

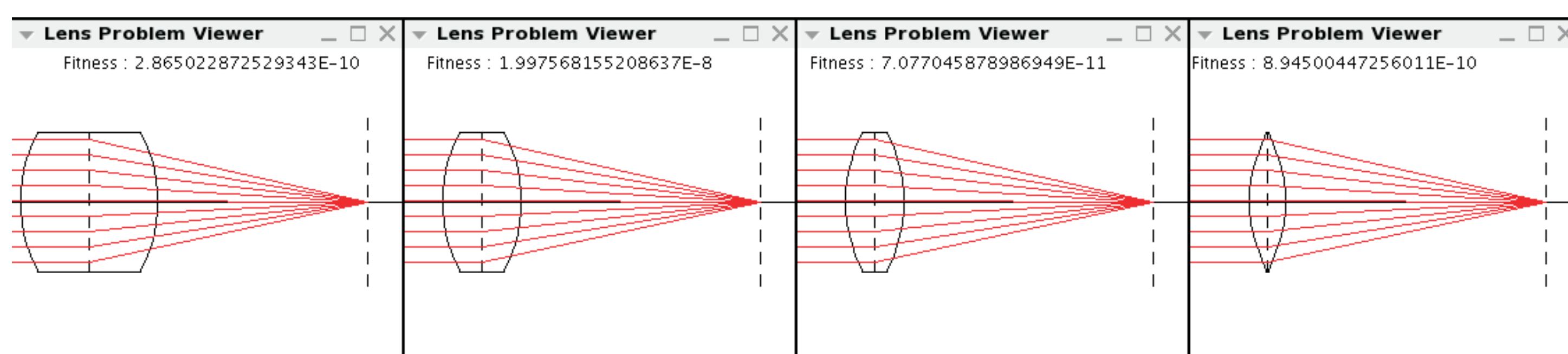
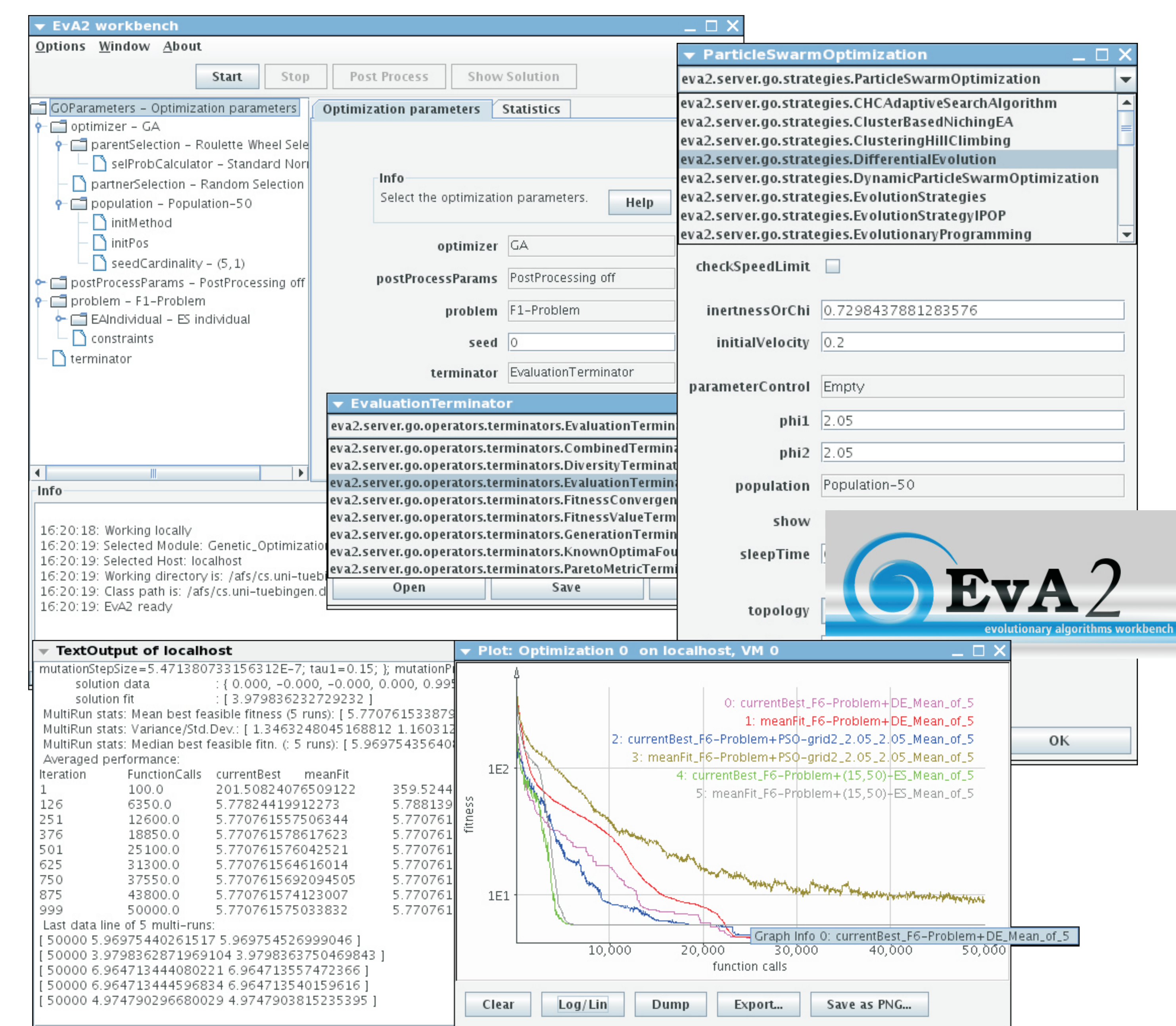


EvA2: A Heuristic Optimization System in Java

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EvA2 (Evolutionary Algorithms workbench, version 2) is a comprehensive metaheuristic optimization framework with emphasis on Evolutionary Algorithms (EA) implemented in Java. It is a revised version of the JavaEvA optimization toolbox and it is available under the open source LGPL license. EvA2 integrates classical derivative-free optimization techniques and a large set of modern population-based heuristics.

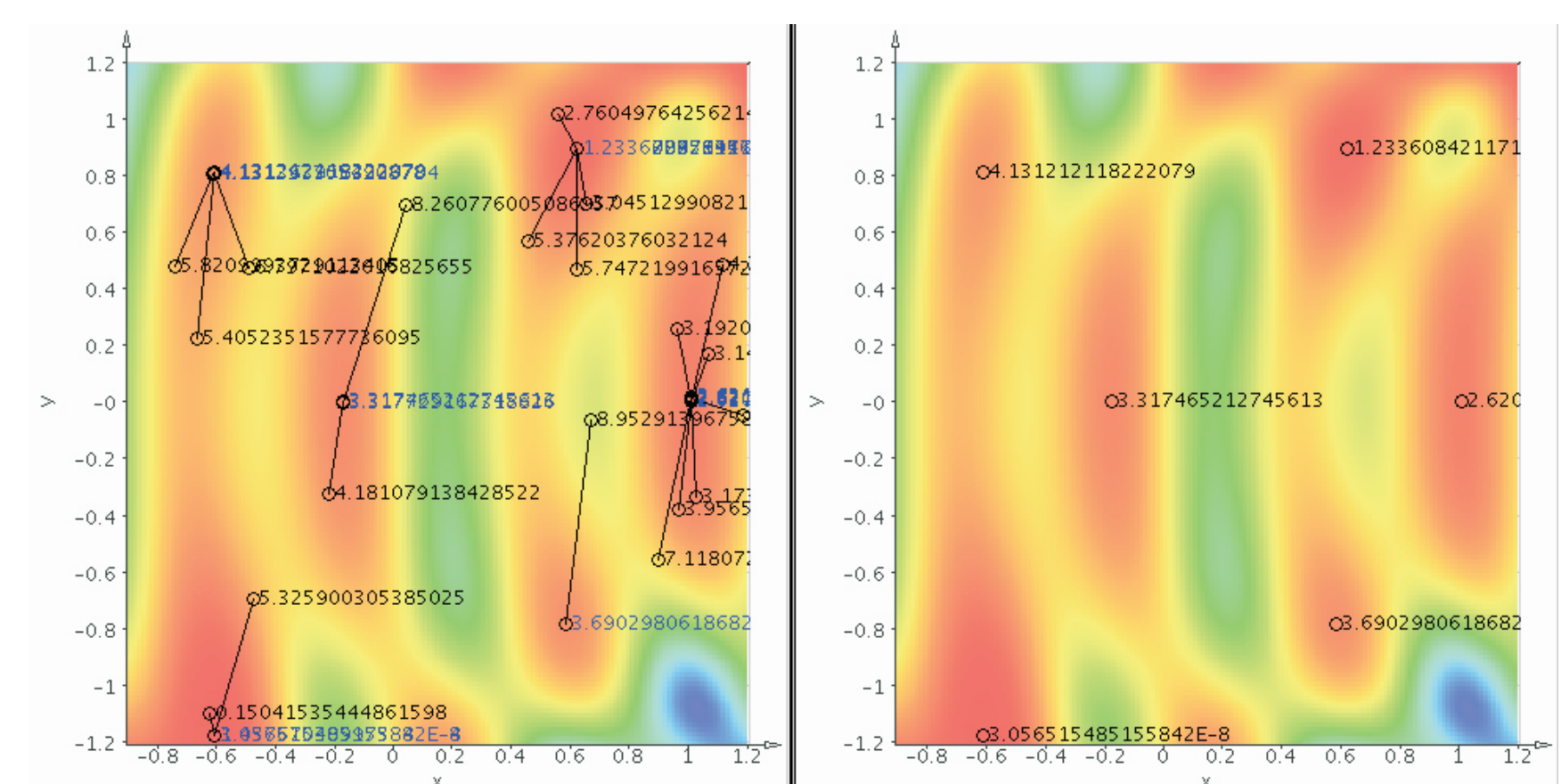
Due to a modular structure, heuristic operators can readily be interchanged between optimization methods and applied to an optimization problem at hand. Enhanced techniques for niching and multi-objective optimization are implemented. Out-of-the-box standard benchmark functions simplify evaluation of newly developed methods. Predefined interfaces to external programs such as Matlab allow the straight-forward application on existing target functions and quick employment in real-world scenarios.



Niching methods search for multiple local optima of a target function. In the above example, a clustering-based niching swarm method (CBN-PSO) finds multiple focusing lenses of varying thickness in parallel during a single run.

Popular Optimization Strategies

- Evolution strategies (IPOP-CMA-ES, rank- μ -CMA-ES)
- Genetic algorithms with multiple encodings
- Particle Swarm Optimization (PSO), Tribes
- Genetic programming
- Differential evolution variants
- Binary and real-valued scatter search
- Clustering-based niching EA, dynamic Clustering-based PSO
- NichePSO, ANPSO, Island-model EA
- Multi-objective EA in multiple variants
- Memetic algorithms
- Model-assisted optimization methods
- Gradient-descent methods, simulated annealing, Nelder-Mead-simplex
- Population-based incremental learning



Post-processing by a local search method and clustering removes redundancy and identifies multiple optima of a 2D target function.

Real-world Applications

- Parameter estimation in systems biology
- Distribution of geothermal heat pumps
- Visual localization of mobile robots
- Effective irrigation scheduling in agriculture
- Automotive engineering optimization
- Active component search in drug design
- Optimization of industrial excavators
- Automatic color calibration for robot vision

References

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- [2] Kronfeld M. EvA2 Short Documentation. Center for Bioinformatics Tübingen, University of Tübingen, 2008.
- [3] Streichert F, Ulmer H. JavaEvA: a Java based framework for Evolutionary Algorithms. Tech.Rep. 2005-06, Center for Bioinformatics Tübingen, University of Tübingen, 2005.