Artificial intelligence and high performance computing

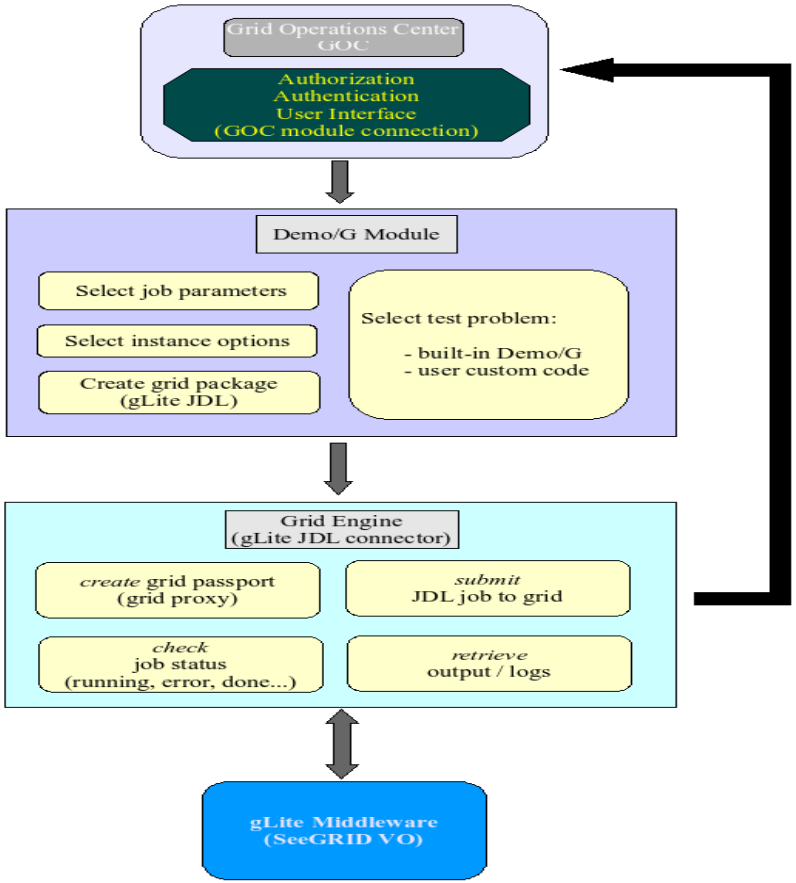
Past and future @ UVT

Daniel Pop

Agenda

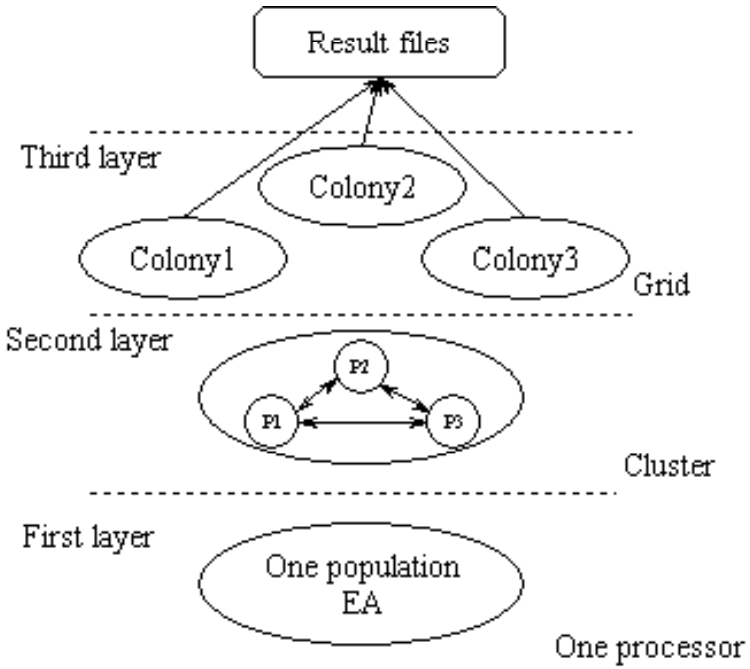
- Work done
- On-going projects
- Future plans

Work done // Grid-based framework



- Grid Operation Center (GOC)
  - Authentication module
  - Application interface (DEMO/G)
  - Grid Engine
- Technologies:
  - JSP, DB
  - gLite

Work done // DEMO/G



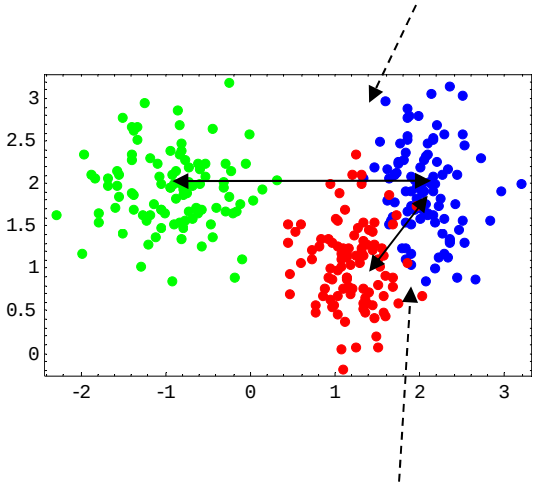
Java implementation of **Evolutionary Multiobjective Optimization Algorithms (EMOA)** based on a layered structure

- First layer: sequential EMOA executed on one processor
- Second layer: parallel EMOA based on a colony of inter-communicating populations
- Third layer: multiple colonies which evolves separately

S. Panica, D. Petcu, D. Zaharie – A Grid-enabled Framework for Evolutionary Multiobjective Optimization, SACCS 2007

Work done // EMOA

Larger inter-class distance



Small inter-class distance

- EA for single objective optimization + techniques to deal with Pareto dominance relationship
- Analyzing the impact of periodical and final communication on the efficiency of parallel implementation corresponding to the second layer
- *Analyzing the applicability of the grid layer for:*
  - *Experimental design of evolutionary algorithms for multiobjective optimization*
  - *Solving multiobjective optimization problems by dividing them in independent subproblems*

Work done // Experimental design of EMOA

- Combination of NSGA-II and PDE algorithms
- 4 communication strategies: random migration, ring migration, random pollination and ring pollination
- Different values for control parameters

Work done // Attributes selection

- Attributes selection problem aims to produce a ranking of attributes which expresses their relevance with respect to a classification task
- Multi-Objective Optimization approach: find a set of weights associated to attributes which optimizes three criteria:
  - Minimize the intra-class distance
  - Maximize the inter-class distance
  - Maximize attribute to class correlation

Work done // Airfoil shape optimisation

- NACA0012 symmetric profile model has been used
- Optmisation task consists of minimizing the drag coefficient (C_D) unde the constraint that the lift coefficient (C_L) is as close as possible to a given value (C_L^*) that can be transformed into a bi-objective one which minimises both C_D and $|C_L - C_L^*|$
- Master-slave model for the parallelisation of the EMOA, because the cost of elements evaluation is higher than the cost of other operators
- Comparison of synchronous vs asynchronous communication models between master and slaves were investigatedd
  - Synchronous: a new generation is started after all slaves finish current one
  - Asynchronous: generation and evaluation are interleaved

D. Zaharie, M. Dragan, S. Panica, D. Petcu, M. Stoia-Djeska – Asynchronous master-slave parallelization of evolutionary optimization in airfoil shape design; PARA 2008

Work done // Airfoil shape optimisation

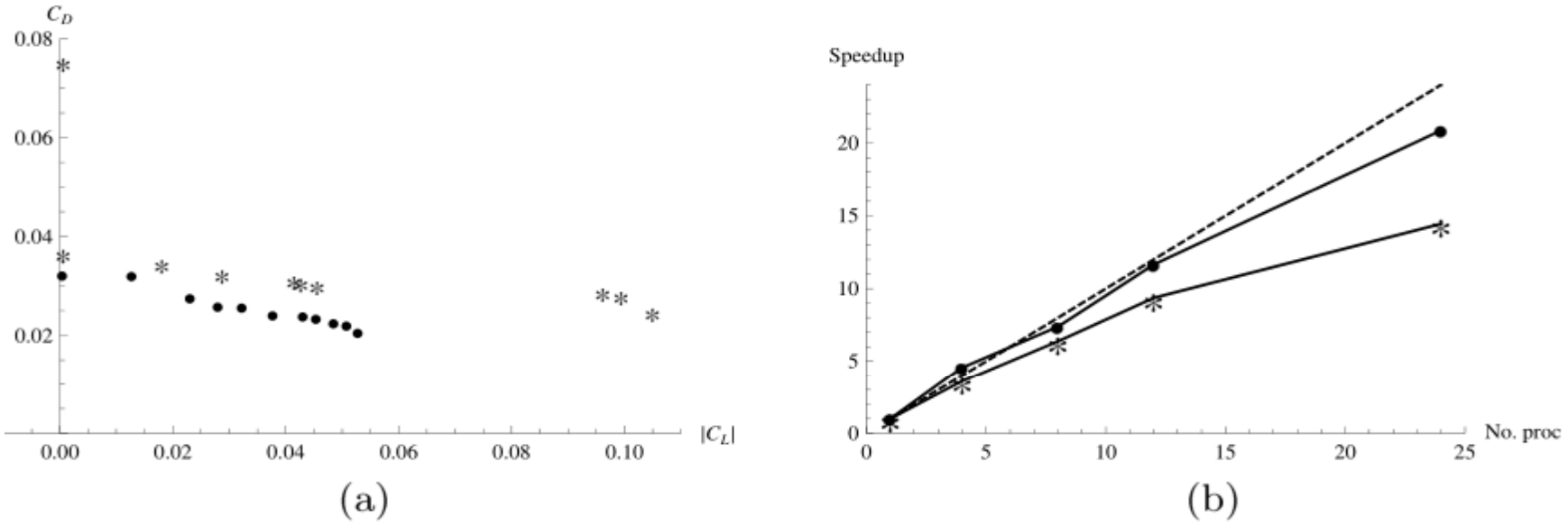


Fig. 1. Comparison between the synchronous strategy (stars) and the asynchronous one (disks) (a) Pareto fronts (obtained after 20 generations, $m = 24$); (b) Speedup

- Implementation in Java plus MPIJava
- Cluster with 14 Intel Core 2 Duo 1.6GHz and comm. speed of 1000Mbps

Future plans // Tools and methods

- Develop software package(s) for scalable, intelligent algorithms on distributed environments (cloud, grid, cluster) and their validation on real areas:
  - Applications with local companies (industry) like telecom, automotive etc
  - Reinforce the collaborations with environmental / meteorology data suppliers in the region (Belgrade, Timisoara, Bucharest)
  - Reinforce collaborations medical-related partners
  - Image classification aglorithms in distributed environments

Future plans // New opportunities

- Pursue new projects, programs, opportunities like
  - Smart grids / future energy networks: models, optimisations, multi-agents concepts and applications
  - Online recognition and information retrieval about a subject: data sources ranking, classification and evaluation, disambiguation resolution