

A New Measure For Evolutionary Algorithms

15-48 EC masters' thesis project

For: Master Students that know how to program - and are interested.
If you've ever done a course in heuristics, it is a pre.
Load: 15 - 48 EC, depending on blocks (see below)
Period (approx.): From September 2021 onward
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Introduction video: <https://bit.ly/3DWGFrG>

About the project

Evolutionary Algorithms typically start off with a complete solution to an optimization problem, mutate one or more individuals, and try to improve the quality of the solution. As one example, simulated annealing starts off with a complete TSP-tour (fig. 1, left), changes a few connections, and hopes for improvement.

Thomas Weise has thought of something radically different. Instead of steering the evolutionary algorithm towards the best fitness, the "Frequency Fitness Assignment" (FFA) principle steers the algorithm *away* from the *most occurring* fitnesses [1][2]. This makes a bit of sense, as both the very good and very bad solutions to a problem are quite rare, and Weise even claims some successes, for instance on MaxSat[2] and the job shop scheduling problem (JSSP) [3]. Whatever it is, it is new, and deserves a good investigation.

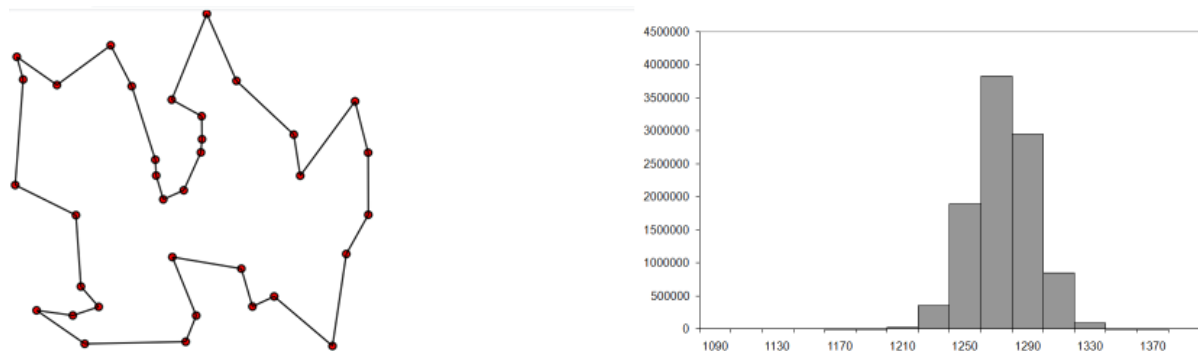


Figure 1 Not all tour lengths occur equally often. Does it make sense to use the frequency of a seen fitness as the directive for the algorithm rather than it's magnitude?

Each block is about 15-18 EC's worth. You can choose blocks to your liking, though there is a strong emphasis on doing Block #1 first. Generally, we can adapt blocks as we go along, but once a block is finished, we're not going back, only forward.

Block #1

Start reading the papers below, and make a replication of Thomas Weise's 2021 results on JSSP. Maybe *everything* is a bit much, just select some problem instances to start off with.

Block #2

Let's try a few different problems. We have some TSP instances, but maybe we can also use some benchmark test functions [4] – with a few tricks. This sounds a bit small work for a whole block of work, but we have to thread carefully with these new endeavours, and expand step by step.

Block #3

FFA can surely be plugged into some different algorithms. How about PPA [4]-[8], or simulated annealing [9]?

References

[1] Weise, Thomas, et al. "Frequency fitness assignment." IEEE Transactions on Evolutionary Computation 18.2 (2013): 226-243.

[2] Weise, Thomas, et al. "Frequency Fitness Assignment: Making Optimization Algorithms Invariant under Bijective Transformations of the Objective Function Value." IEEE Transactions on Evolutionary Computation 25.2 (2020): 307-319.

[3] Weise, Thomas, et al. "Solving job shop scheduling problems without using a bias for good solutions." Proceedings of the Genetic and Evolutionary Computation Conference Companion. 2021.

[4] <https://bit.ly/3jH1Eqe>

[5] <https://bit.ly/3r2fc1D>

[6] <https://bit.ly/36qLTMQ>

[7] <https://bit.ly/3e4b4Jg>

[8] <https://bit.ly/36qNXEr>

[9] <https://bit.ly/3yHtF5A>