'bbo' Package

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2 Introduction

This package is an R implementation of the 'Biogeography-Based Optimization'[1] technique invented by Prof. D. Simon, Cleveland State University, Ohio. More details of this method can be looked up at http://embeddedlab.csuohio.edu/BBO/ and in [1]

The core function of this package is *bbo* which outputs a list object of *bbo*. This list contains the details of the final best computed solution and the best habitat leading to the best solution in addition to habitats leading to best solutions at each iteration of the optimization loop. The function *summary* and *plot* present more information about this object.

3 Usage

The *bbo* function takes as input the following:

- the objective function
- the lower limit for each parameter/variable; a scalar real value for each parameter
- the upper limit for each parameter/variable; a scalar real value for each parameter

[1] http://embeddedlab.csuohio.edu/BBO/

- a display flag denoting verbose output
- boolean variable to plot results
- a random seed
- control parameters for the biogeography-based optimization technique

The control parameters to be set for the optimization technique are:

- probability that a habitat gets modified
- habitat mutation probability
- habitat elitism parameter
- population size (#habitats)
- #generations
- number of variables to be optimized (dimensionality of the problem)
- whether order dependency of the parameters is TRUE?

These control parameters can be set by a call to *bbo.control*. More information about the default values for these parameters can be seen in the help for these individual functions.

```
> library(bbo)
> Rosenbrock <- function(x){
+           x1 <- x[1]
+           x2 <- x[2]
+           return(  100 * (x2 - x1 * x1)^2 + (1 - x1)^2 )
+         }
> output.of.bbo <- bbo(Rosenbrock, -1, 2,
+                      control = bbo.control(pMutate = 0.4, numVar = 2,
+                                            popSize = 50, KEEP = 10, maxGen = 10))

The best and mean of Generation #  1  are  0.3544278  and  91.50572
The best and mean of Generation #  2  are  0.1882359  and  48.30919
The best and mean of Generation #  3  are  0.1275867  and  33.25449
The best and mean of Generation #  4  are  0.1275867  and  62.90403
The best and mean of Generation #  5  are  0.1202008  and  48.7407
The best and mean of Generation #  6  are  0.007957836  and  44.07037
The best and mean of Generation #  7  are  0.007957836  and  40.51833
The best and mean of Generation #  8  are  0.007957836  and  36.79977
The best and mean of Generation #  9  are  0.007957836  and  22.10273
The best and mean of Generation #  10  are  0.007957836  and  22.3925

>
```

The summary of this *bbo* object can be obtained with the *summary* function.

```
> output.of.bbo <- bbo(Rosenbrock, -1, 2,
+                      control = bbo.control(pMutate = 0.4, numVar = 2,
+                                                popSize = 50, KEEP = 10, maxGen = 10))
```

```
The best and mean of Generation #  1  are  1.006137  and  67.62126
The best and mean of Generation #  2  are  0.4022633  and  33.64258
The best and mean of Generation #  3  are  0.4022633  and  20.85658
The best and mean of Generation #  4  are  0.1383486  and  19.10128
The best and mean of Generation #  5  are  0.009620684  and  23.11816
The best and mean of Generation #  6  are  0.009620684  and  21.3208
The best and mean of Generation #  7  are  0.009620684  and  35.51638
The best and mean of Generation #  8  are  0.009620684  and  11.71189
The best and mean of Generation #  9  are  0.009620684  and  26.93531
The best and mean of Generation #  10  are  0.009620684  and  19.70622
```

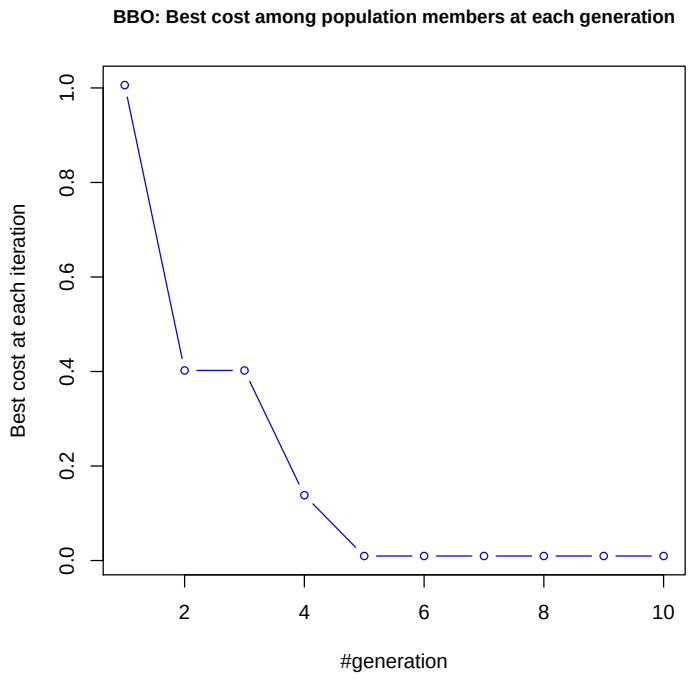
> bbo:::summary.bbo(output.of.bbo)

```
 ::summary of BBO run::
-----------
Properties:
-----------
numVar:  2
popSize:  50
maxGen:  10
Keep:  10
pMutate:  0.4
pModify:  1
orderDep:  TRUE

--------------
Best Solution:
--------------
Best habitat:
[1] 0.98683 0.98356
Best value/minimum cost:
[1] 0.00962

------------
Generations:
------------
Average population value for each generation:
 [1] 67.62126 33.64258 20.85658 19.10128 23.11816 21.32080 35.51638 11.71189
 [9] 26.93531 19.70622
Best habitat for each generation:
         [,1]    [,2]
 [1,] 0.34173 0.04109
 [2,] 0.85401 0.79105
 [3,] 0.85401 0.79105
 [4,] 1.35458 1.82365
 [5,] 0.98683 0.98356
 [6,] 0.98683 0.98356
 [7,] 0.98683 0.98356
 [8,] 0.98683 0.98356
 [9,] 0.98683 0.98356
```

```
[10,] 0.98683 0.98356
Best(minimum) function cost for each generation:
 [1] 1.00614 0.40226 0.40226 0.13835 0.00962 0.00962 0.00962 0.00962 0.00962
[10] 0.00962
```

And the plot function can be used to visualize the results of the optimization.

```
> bbo:::plot.bbo(output.of.bbo, plot.type = c("itersBestValue"))
```



References

[1] D. Simon. Biogeography-based optimization. *IEEE Transactions on Evolutionary Computation*, 12(6):702–713, 2008.