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

```c
#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 

\[ t_i = \cos\left(\frac{(i-1)\pi}{n}\right), \quad \text{for } i = 1, 2, \ldots, n+1. \]

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


5 Arguments

1: \textbf{n} – Integer \textit{Input}

\textit{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.

\textit{Constraint}: \(n > 0\) and \(n\) is even.

2: \textbf{a} – double \textit{Input}

\textit{On entry}: \(a\), the lower bound of domain \([a, b]\).

\textit{Constraint}: \(a < b\).

3: \textbf{b} – double \textit{Input}

\textit{On entry}: \(b\), the upper bound of domain \([a, b]\).

\textit{Constraint}: \(b > a\).

4: \textbf{x[n+1]} – double \textit{Output}

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

5: \textbf{fail} – NagError * \textit{Input/Output}

The NAG error argument (see Section 3.6 in the Essential Introduction).
6 Error Indicators and Warnings

NE_ALLOC_FAIL
Dynamic memory allocation failed.
See Section 3.2.1.2 in the Essential Introduction for further information.

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

NE_INT
On entry, n = ⟨value⟩.
Constraint: n > 0.
On entry, n = ⟨value⟩.
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.
An unexpected error has been triggered by this function. Please contact NAG.
See Section 3.6.6 in the Essential Introduction for further information.

NE_NO_LICENCE
Your licence key may have expired or may not have been installed correctly.
See Section 3.6.5 in the Essential Introduction for further information.

NE_REAL_2
On entry, a = ⟨value⟩ and b = ⟨value⟩.
Constraint: a < 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 nlog (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).