NAG Library Function Document

nag_3d_shep_eval (e01thc)

1 Purpose

nag_3d_shep_eval (e01thc) evaluates the three-dimensional interpolating function generated by nag_3d_shep_interp (e01tgc) and its first partial derivatives.

2 Specification

```
#include <nag.h>
#include <nage01.h>
```

```
void nag_3d_shep_eval (Integer m, const double x[], const double y[],
     const double z[], const double f[], const Integer iq[],
     const double rq[], Integer n, const double u[], const double v[],
     const double w[], double q[], double qx[], double qy[], double qz[],
     NagError *fail)
```

3 Description

nag_3d_shep_eval (e01thc) takes as input the interpolant $Q(x,y,z)$ of a set of scattered data points (x_r, y_r, z_r, f_r), for $r = 1, 2, \ldots, m$, as computed by nag_3d_shep_interp (e01tgc), and evaluates the interpolant and its first partial derivatives at the set of points (u_i, v_i, w_i), for $i = 1, 2, \ldots, n$.

nag_3d_shep_eval (e01thc) must only be called after a call to nag_3d_shep_interp (e01tgc).

This function is derived from the function QS3GRD described by Renka (1988).

4 References

Renka R J (1988) Algorithm 661: QSHEP3D: Quadratic Shepard method for trivariate interpolation of scattered data *ACM Trans. Math. Software* **14** 151–152

5 Arguments

1: **m** – Integer *Input*
2: **x**[**m**] – const double *Input*
3: **y**[**m**] – const double *Input*
4: **z**[**m**] – const double *Input*
5: **f**[**m**] – const double *Input*

On entry: **m**, **x**, **y**, **z** and **f** must be the same values as were supplied in the preceding call to nag_3d_shep_interp (e01tgc).

6: **iq**[$(\mathbf{2} \times \mathbf{m} + \mathbf{1})$] – const Integer *Input*

On entry: must be unchanged from the value returned from a previous call to nag_3d_shep_interp (e01tgc).

7: **rq**[$(\mathbf{10} \times \mathbf{m} + \mathbf{7})$] – const double *Input*

On entry: must be unchanged from the value returned from a previous call to nag_3d_shep_interp (e01tgc).

8: **n** – Integer *Input*

On entry: n, the number of evaluation points.

Constraint: $\mathbf{n} \geq 1$.

9: **u**[**n**] – const double *Input*
10: **v**[**n**] – const double *Input*
11: **w**[**n**] – const double *Input*

On entry: **u**$[i-1]$, **v**$[i-1]$, **w**$[i-1]$ must be set to the evaluation point (u_i, v_i, w_i), for $i = 1, 2, \ldots, n$.

12: **q**[**n**] – double *Output*

On exit: **q**$[i-1]$ contains the value of the interpolant at (u_i, v_i, w_i), for $i = 1, 2, \ldots, n$. If any of these evaluation points lie outside the region of definition of the interpolant the corresponding entries in **q** are set to the largest machine representable number (see nag_real_largest_number (X02ALC)), and nag_3d_shep_eval (e01thc) returns with **fail.code** = NE_BAD_POINT.

13: **qx**[**n**] – double *Output*
14: **qy**[**n**] – double *Output*
15: **qz**[**n**] – double *Output*

On exit: **qx**$[i-1]$, **qy**$[i-1]$, **qz**$[i-1]$ contains the value of the partial derivatives of the interpolant $Q(x, y, z)$ at (u_i, v_i, w_i), for $i = 1, 2, \ldots, n$. If any of these evaluation points lie outside the region of definition of the interpolant, the corresponding entries in **qx**, **qy** and **qz** are set to the largest machine representable number (see nag_real_largest_number (X02ALC)), and nag_3d_shep_eval (e01thc) returns with **fail.code** = NE_BAD_POINT.

16: **fail** – NagError * *Input/Output*

The NAG error argument (see Section 3.6 in the Essential Introduction).

6 Error Indicators and Warnings

NE_BAD_PARAM

On entry, argument ⟨*value*⟩ had an illegal value.

NE_BAD_POINT

On entry, at least one evaluation point lies outside the region of definition of the interpolant. At all such points the corresponding values in **q**, **qx**, **qy** and **qz** have been set to nag_real_largest_number: nag_real_largest_number = ⟨*value*⟩.

NE_INT

On entry, **m** = ⟨*value*⟩.
Constraint: $\mathbf{m} \geq 10$.

On entry, **n** = ⟨*value*⟩.
Constraint: $\mathbf{n} \geq 1$.

NE_INT_ARRAY

On entry, values in **iq** appear to be invalid. Check that **iq** has not been corrupted between calls to nag_3d_shep_interp (e01tgc) and nag_3d_shep_eval (e01thc).

NE_INTERNAL_ERROR

An internal error has occurred in this function. Check the function call and any array sizes. If the call is correct then please contact NAG for assistance.

NE_REAL_ARRAY

On entry, values in **rq** appear to be invalid. Check that **rq** has not been corrupted between calls to nag_3d_shep_interp (e01tgc) and nag_3d_shep_eval (e01thc).

7 Accuracy

Computational errors should be negligible in most practical situations.

8 Parallelism and Performance

nag_3d_shep_eval (e01thc) is threaded by NAG for parallel execution in multithreaded implementations of the NAG Library.

Please consult the Users' Note for your implementation for any additional implementation-specific information.

9 Further Comments

The time taken for a call to nag_3d_shep_eval (e01thc) will depend in general on the distribution of the data points. If **x**, **y** and **z** are approximately uniformly distributed, then the time taken should be only $O(\mathbf{n})$. At worst $O(\mathbf{mn})$ time will be required.

10 Example

See Section 10 in nag_3d_shep_interp (e01tgc).