GRASP – Gradient-aided Swarm Optimization

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The larger picture

- Hybrid optimization method
  - Gradient based method
    - Consecutive search attempts along directions related to gradient
    - Suitable/trapped for/in local search/minima
  - Swarm based method
    - A set of points in the search space that interact between them to produce the next generation
    - Suitable/escaping for/in global/local search/minima
Gradient half-lines intersection

- **Gradient half-lines intersection**

  - **Personal best**
  - **Parent particle**
  - **Global best**
  - **New particle**
  - **Child particle for PSO**
  - **Child particle for GRASP**

  - **Guess search direction by PSO**
  - **Int**
  - **Int**
  - **New particle**

College of Management and Technology
Motivation
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Algorithm

• While stop conditions not met perform alternatively
  – Swarm
    • intersect each particle’s gradient half-line with all other particles’ gradient half-lines
    • retain the fittest intersection point or, if no intersection occurs, the particle itself
  – Gradient
    • only for the fittest ever particle (gbest)
    • Broyden–Fletcher–Goldfarb–Shannon (BFGS)
Algorithm

• Fully distributed
• Does not use the guidance provided by
  – personal and global fittest particles
• Matches better the core idea of making use of gradient directions
Algorithm

• Swarm step more successful far away from minima, while gradient step more successful closer to minima

• No parameters!
Benchmark

- CEC2005 benchmark
- 25 functions
- Comparison with Particle Swarm Optimization
  – constriction factor
Further development

• Computer-implemented version of the objective function and its gradient function
• MAD tool overloads a large but not the full set of MATLAB toolboxes
• Replacing BFGS by a parameter-less gradient-based method