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: **n** > 0 and **n** is even.

2: **a** – double *Input*

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

Constraint: **a** $<$ **b**.

3: **b** – double *Input*

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

Constraint: **b** $>$ **a**.

4: **x**[**n** + **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 3.6 in the Essential Introduction).

6 Error Indicators and Warnings

NE_BAD_PARAM

On entry, argument ⟨*value*⟩ 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: **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.

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

Not applicable.

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).