Package ‘RGN’

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Type Package

Title Robust-Gauss Newton (RGN) Optimization of Sum-of-Squares Objective Function

Version 1.0.0

Description Implementation of the Robust Gauss-Newton (RGN) algorithm, designed for solving optimization problems with a sum of least squares objective function. For algorithm details please refer to Qin et. al. (2018) <doi:10.1029/2017WR022488>.

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URL https://github.com/ClimateAnalytics/RGN/

BugReports https://github.com/ClimateAnalytics/RGN/issues

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Author David McInerney [cre, aut] (<https://orcid.org/0000-0003-4876-8281>),
Michael Leonard [aut] (<https://orcid.org/0000-0002-9519-3188>),
Dmitri Kavetski [aut] (<https://orcid.org/0000-0003-4966-9234>),
Youwei Qin [aut] (<https://orcid.org/0000-0001-5425-539X>),
George Kuczera [aut]

Maintainer David McInerney <dmcinern@gmail.com>

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`BassRiverData` *Hydrological data for Bass River catchment in Victoria, Australia*

Description

Streamflow, rainfall and PET data for Bass River catchment (227219) in Victoria, Australia. Originally obtained from Francis Chiew.

Usage

```
data(BassRiver)
```

Format

List containing numerical vectors for precipitation (`Rain.mm`), potential evapotranspiration (`ET.mm`), and runoff (`Runoff.mm.day`), and date vector (`Date`)

References

https://github.com/eachonly/Robust-Gauss-Newton-Algorithm, http://www.bom.gov.au/water/hrs/

`rgn` *Robust Gauss Newton optimization*

Description

`rgn` performs optimization of weighted-sum-of-squares (WSS) objective function using the Robust Gauss Newton algorithm

Usage

```
rgn(
  simFunc,
  simTarget = 0,
  weights = NULL,
  par,
  lower,
  upper,
  control = NULL,
  ...
)
```

Arguments

`simFunc`	is a function that simulates a (vector) response, with first argument the vector of parameters over which optimization is performed
`simTarget`	is the target vector that `simFunc` is trying to match
`weights`	is a vector of weights used in the WSS objective function. Defaults to equal weights.
`par`	is the vector of initial parameters
`lower`	is the lower bounds on parameters
`upper`	is the upper bounds on parameters
`control`	list of RGN settings • `control$n.multi` is number of multi-starts (i.e. invocations of optimization with different initial parameter estimates). Default is 1. • `control$iterMax` is maximum iterations. Default is 100. • `control$dump` is level of diagnostic outputs between 0 (none) and 3 (highest). Default is 0. • `control$keep.multi` (TRUE/FALSE) controls whether diagnostic output from each multi-start is recorded. Default is FALSE. • `control$logFile` is log file name
`...`	other arguments to `simFunc()`

Details

`rgn` minimizes the objective function `sum((weights*(simFunc-simTarget)^2))`, which is a sum of squared weighted residuals (`residuals=weights*(simFunc-simTarget)`). Note `simFunc` corresponds to the vector of residuals when default arguments for `simTarget` and `weights` are used.

Value

List with

- `par`, the optimal parameters
- `value`, the optimal objective function value

- sim, the simulated vector using optimal parameters
- residuals, the vector of residuals using optimal parameters
- counts, the total number of function calls
- convergence, an integer code indicating reason for completion. 1 maximum iterations reached, 2 relative reduction in function value small. 3 absolute reduction in function value small 4 relative change in parameters small

Examples

```
# Example 1: Rosenbrock
simFunc_rosenbrock=function(x) c(1.0-x[1],10.0*(x[2]-x[1]**2))
rgnOut = rgn(simFunc=simFunc_rosenbrock,
             par=c(-1.0,  0.0), lower=c(-1.5, -1.0), upper=c( 1.5,  3.0),
             simTarget=c(0,0))
rgnOut$par #optimal parameters
rgnOut$value #optimal objective function value

# Example 2: Hymod

data("BassRiver") # load Bass River hydrological data
rgnOut = rgn(simFunc=simFunc_hymod,
             par=c(400.,0.5,0.1,0.2,0.1),
             lower=c(1.,0.1,0.05,0.000001,0.000001),
             upper=c(1000.,2.,0.95,0.99999,0.99999),
             simTarget=BassRiverData$Runoff.mm.day[365:length(BassRiverData$Date)],
           stateVal=c(100.0,30.0,27.0,25.0,30.0,0.0,0.0,0.0), # initial states for hymod
             nWarmUp=365,                                      # warmup period
             rain=BassRiverData$Rain.mm,                       # precip input
             pet=BassRiverData$ET.mm)                          # PET input
rgnOut$par #optimal parameters
rgnOut$value #optimal objective function value
```

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simFunc_hymod *hymod simulation*

Description

Simulation of hymod rainfall-runoff model

Usage

```
simFunc_hymod(
  x,
  rain,
  pet,
  nWarmUp,
  stateVal = c(100, 30, 27, 25, 30, 0, 0, 0)
)
```

Arguments

`x`	parameter values
`rain`	precipitation input (mm/day)
`pet`	potential evapotranspiration (mm/day)
`nWarmUp`	length of warmup period
`stateVal`	(optional) initial states

Value

Vector of simulated runoff

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