

Algorithm for Optimization

Practical No. 5

AIM: Implement radial basis functions using surrogate modelling.

SurrogateModelOptim:

SurrogateModelOptim is a Julia package for the optimisation of expensive functions.

The surrogate model is based on an ensemble of Radial Basis Function interpolants with adaptive axis scaling.

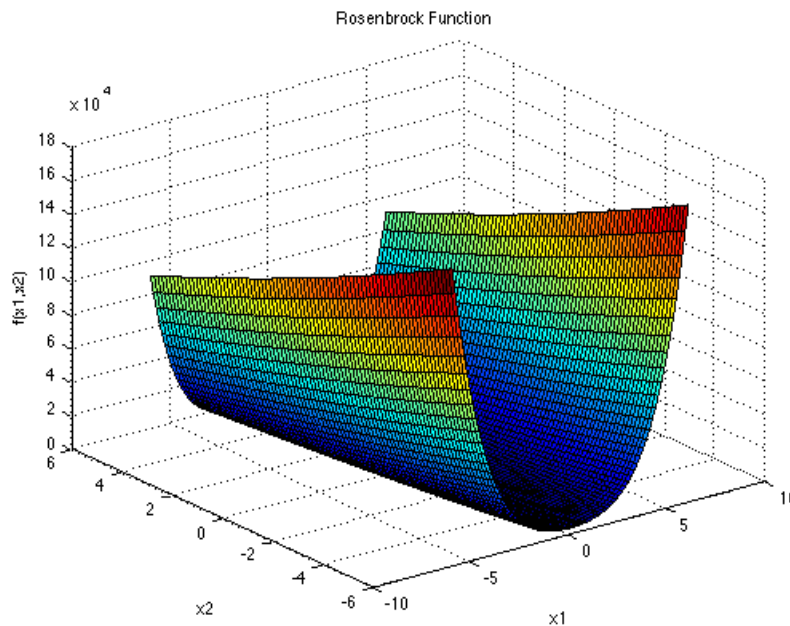
Installation:

The package is registered and can be installed.

The Rosenbrock function, also referred to as the Valley or Banana function, is a popular test problem for gradient-based optimization algorithms. It takes the following form:

$$f(\mathbf{x}) = \sum_{i=1}^{d-1} [100(x_{i+1} - x_i^2)^2 + (x_i - 1)^2]$$

It is shown in the plot above in its two-dimensional form.



The function is unimodal, and the global minimum lies in a narrow, parabolic valley.

The function is usually evaluated on the hypercube $x_i \in [-5, 10]$, for all $i = 1, \dots, d$ (dimensions), although it may be restricted to the hypercube $x_i \in [-2.048, 2.048]$, for all $i = 1, \dots, d$ (dimensions).

Optimization:

This package is intended to be used for functions which are expensive. We consider an expensive function `rosenbrock_2D` that evaluates in several minutes to days.

The simplest form of usage is as follows.

```
using SurrogateModelOptim
```

```
rosenbrock_2D(x) = (1.0 - x[1])^2 + 100.0 * (x[2] - x[1]^2)^2
```

```
search_range=[(-5.0,5.0),(-5.0,5.0)]
```

```
smoptimize(rosenbrock_2D, search_range)
```

```
julia> using SurrogateModelOptim

julia> rosenbrock_2D(x) = (1.0 - x[1])^2 + 100.0 * (x[2] - x[1]^2)^2
rosenbrock_2D (generic function with 1 method)

julia> search_range=[(-5.0,5.0),(-5.0,5.0)]
2-element Vector{Tuple{Float64, Float64}}:
 (-5.0, 5.0)
 (-5.0, 5.0)

julia> smoptimize(rosenbrock_2D, search_range)
  Iteration      Function value      Improvement
  1 out of 5           168.5              N/A
  2 out of 5           168.5              N/A
  3 out of 5           168.5              N/A
  4 out of 5           168.5              N/A
  5 out of 5           168.5              N/A
Surrogate Model Optim Result
Best fitness:      168.5, (worst 75641)
Best candidate:    [-2.5; 5.0;;]
Function calls:    10
Iterations:        5
LHC sampling points: 5
Infill criteria:   [:std, :median, :wstdmed03, :wstdmed06]
Mean axis scaling: [1.0, 0.9474874914335221] (relative to first dimension)
Smooth:           single (set to :single if noise is expected)
Returned surrogate contains all samples: false
```