

**NAME**

CUTEst\_cgrdh\_threaded – CUTEst tool to evaluate constraints gradients, Hessian of Lagrangian function and gradient of objective/Lagrangian function.

**SYNOPSIS**

CALL CUTEst\_cgrdh\_threaded( status, n, m, X, Y, grlagf, G, jtrans, lj1, lj2, J\_val, lh1, H\_val, thread )

**DESCRIPTION**

The CUTEst\_cgrdh\_threaded subroutine evaluates the gradients of the general constraints and of either the objective function  $f(x)$  or the Lagrangian function  $l(x, y) = f(x) + y^T c(x)$  corresponding to the problem decoded from a SIF file by the script *sifdecoder* at the point  $(x, y) = (X, Y)$ . It also evaluates the Hessian matrix of the Lagrangian function at  $(x, y)$ . The gradients and matrices are stored in a dense format.

The problem under consideration is to minimize or maximize an objective function  $f(x)$  over all  $x \in R^n$  subject to general equations  $c_i(x) = 0$ , ( $i \in 1, \dots, m_E$ ), general inequalities  $c_i^l(x) \leq c_i(x) \leq c_i^u(x)$ , ( $i \in m_E + 1, \dots, m$ ), and simple bounds  $x^l \leq x \leq x^u$ . The objective function is group-partially separable and all constraint functions are partially separable.

**ARGUMENTS**

The arguments of CUTEst\_cgrdh\_threaded are as follows

**status** [out] - integer

the output status: 0 for a successful call, 1 for an array allocation/deallocation error, 2 for an array bound error, 3 for an evaluation error, 4 for an out-of-range thread,

**n** [in] - integer

the number of variables for the problem,

**m** [in] - integer

the total number of general constraints,

**X** [in] - real/double precision

an array which gives the current estimate of the solution of the problem,

**Y** [in] - real/double precision

an array which should give the Lagrange multipliers whenever grlagf is set .TRUE. but need not otherwise be set,

**grlagf** [in] - logical

a logical variable which should be set .TRUE. if the gradient of the Lagrangian function is required and .FALSE. if the gradient of the objective function is sought,

**G** [out] - real/double precision

an array which gives the value of the gradient of the objective function evaluated at X (GRLAGF = .FALSE.) or of the Lagrangian function evaluated at X and Y (GRLAGF = .TRUE.),

**jtrans** [in] - logical

a logical variable which should be set to .TRUE. if the transpose of the constraint Jacobian is required and to .FALSE. if the Jacobian itself is wanted. The Jacobian matrix is the matrix whose i-th row is the gradient of the i-th constraint function,

**lj1** [in] - integer

the actual declared size of the leading dimension of J\_val (with lj1 no smaller than n if jtrans is .TRUE. or m if jtrans is .FALSE.),

**lj2** [in] - integer

the actual declared size of the second dimension of J\_val (with lj2 no smaller than m if jtrans is .TRUE. or n if jtrans is .FALSE.),

**J\_val** [out] - real/double precision

a two-dimensional array of dimension (lj1, lj2) which gives the value of the Jacobian matrix of the constraint functions, or its transpose, evaluated at X. If jtrans is .TRUE., the i,j-th component of the

array will contain the i-th derivative of the j-th constraint function. Otherwise, if jtrans is `.FALSE.`, the i,j-th component of the array will contain the j-th derivative of the i-th constraint function.

**lh1** [in] - integer

the actual declared size of the leading dimension of `H_val` (with `lh1` no smaller than `n`),

**H\_val** [out] - real/double precision

a two-dimensional array which gives the value of the Hessian matrix of the Lagrangian function evaluated at `X` and `Y`,

**thread** [in] - integer

thread chosen for the evaluation; threads are numbered from 1 to the value `threads` set when calling `CUTEst_csetup_threaded`.

## AUTHORS

I. Bongartz, A.R. Conn, N.I.M. Gould, D. Orban and Ph.L. Toint

## SEE ALSO

*CUTEst: a Constrained and Unconstrained Testing Environment with safe threads*,  
N.I.M. Gould, D. Orban and Ph.L. Toint,  
Technical Report, Rutherford Appleton Laboratory, 2013.

*CUTEr (and SifDec): A Constrained and Unconstrained Testing Environment, revisited*,  
N.I.M. Gould, D. Orban and Ph.L. Toint,  
ACM TOMS, **29**:4, pp.373-394, 2003.

*CUTE: Constrained and Unconstrained Testing Environment*, I. Bongartz, A.R. Conn, N.I.M. Gould and Ph.L. Toint, ACM TOMS, **21**:1, pp.123-160, 1995.

`cutest_ugrrdh_threaded(3M)`, `sifdecoder(1)`.

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the actual declared size of the second dimension of J\_val (with lj2 no smaller than m if jtrans is .TRUE. or n if jtrans is .FALSE.),

**J\_val** [out] - real/double precision

a two-dimensional array of dimension (lj1, lj2) which gives the value of the Jacobian matrix of the constraint functions, or its transpose, evaluated at X. If jtrans is .TRUE., the i,j-th component of the

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**lh1** [in] - integer

the actual declared size of the leading dimension of `H_val` (with `lh1` no smaller than `n`),

**H\_val** [out] - real/double precision

a two-dimensional array which gives the value of the Hessian matrix of the Lagrangian function evaluated at `X` and `Y`,

**thread** [in] - integer

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