NAG Library Function Document

nag_ode_bvp_ps_lin_cgl_grid (d02ucc)

1 Purpose

nag_ode_bvp_ps_lin_cgl_grid (d02ucc) returns the Chebyshev Gauss–Lobatto grid points on $[a, b]$.

2 Specification

```
#include <nag.h>
#include <nagd02.h>
void nag_ode_bvp_ps_lin_cgl_grid (Integer n, double a, double b, double x[],
     NagError *fail)
```

3 Description

nag_ode_bvp_ps_lin_cgl_grid (d02ucc) returns the Chebyshev Gauss–Lobatto grid points on $[a, b]$. The Chebyshev Gauss–Lobatto points on $[-1, 1]$ are computed as $t_i = -\cos\left(\frac{(i-1)\pi}{n}\right)$, for $i = 1, 2, \ldots, n + 1$. The Chebyshev Gauss–Lobatto points on an arbitrary domain $[a, b]$ are:

$$x_i = \frac{b-a}{2} t_i + \frac{a+b}{2}, \quad i = 1, 2, \ldots, n + 1.$$

4 References

Trefethen L N (2000) *Spectral Methods in MATLAB* SIAM

5 Arguments

1: **n** – Integer *Input*

On entry: n, where the number of grid points is $n + 1$. This is also the largest order of Chebyshev polynomial in the Chebyshev series to be computed.

Constraint: $\mathbf{n} > 0$ and **n** is even.

2: **a** – double *Input*

On entry: a, the lower bound of domain $[a, b]$.

Constraint: $\mathbf{a} < \mathbf{b}$.

3: **b** – double *Input*

On entry: b, the upper bound of domain $[a, b]$.

Constraint: $\mathbf{b} > \mathbf{a}$.

4: $\mathbf{x}[\mathbf{n} + \mathbf{1}]$ – double *Output*

On exit: the Chebyshev Gauss–Lobatto grid points, x_i, for $i = 1, 2, \ldots, n + 1$, on $[a, b]$.

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

The NAG error argument (see Section 2.7 in How to Use the NAG Library and its Documentation).

6 Error Indicators and Warnings

NE_ALLOC_FAIL

Dynamic memory allocation failed.
See Section 2.3.1.2 in How to Use the NAG Library and its Documentation for further information.

NE_BAD_PARAM

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

NE_INT

On entry, $\mathbf{n} = \langle value \rangle$.
Constraint: $\mathbf{n} > 0$.

On entry, $\mathbf{n} = \langle value \rangle$.
Constraint: $\mathbf{n}$ is even.

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.

An unexpected error has been triggered by this function. Please contact NAG.
See Section 2.7.6 in How to Use the NAG Library and its Documentation for further information.

NE_NO_LICENCE

Your licence key may have expired or may not have been installed correctly.
See Section 2.7.5 in How to Use the NAG Library and its Documentation for further information.

NE_REAL_2

On entry, $\mathbf{a} = \langle value \rangle$ and $\mathbf{b} = \langle value \rangle$.
Constraint: $\mathbf{a} < \mathbf{b}$.

7 Accuracy

The Chebyshev Gauss–Lobatto grid points computed should be accurate to within a small multiple of ***machine precision***.

8 Parallelism and Performance

nag_ode_bvp_ps_lin_cgl_grid (d02ucc) is not threaded in any implementation.

9 Further Comments

The number of operations is of the order $n\log(n)$ and there are no internal memory requirements; thus the computation remains efficient and practical for very fine discretizations (very large values of n).

10 Example

See Section 10 in nag_ode_bvp_ps_lin_solve (d02uec).