Solution Pluralism, Deliberation, and Metaheuristics

Extracting More Value from Optimization Models
Part 2: Engineering and Scientific Challenges.

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MIC: Metaheuristics International Conference, Singapore,
5–8 August 2013

http://research.larc.smu.edu.sg/mic2013/
Outline

1. How to get Sol samples?
2. How best to sample the Sols?
3. Processing Sols
4. Robustness under Risk
Sampling in our examples of part 1

- Philly redistricting project. See cited papers. Basically, OR (IP) heuristic models for initial contiguous solutions, then innovative GA to find high-quality new solutions.

- TSP. Well-known heuristic, Lin 2-opt, with multiple starting points. Lots of obvious alternatives.

- GAP. FI-2Pop GA. Especially good at finding IoIs [Kimbrough et al., 2008, Kimbrough et al., 2009].

- VRPs. RJR (homegrown, “rotate, jiggle, repair”) on top of TSP. Affords multiple solutions.

Sampling the Sols

- Evolutionary computation is a natural place to look first.
- In general, population-based approaches
  - Particle swarm optimization, many forms of EC, ant colony optimization, artificial immune systems, ...
- NB: Interacts with constraint handling.
  - Again, the FI-2Pop GA has been especially good at finding IoIs [Kimbrough et al., 2008, Kimbrough et al., 2009].
Points arising

• Very little is known about which methods of sampling (particularly which metaheuristics) are most effective.

• Conducting local search in the neighborhood of a known (e.g., conventionally discovered) solution is an obvious tactic (but is largely unexplored for these purposes).

• In experiments with GAPs, we found that the Sols (both Fols and lols) were quite dense [Kimbrough et al., 2010].

• Do different sampling methods find very different samples?
How to process large numbers of sampled Sols?

- Reduce by DEA, Pareto dominance.
- DSS. Prototype for GAP-like problems.
Robust optimization

- Standardly: under uncertainty.
- Solution pluralism affords under-risk analyses [Kimbrough et al., 2011].


On using genetic algorithms to support post-solution deliberation in the generalized assignment problem.

MIC 2009: The VIII METAHEURISTICS INTERNATIONAL CONFERENCE, conference CD.
How to get Sol samples?

How best to sample the Sol samples?

Processing Sol samples

Robustness under Risk