SAOOA

Surrogate Assisted Online Optimization Algorithm

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Problems

- Very expensive evaluation
- Dynamic environment
- Noise
- Evaluation of bad individuals should be avoided

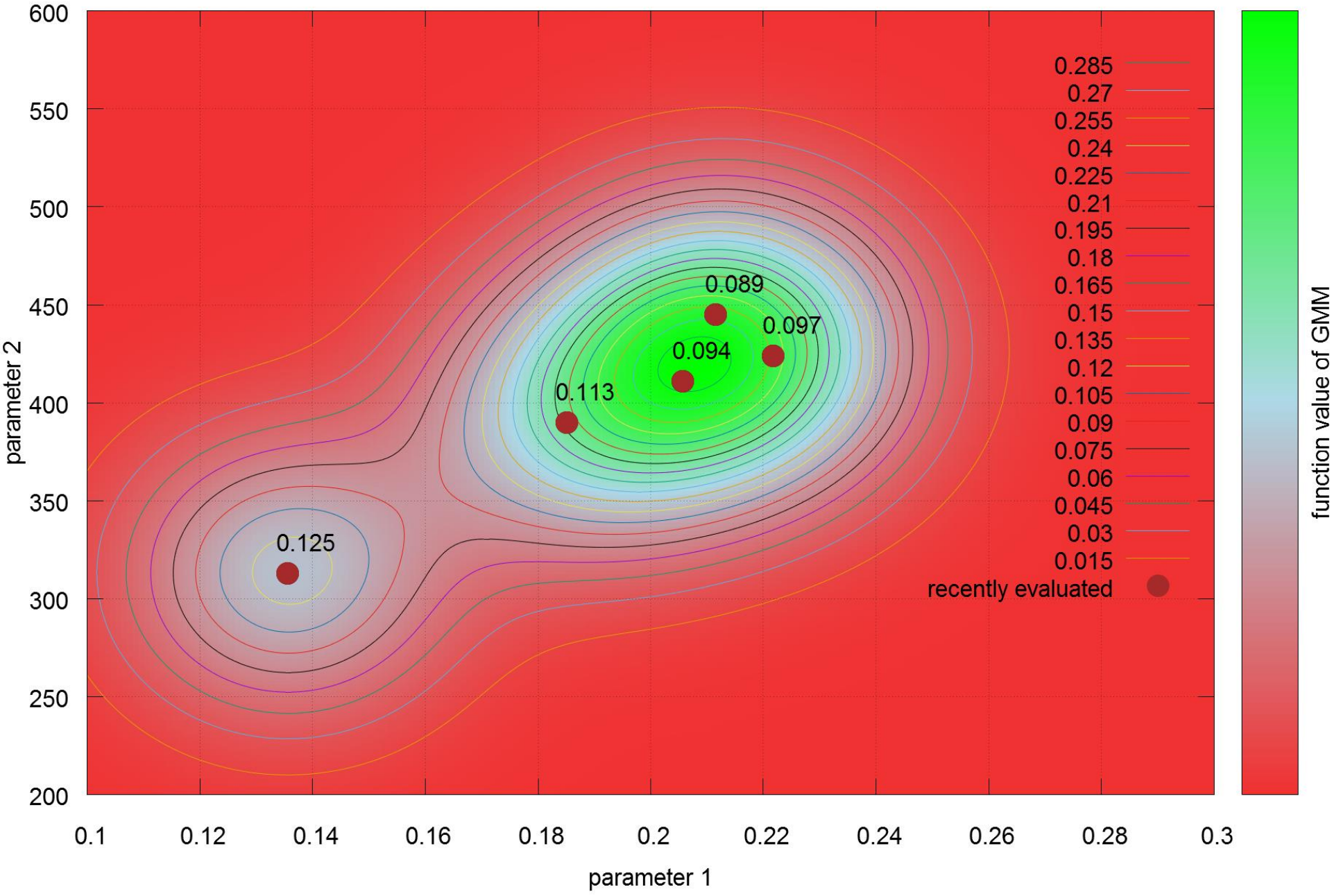
Solution

- Online optimization
- Gaussian Mixture Model = GMM
- Penalization of sub-average gaussians
- Simulated annealing
- Elitist selection
- Detection of and reaction to sudden changes

Algorithm description

- param configuration = point = individual

1. Evaluate initial individual
2. Create GMM based on current population
3. Generate new individuals according to the GMM
4. Remove individuals older than 3 generations from population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recently evaluated
0.089
0.097
0.094
0.113
0.125
parameter 1
parameter 2
function value of GMM
600
550
500
450
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350
300
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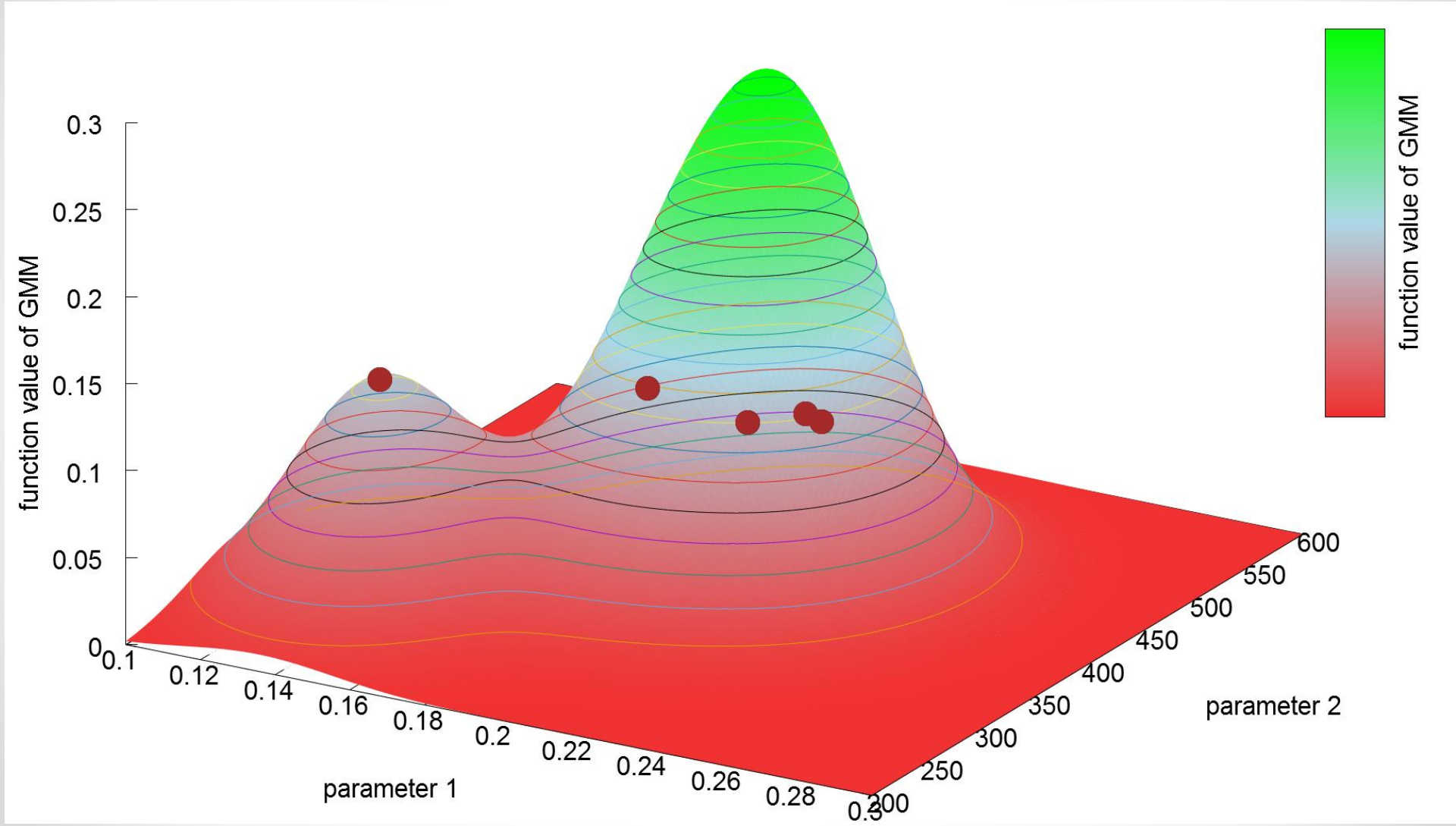
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parameter 1
200
250
300
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400
450
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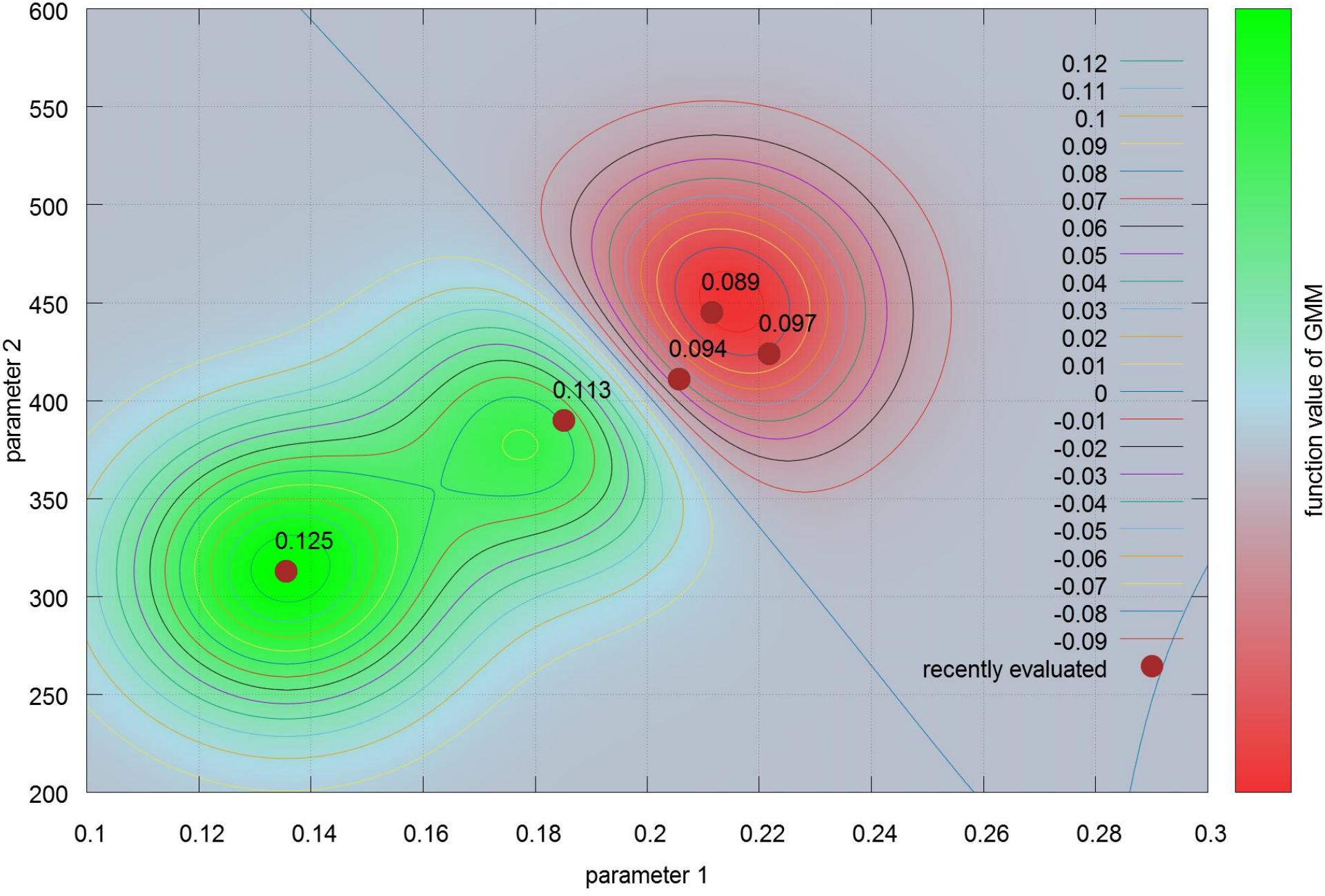
550
600
parameter 2
function value of GMM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recently evaluated
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parameter 2
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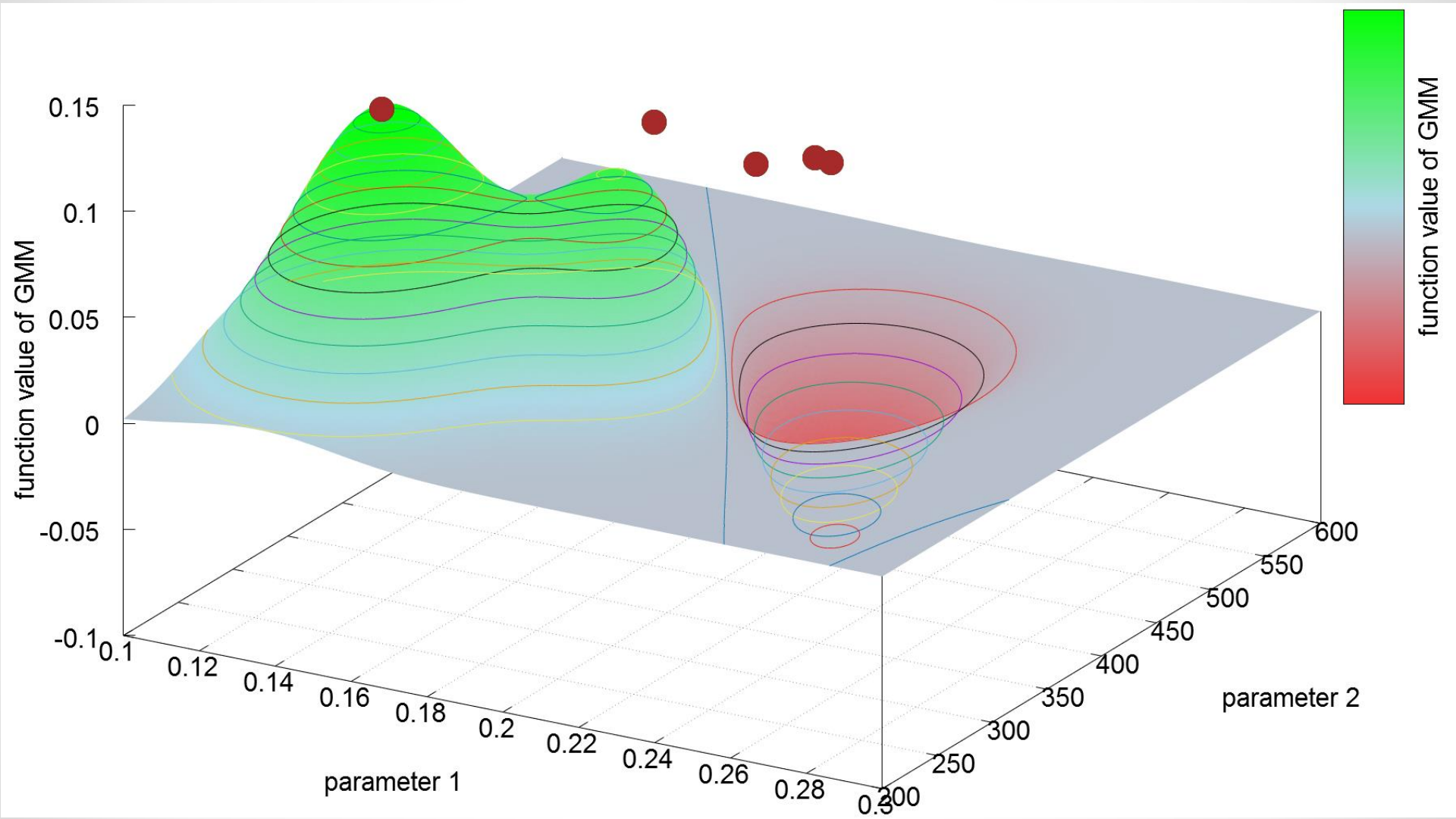
parameter 1
function value of GMM


0.15
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-0.05
-0.1
function value of GMM
0.1
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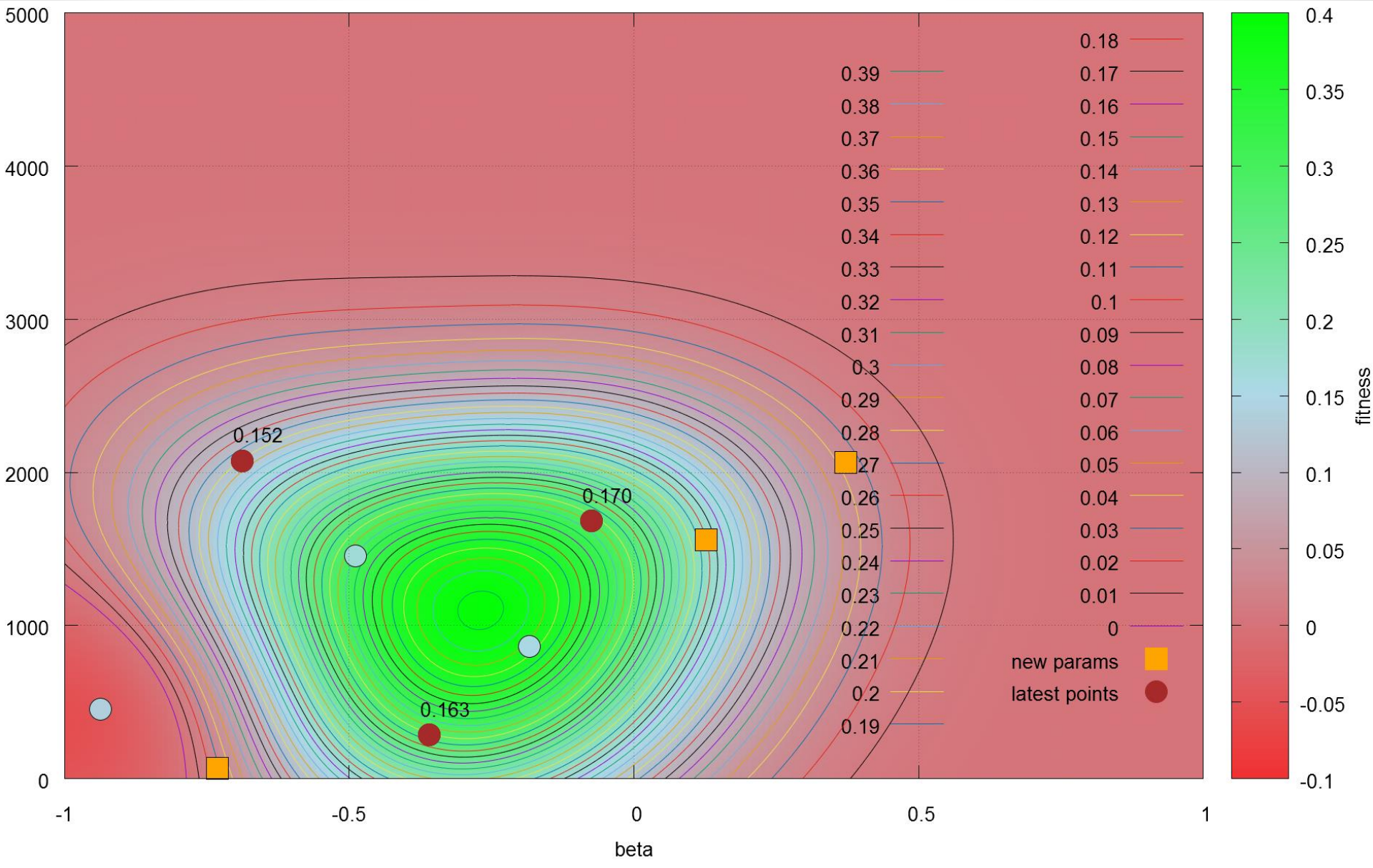
0.2
0.22
0.24
0.26
0.28
0.3
parameter 1
600
550
500
450
400
350
300
250
200
parameter 2
function value of GMM

Problems

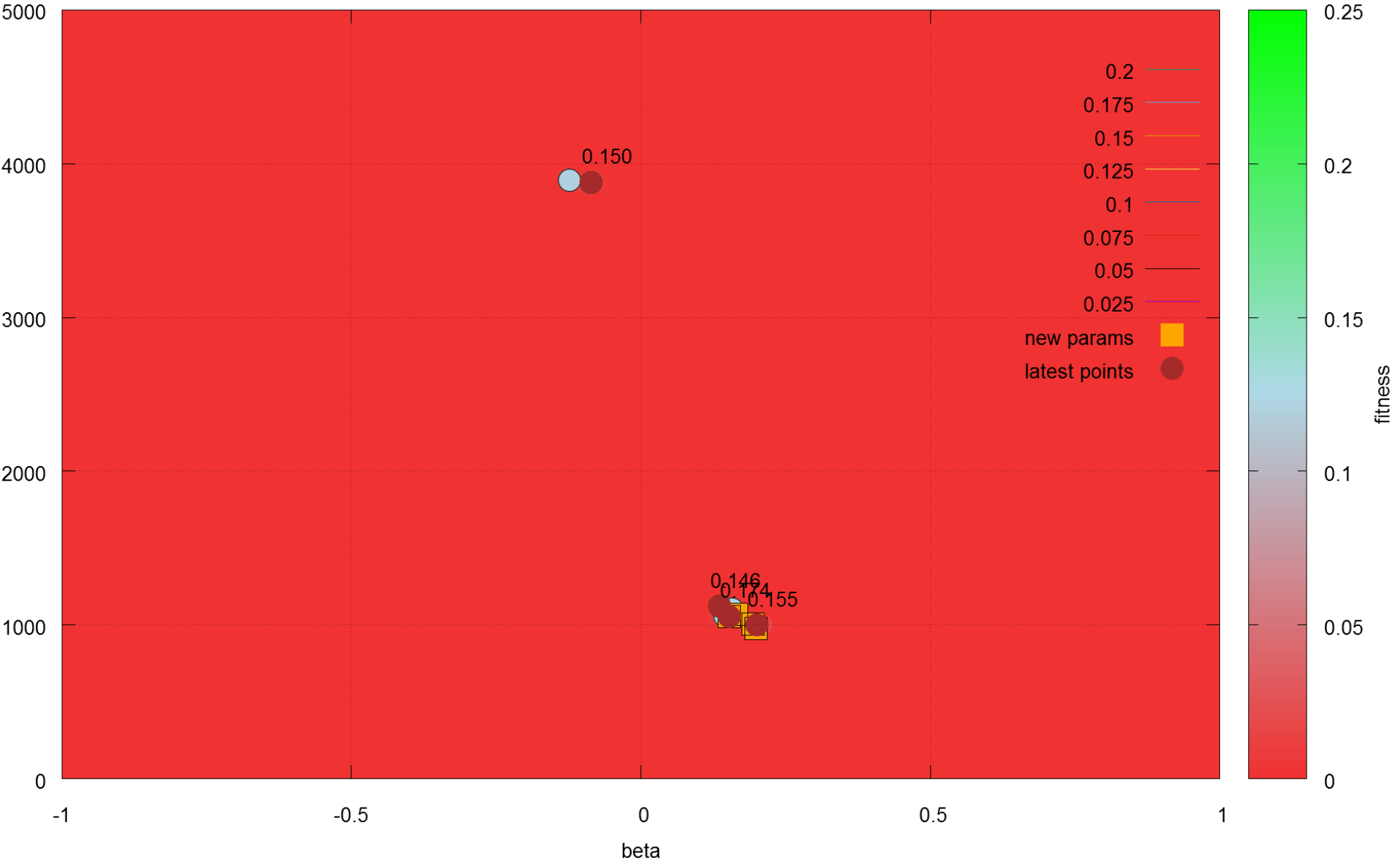
- Expensive eval = kind of solved by GMM
  (there is no real solution)

- We don't want to evaluate bad individuals
  => need of convergence
  => **simulated annealing**

Get from this:



To this: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3000
2000
1000
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-0.5
0
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1
beta
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0.2
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0.1
0.05
0
fitness
0.2
0.175
0.15
0.125
0.1
0.075
0.05
0.025
new params
latest points
0.150
0.146
0.154
0.155

Problems

- Noisy measurements could catapult us far away
  - => we need to be more conservative
  - => **elitist selection**
  - => stabilizes exploration
  - => allows tracking of changes in the environment

Problems

- A sudden change in the environment usually implies a change of the fitness landscape

  => we need to start exploring more

  = increased exploration rate

  = increased standard deviation of gaussians

Solution revisited

- Gaussian Mixture Model = GMM
- Penalization of sub-average gaussians
- Simulated annealing
- Elitist selection
- Detection of and reaction to sudden changes