

Package ‘GenSA’

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Title R 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.
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GenSA	<i>Generalized Simulated Annealing Function</i>
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Description

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

Usage

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

Arguments

<code>par</code>	Vector. Initial values for the components to be optimized. Default is <code>NULL</code> , 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>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 unction value <code>threshold.stop</code> is reached. Default value is <code>NULL</code>. <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. <code>TRUE</code> when the objective function is smooth, or differentiable almost everywhere in the region of <code>par</code>, <code>FALSE</code> otherwise. Default value is <code>TRUE</code>. <code>max.call</code> Integer. Maximum number of call of the objective function. Default is set to <code>1e7</code>. <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. <code>TRUE</code> means that messages from the algorithm are shown. Default is <code>FALSE</code>. <code>simple.function</code> Logical. <code>FALSE</code> means that the objective function has only a few local minima. Default is <code>FALSE</code> which means that the objective function is complicated with many local minima. <code>trace.mat</code> Logical. Default is <code>TRUE</code> which means that the trace matrix will be available in the returned value of GenSA call. <code>seed</code> Integer. Negative integer value that can be set to initialize the internal random generator.
<code>...</code>	allows the user to pass additional arguments to the function <code>fn</code> .

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.

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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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