Surface optimization

HEURISTICS

Gustavo Fleury Soares

Induraj P. ramamurthy

Professor:

PhD. Rachid Chelouah

Cergy / FR

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# Introduction

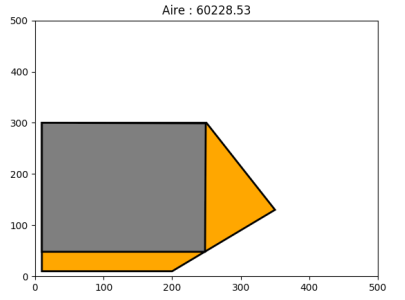
Optimization consist in find the best element (maximize or minimize), considering some criterion or boundaries, from some function or set of available alternatives. For some problems when the traditional process of optimization does not give a good result in acceptable time, we use the approach of heuristic optimization. Like explained in [1], “*this is achieved by trading optimality, completeness, accuracy, or precision for speed. In a way, it can be considered a shortcut*.”

These type of optimization techniques start with some initial solutions, and find the best from several moves made.

The subject of this work is try some heuristic optimization for the problem:

“**find the building with the largest rectangular floor area contained in the given area**”

The follow figure exemplifies the problem:



**Figure 1**. Example of given area and solution.

This work present adaptations of Simulated Annealing and Particle Swarm Optimizations for solve this problem.

# Problem modeling

We used the proposed solution of the exercise, that is the same presented in [2].

|  |  |
| --- | --- |
|  |  |
| **Figure 2.** Largest rectangle in poly | **Figure 3.** Values to characterize the rectangle: Points A, O and Angle. |

XXXX – Equations of calculate the points ABCD of rectangle.

# Simulated Annealing Solution

Simulated Annealing –SA is a metaheuristic probabilistic technique of optimization. The name come from annealing in metallurgy. The simulation is performed using a stochastic sampling method, the Metropolis algorithm.

## Solution

XXXXX . Parts of the code.

## Tests

The tests are done with the following parameters:

# \*\*\*\*\*\*\*\*\*\*\*\* Paramètres de la métaheuristique \*\*\* S. Annealing Parameters

T0 = 10 # initial temperature

Tmin = 1e-3 # final temperature

tau = 1e4 # constant for temperature decay

Alpha = 0.9 # constant for geometric decay

Step = 7 # number of iterations on a temperature level

IterMax = 1500 # 15000 max number of iterations of the algorithm

sizeNeigh = 1 # Size of the Xmax-Xmin to randomize

anglemin = 30

anglemax = 150

# \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

|  |  |
| --- | --- |
| polygone = ((10,10),(10,400),(400,400),(400,10)) | |
|  |  |
| Initial Random. | Final |
|  | |
| Energy evolution and number of improvements. | |

|  |  |
| --- | --- |
| polygone = ((10,10),(10,300),(250,300),(350,130),(200,10)) | |
|  |  |
| Initial Random. | Final |
|  | |
| Energy evolution and number of improvements. | |

|  |  |
| --- | --- |
| polygone = ((50,150),(200,50),(350,150),(350,300),(250,300),(200,250),(150,350),(100,250),(100,200)) | |
|  |  |
| Initial Random. | Final |
|  | |
| Energy evolution and number of improvements. | |

|  |  |
| --- | --- |
| polygone = ((50,50),(50,400),(220,310),(220,170),(330,170),(330,480),(450,480),(450,50)) | |
|  |  |
| Initial Random. | Final |
|  | |
| Energy evolution and number of improvements. | |

## 

## Sample of 30 results and Tuckey Boxes

We ran the code for each polygon 30 times and take the best values. All test used the same initial configurations.

|  |  |
| --- | --- |
| polygone = ((10,10),(10,400),(400,400),(400,10)) | |
|  | AREA  MIN: 134858  MAX: 152101  MEAN: 144899.0  STD: 4645 |
|  | |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| polygone = ((10,10),(10,400),  (400,400),(400,10)) | | | | polygone = ((10,10),(10,300),  (250,300),(350,130),(200,10)) | | |
|  | | | |  | | |
| MIN: 134858  MAX: 152101 | | MEAN: 144899.0  STD: 4645 | | MIN: 63082  MAX: 82944 | | MEAN: 71328.0  STD: 5228 |
| polygone = ((50,150),(200,50),  (350,150),(350,300),(250,300),  (200,250),(150,350),(100,250),  (100,200)) | | | polygone = ((50,50),(50,400),  (220,310),(220,170),(330,170),  (330,480),(450,480),(450,50)) | | | |
|  | | |  | | | |
| MIN: 45730  MAX: 67570 | MEAN: 55792.0 STD: 5067 | | MIN: 85153  MAX: 167290 | | MEAN: 118653.0 STD: 19940 | |

The results show an acceptable STD.

# Particle Swarm Optimization

asdfasdf

## Solution

sdfdsaf

## Tests

|  |  |
| --- | --- |
|  |  |
|  |  |

## Sample of 30 results and Tuckey Boxes

# Conclusion

XXXX - Compare 2 methods

Xxxxx - Define a fair comparison criterion – Could be TIME;

XXXX – Use an appropriate statistical test to compare the algorithms with each

# Bibliographics References

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| --- | --- |
| [1] | MIT, Heuristic Design and Optimization. |
| [2] | C. Knauer, L. Schlipf, J. Schimidt and T. Hans, Largest inscribed rectangles in convex polygons, University Bayreuth, 2011. |