# Improving population-based algorithms used in Global Optimization with Fitness Deterioration techniques

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**Abstract**

A Global Optimization Algorithm is defined as optimization algorithm that employs measures that prevent convergence to local optima and increase the probability of finding a global optimum.

However, there are domains where the global solution may not suffice. Such problems require the location and maintenance of multiple robust local solutions, i.e local solutions whose basins of attraction are properly wide and deep.

The most common technique in evolutionary algorithm which is used to achieve this goal is to incorporate some sort of niching method like *crowding* or *fitness sharing* which promote diversity of population, which in turn delay premature convergence and likely enable the algorithm to find multiple optimal solutions in single population.

Standard niching methods are often ineffective and hard to introduce in existing evolutionary algorithms. In this paper we adopt a different approach to multimodal function optimization. Instead of embedding a niching method in the evolutionary algorithm itself we

use a hybrid approach in which we perform several runs of a evolutionary algorithm and alter the fitness function in every subsequent run in a way that prevents exploration of basins of attraction which were found in previous runs of the algorithm.

In each iteration we run EA, then cluster received population and based on the assumption that clusters of individuals obtained from the clustering algorithm are located in basins of attraction we interpolate each basin by multidimensional Gaussian function. By combining these functions with current objective function in a proper way we create deteriorated fitness function which will discourages future runs from revisiting the same area.

We have implemented a general-purpose framework which can be use to test our fitness deterioration techniques in conjunction with various evolutionary algorithms.

While this general schema may be used with many types of EAs it would be the most efficient when used with algorithms which are capable of finding many local solutions in single run. This is why for test we choose so called Hierarchical Genetic Strategy which performs efficient concurrent search in the optimization landscape by many small populations.

The quality of the deterioration process strongly depends on clustering process. We choose density-based algorithm called OPTICS to accomplish this goal as with this method we can extract clusters of different densities very efficiently and choose clusters which give the best accuracy of fitness deterioration process.

Described sequential niching approach has several advantages:

- it is simple to incorporate in existing optimization methods
- it efficiently finds many local solutions
- it provides reasonable stop criterion which in this case is based on the quality of clusters returned by the clustering algorithm

# References

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