Particle Swarm Optimization simulation

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Introduction

Particle swarm optimization (PSO) is a nature-inspired metaheuristic. Particles, which do little on their own, as a collective swarm can bring forth global behaviours, which are useful in giving approximate solutions to optimization problems. In this project an interactive web-based simulator for PSO was built.

The algorithm

PSO works in an iterative process. First generation of particles is initialized with random positions and velocities. Algorithm approaches optima by updating generations. Variables used in the simulation are:

- k – iteration number
- i – particle's index unumber
- $\boldsymbol{p}_k^i$ - best solution (fitness) the particle has achieved so far
- $\boldsymbol{p}_k^g$ - best value obtained by any particle in the neighbourhood
- $\boldsymbol{x}_k^i$ - position of the particle
- $\boldsymbol{v}_k^i$ - velocity of the particle
- ω – inertia
- r - random number between (0,1)
- φ_p, φ_g – influence factor of personal/global best

Iteration

Updating particle's velocity:

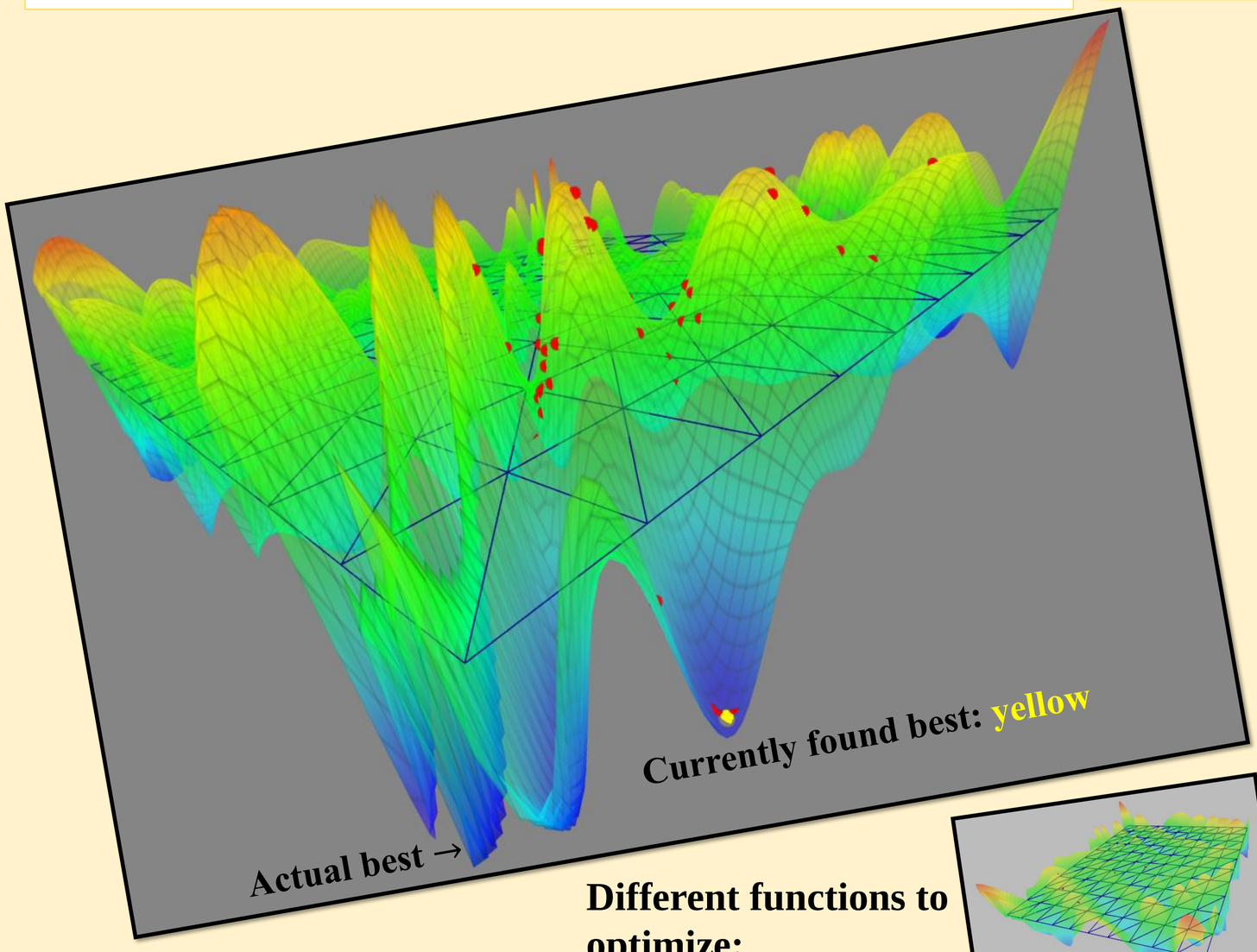
$$\boldsymbol{v}_{k+1}^i = \omega \boldsymbol{v}_k^i + \varphi_p r_1 \left(\boldsymbol{p}_k^i - \boldsymbol{x}_k^i\right) + \varphi_g r_2 (\boldsymbol{p}_k^g - \boldsymbol{x}_k^i)$$

Updating particle's position:

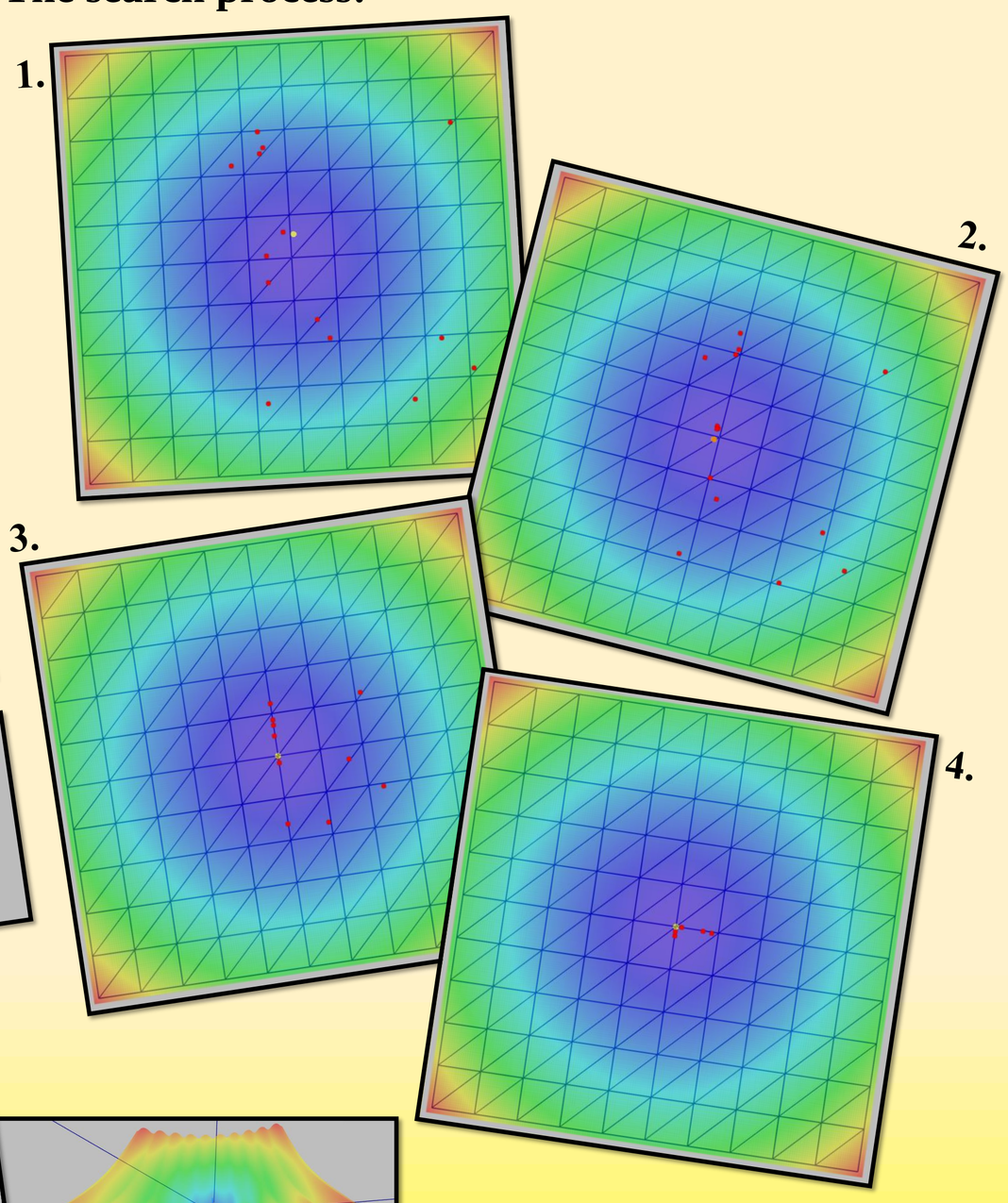
$$\boldsymbol{x}_{k+1}^i = \boldsymbol{x}_k^i + \boldsymbol{v}_{k+1}^i$$

Simulator

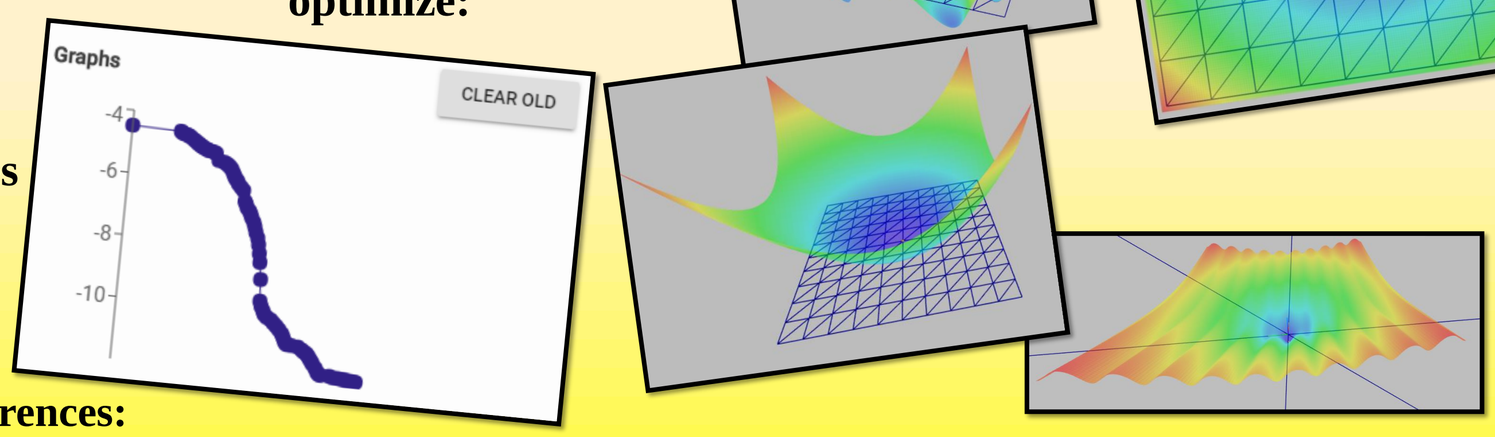
As the result of the project for the course Advanced Algorithmics (fall 2017), a web-based simulator was created. The simulator enables user to change functions, topologies, particle count, algorithm's parameters and more. Main technologies used were React, WebGL with Three.js and JavaScript.



The search process:



Different functions to optimize:



A graph is used to show the best values found by particles:

References:

Xiaouhui Hu "PSO Tutorial", 2006. http://www.swarmintelligence.org/tutorials.php [09.01.2018]

Maurice Clerc "Standard Particle Swarm Optimisation", 2012. http://clerc.maurice.free.fr/pso/SPSO_descriptions.pdf [09.01.2018]

Repository

Simulation