

NAG C 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

```
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

This function 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 $r = 1, 2, \dots, m$, 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 $i = 1, 2, \dots, n$.

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 (1988b).

4 References

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

5 Parameters

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|----|----------------------------|--------------|
| 1: | m – Integer | <i>Input</i> |
| 2: | x[m] – const double | <i>Input</i> |
| 3: | y[m] – const double | <i>Input</i> |
| 4: | z[m] – const double | <i>Input</i> |
| 5: | f[m] – const double | <i>Input</i> |

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).

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| 6: | iq[dim] – const Integer | <i>Input</i> |
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Note: the dimension, *dim*, of the array **iq** must be at least $2 \times m + 1$.

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

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| 7: | rq[dim] – const double | <i>Input</i> |
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Note: the dimension, *dim*, of the array **rq** must be at least $10 \times m + 7$.

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

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| 8: | n – Integer | <i>Input</i> |
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On entry: **n**, the number of evaluation points.

Constraint: **n** ≥ 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 $i = 1, 2, \dots, n$.
- 12: **q[n]** – double *Output*
- On exit: **q**[$i-1$] contains the value of the interpolant at (u_i, v_i, w_i) , for $i = 1, 2, \dots, n$. 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 $i = 1, 2, \dots, n$. 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 parameter (see the Essential Introduction).

6 Error Indicators and Warnings

NE_INT

On entry, **n** = $\langle value \rangle$.
 Constraint: **n** ≥ 1 .
 On entry, **m** = $\langle value \rangle$.
 Constraint: **m** ≥ 10 .

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_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` (X02ALC)(); `nag_real_largest_number` (X02ALC)() = $\langle value \rangle$.

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).

NE_BAD_PARAM

On entry, parameter $\langle value \rangle$ had an illegal value.

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 consult NAG for assistance.

7 Accuracy

Computational errors should be negligible in most practical situations.

8 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.

9 Example

See Section 9 of the document for `nag_3d_shep_interp` (e01tgc).
