Package ‘ttcg’

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**ttcg: Three-term conjugate gradient minimization algorithms**

**Description**


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**See Also**

Useful links:
- [https://git.sr.ht/~hckiang/ttcg](https://git.sr.ht/~hckiang/ttcg)

**ttcg**

*Accelerated three-term conjugate gradient optimization with restart*

**Description**

The `ttcg` function minimizes a given function using several Neculai Andrei’s three-term conjugate gradient algorithms.

**Usage**

`ttcg(par, fn, gr = NULL, method = "TTDES", control = list(), ...)`

**Arguments**

- `par`  A numerical vector containing the initial parameters.
- `fn`  A function to be minimized. It should accept a numerical vector as its sole argument and return a scaler.
- `gr`  The gradient function of `fn`. It should accept the same argument as `fn` and return a vector of the same length as `par`. If it is `NULL` then numerical finite difference is used to obtain the gradient.
- `method`  A character string, one of 'TTDES', 'TTCG', 'THREECG'. This determines how the line search direction is computed. 'TTDES' is the default method.
- `control`  A list of control parameters. See Details.
- `...`  Extra arguments to be passed to `fn`
Details

By default, the algorithm stops when any one of the following three convergence tests is satisfied. (1) The squared Euclidean norm of the squared Euclidean norm of the gradient is smaller than a tolerance; (2) The infinity norm of the gradient is smaller than a tolerance; (3) \( |f_{k+1} - f_k| < \epsilon * (1 + |f_k|) \). These three tolerances can be set in the control argument, and turned off by setting them to any negative values. If all three were turned off, the algorithm may never stop.

The method argument specifies how the search direction in each step is computed. Please see the three Neculai Andrei’s three papers in the citation section for more detailed description. An acceleration scheme and a restart procedure are implemented according to his three papers. Line search is done by a bisection-like weak-Wolfe search described in Oliveira and Takahashi’s (2020) interpolate-truncate-project algorithm, but replacing their gradient-secant interpolation with some of More-Thuente’s (1994) cubic interpolation idea.

The control argument is a list that can contain any of the following named elements:

- **maxit** The maximal number of iteration. Default is 500.
- **gl2tol** A positive small number. The iteration will be terminated if the squared Euclidean norm of the gradient is smaller than this number. Default is \( \min(1e-9, \text{length(par)} * 1e-10) \). To turn off this test, set it to any negative values.
- **gmaxtol** A positive small number. The iteration will be terminated if the infinity norm of the gradient is smaller than \( \text{gmaxtol} \). Default is 1e-6. To turn off this test, set it to any negative values.
- **ftol** A positive small number. The iteration will be terminated if \( |f_{k+1} - f_k| < \text{ftol} * (1 + |f_k|) \). To turn off this test, set it to any negative values.
- **c1** The line search parameter for the sufficient descent condition. Default is 1e-3.
- **c2** The line search parameter for the curvature condition. Default is 0.08.
- **trace** Either TRUE or FALSE, indicating whether or not details should be printed to the terminal during the optimization. Default is FALSE.

Value

A list containing the following named elements.

- **par** The optimal parameter.
- **value** The optimal function value.
- **counts** An integer vector containing the number of function and gradient calls used during the optimization.
- **convergence** An integer indicating convergence status. '0' means successful convergence; '1' means maxit has been reached; '2' means a line search failure in which a point that satisfies the weak Wolfe condition is not found. Among other possibilities, this may happen when the function is unbounded below or the function is non-differentiable.)
- **message** A character string giving additional message.
References


Examples

```r	nqm = rnorm(500)*2	nf = function (x,nqm1) sum((x - nqm1)^2.)
gr = function (x,nqm1) 2.*(x - nqm1)
rr = ttcg(par = rnorm(500)*4., fn = fn, gr = gr, method='TTDES', nqm=nqm)
all.equal(r$value, 0.0)
```
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