

Package ‘GenSA’

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Type Package

Title Functions for Generalized Simulated Annealing

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Description Performs search for global minimum of a very complex non-linear objective function with a very large number of optima.

License GPL-2

LazyLoad yes

NeedsCompilation yes

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GenSA-package	<i>Package for Generalized Simulated Annealing</i>
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Description

Implementation of a function that searches for global minimum of a very complex non-linear objective function with a very large number of optima.

Details

Package: GenSA
Type: Package
Version: 1.1.5
Date: 2015-03-31
License: GPL-2
LazyLoad: yes

Author(s)

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References

- Xiang Y, Gubian S, Suomela B, Hoeng. "Generalized Simulated Annealing for Global Optimization: the GenSA Package". *The R Journal*, 5(1):13-29, June 2013.
- Tsallis C (1988). "Possible generalization of Boltzmann-Gibbs statistics." *Journal of Statistical Physics*, 52, 479–487.
- Tsallis C, Stariolo DA (1996). "Generalized Simulated Annealing." *Physica A*, 233, 395–406.
- Xiang Y, Sun DY, Fan W, Gong XG (1997). "Generalized Simulated Annealing Algorithm and Its Application to the Thomson Model." *Physics Letters A*, 233, 216–220.
- Xiang Y, Gong XG (2000a). "Efficiency of Generalized Simulated Annealing." *PHYSICAL REVIEW E*, 62, 4473.
- Xiang Y, Sun DY, Gong XG (2000). "Generalized Simulated Annealing Studies on Structures and Properties of Nin (n=2-55) Clusters." *Journal of Physical Chemistry A*, 104, 2746–2751.

GenSA

Generalized Simulated Annealing Function

Description

Function which searches for global minimum of a very complex non-linear objective function with a very large number of optima.

Usage

```
GenSA(par, fn, lower, upper, control=list(), ...)
```

Arguments

<code>par</code>	Vector. Initial values for the components to be optimized. Default is NULL, in which case, default values will be generated automatically.
<code>fn</code>	A function to be minimized, with first argument the vector of parameters over which minimization is to take place. It should return a scalar result.
<code>lower</code>	Vector with length of <code>par</code> . Lower bounds for components.
<code>upper</code>	Vector with length of <code>par</code> . Upper bounds for components.
<code>...</code>	allows the user to pass additional arguments to the function <code>fn</code> .
<code>control</code>	The argument is a list that can be used to control the behavior of the algorithm: <ul style="list-style-type: none"> <code>maxit</code> Integer. Maximum number of iterations of the algorithm. <code>threshold.stop</code> Numeric. The program will stop when the expected objective function value <code>threshold.stop</code> is reached. Default value is NULL <code>nb.stop.improvement</code> Integer. The program will stop when there is no any improvement in <code>nb.stop.improvement</code> steps. <code>smooth</code> Logical.TRUE when the objective function is smooth, or differentiable almost everywhere in the region of <code>par</code>, FALSE otherwise. Default value is TRUE. <code>max.call</code> Integer. Maximum number of call of the objective function. Default is set to $1e7$. <code>max.time</code> Numeric. Maximum running time in seconds. <code>temperature</code> Numeric. Initial value for temperature. <code>visiting.param</code> Numeric. Parameter for visiting distribution. <code>acceptance.param</code> Numeric. Parameter for acceptance distribution. <code>verbose</code> Logical. TRUE means that messages from the algorithm are shown. Default is FALSE. <code>simple.function</code> Logical. FALSE means that the objective function has only a few local minima. Default is FALSE which means that the objective function is complicated with many local minima. <code>trace.fn</code> Character string. The trace matrix will be written in the file <code>trace.fn</code>. Default is NULL which means that the trace matrix will be stored in the returned value rather than in a file.

Details

The default values of the control components are set for a complex optimization problem. For usual optimization problem with medium complexity, GenSA can find a reasonable solution quickly so the user is recommended to let GenSA stop earlier by setting `threshold.stop` if `threshold.stop` is the expected function value, or by setting `max.time` if the user just want to run GenSA for `max.time` seconds, or by setting `max.call` if the user just want to run GenSA within `max.call` function calls. Please refer to the examples below. For very complex optimization problems, the user is recommended to increase `maxit` and `temp`.

Value

The returned value is a list with the following fields:

value: Numeric. The value of `fn` corresponding to `par`.

par: Vector. The best set of parameters found.

trace.mat: A matrix which contains the history of the algorithm. (By columns: Step number, temperature, current objective function value, current minimal objective function value).

counts: Integer. Total number of calls of the objective function.

Author(s)

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References

Xiang Y, Gubian S, Suomela B, Hoeng. "Generalized Simulated Annealing for Global Optimization: the GenSA Package". *The R Journal*, 5(1):13-29, June 2013.

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See Also

`optim`

Examples

```
library(GenSA)
# Try Rastrigin function (The objective function value for global minimum
# is 0 with all components of par are 0.)
Rastrigin <- function(x) {
  sum(x^2 - 10 * cos(2 * pi * x)) + 10 * length(x)
}
# Perform the search on a 30 dimensions rastrigin function. Rastrigin
# function with dimension 30 is known as the most
# difficult optimization problem according to "Yao X, Liu Y, Lin G (1999).
# \Evolutionary Programming Made Faster."
# IEEE Transactions on Evolutionary Computation, 3(2), 82-102.

# GenSA will stop after finding the targeted function value 0 with
# absolute tolerance 1e-13
set.seed(1234) # The user can use any seed.
```

```
dimension <- 30
global.min <- 0
tol <- 1e-13
lower <- rep(-5.12, dimension)
upper <- rep(5.12, dimension)
out <- GenSA(lower = lower, upper = upper, fn = Rastrigin,
             control=list(threshold.stop=global.min+tol,verbose=TRUE))
out[c("value", "par", "counts")]

# GenSA will stop after running for about 2 seconds
# Note: The time for solving this problem by GenSA may vary
# depending on the computer used.
set.seed(1234) # The user can use any seed.
dimension <- 30
global.min <- 0
tol <- 1e-13
lower <- rep(-5.12, dimension)
upper <- rep(5.12, dimension)
out <- GenSA(lower = lower, upper = upper, fn = Rastrigin,
             control=list(max.time=2))
out[c("value", "par", "counts")]
```

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