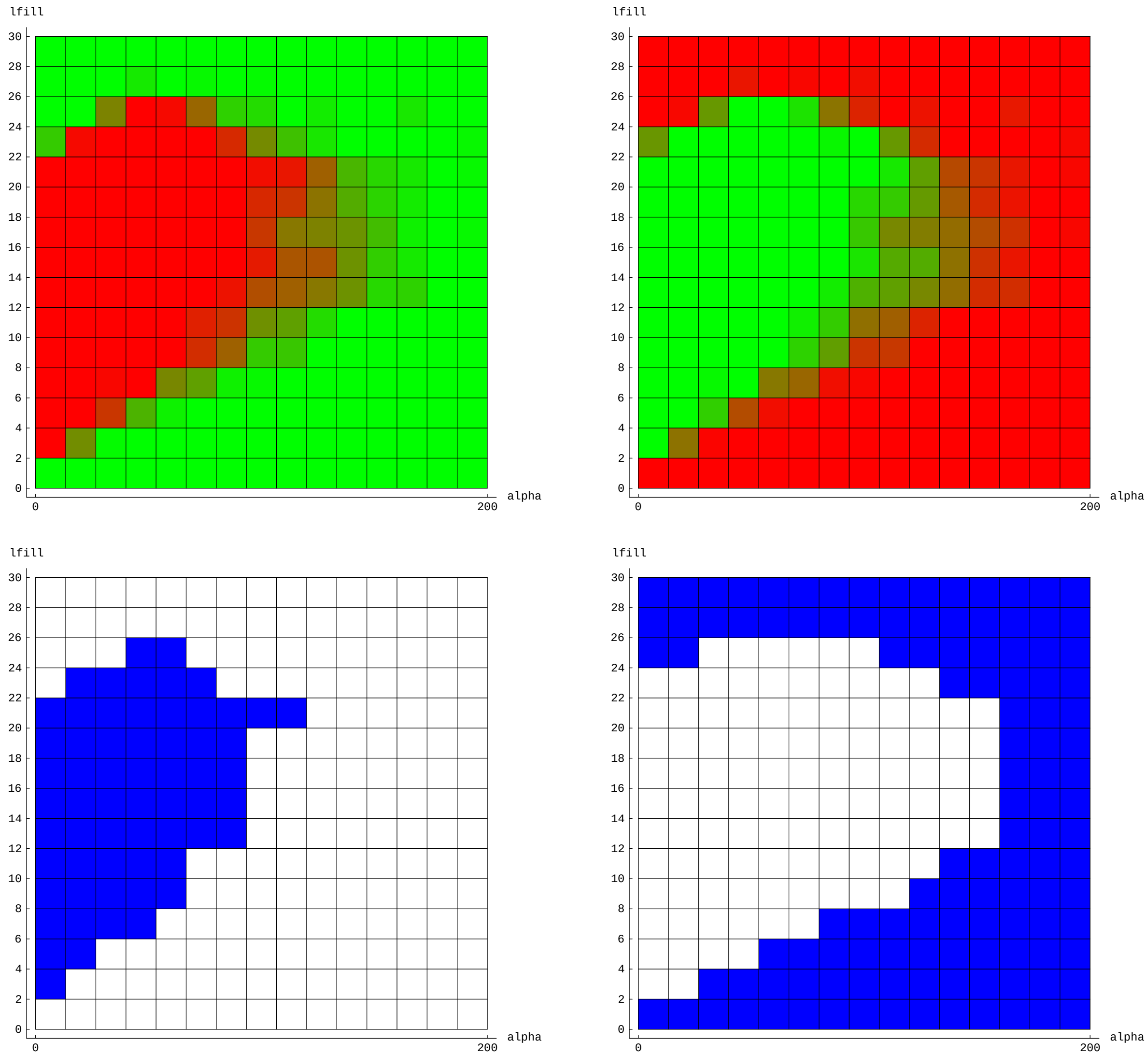
Experimental Framework

ELLPACK: 5-point centered finite difference discretization
SPARSKIT: Krylov Solver with ilutp preconditioning
Problem Parameter: Increasingly ill-conditioned linear system with alpha
Method Parameter: lfill of ilutp

Number of PDE Solves Mined: 45,000

300 values of alpha: 0 <= log(alpha) <= 3
15 values of lfill: 2,4,6,...,30
5 values of another problem parameter
2 values of droptol parameter for iterative solver

Visualizing Recommendation Spaces



Mining in Data-Scarce Domains
(joint work with Layne T. Watson, Virginia Tech)

Conceptual Design of HSCT

Basic aircraft configuration set at the end of this phase
80% of aircraft lifecycle cost is determined here

Model Each Discipline via Numerical/Algebraic Equations

Aerodynamics
Structures
Controls (Mission-related)
Propulsion (Engine Thrust)

Example: 250-passenger HSCT

Minimize Take-Off Gross Weight (TOGW)
Range: 5,500 nautical miles
Cruise Speed: Mach 2.4
Number of HSCT Variables: 29
Number of Constraints: 68

Typical Approach

View a design as a point in high-dimensional space
Design an optimization function to evaluate designs

Requirements from a DM Perspective

Past: Trial and Error Scenarios

- Pick a design point
- Change some nominal aspect
- Run simulation; see how change affects obj. function, constraints

Present: Configurable Solutions

- Two-phase modeling

Future: Suggestive Exploration of Design Spaces

- Help push constraints into the evaluation process
- Anytime evaluation of designs
- Overcome data paucity by active exploration
- Couple visualization with mining

A Slice Through a Design Space