

nag_morlet

1. Purpose

nag_morlet computes values of the Morlet wavelet at the supplied evaluation points.

2. Specification

```
#include <nag.h>
#include <nag_wav_fun.h>
void nag_morlet(Integer wavenum, Integer n, double x[],
                double psi[], NagError *fail)
```

3. Description

nag_morlet computes values of the Morlet wavelet with non-dimensional wave number k

$$\psi(x) = \frac{1}{\pi^{1/4}} \cos(kx) e^{-x^2/2},$$

at the points $x(i)$ for $i = 1, 2, \dots, n$.

4. Parameters

1: **wavenum** – Integer *Input*
On entry: the non-dimensional wave number, k .
Constraint: $5 \leq \mathbf{wavenum} \leq 20$.

2: **n** – Integer *Input*
On entry: the number of data values in **x**.
Constraint: $\mathbf{n} \geq 1$.

3: **x[n]** – double *Input*
On entry: the array of evaluation points.

4: **psi[n]** – double *Output*
On exit: the wavelet values.

5: **fail** — NagError * *Output*
The NAG error parameter (see the Essential Introduction).

5. Error Indicators and Warnings

NE_BAD_PARAM

On entry, parameter *<value>* had an illegal value.

NE_INT

On entry, **wavenum** = *<value>*.

Constraint: $5 \leq \mathbf{wavenum} \leq 20$.

On entry, **n** = *<value>*.

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

6. Example

6.1 Program Text

```
/* nag_morlet_ex.c
 *
 * Copyright 2006 Numerical Algorithms Group
 *
 * Evaluation of Morlet wavelet
 *
 */

#include <stdio.h>
#include <nag.h>
#include <nag_stdlib.h>
#include <nag_wav_fun.h>

int main(void)
{
    Integer exit_status;
    Integer i, n, wavenum;
    double xstep, l_bound, u_bound;
    double *x=0, *psi=0;
    NagError fail;

    INIT_FAIL(fail);
    exit_status = 0;

    /* Read/initialise input data */
    printf("nag_morlet Example Program Results\n");
    /* Skip heading in data file */
    Vscanf("%*[\n] ");
    Vscanf("%ld%*[\n]", &wavenum);

    Vscanf("%ld%*[\n] ", &n);
    if (n <= 0)
        goto END;

    /* Read lower and upper bounds for wavelet evaluation */
    Vscanf("%lf %lf%*[\n] ", &l_bound, &u_bound);

    /* Allocate arrays */
    if ( !(x = NAG_ALLOC(n, double)) ||
        !(psi = NAG_ALLOC(n, double)) )
    {
```

```

        Vprintf("Allocation failure\n");
        exit_status = -1;
        goto END;
    }

    xstep = (u_bound - l_bound)/(double)(n-1);
    x[0] = l_bound;
    for (i = 1; i < n; i++)
        x[i] = x[i-1] + xstep;

    /* Morlet wavelet */
    nag_morlet(wavenum, n, x, psi, &fail);
    if (fail.code != NE_NOERROR)
    {
        Vprintf("Error from nag_morlet.\n%s\n", fail.message);
        exit_status = 1;
        goto END;
    }

    /* Wavelet evaluation result */
    Vprintf("Wavelet values\n\n");
    Vprintf("      x      psi\n");
    for (i = 0; i < n; i++)
        Vprintf("%12.4f %12.4e\n",x[i], psi[i]);

    END:

    if (x) NAG_FREE(x);
    if (psi) NAG_FREE(psi);

    return exit_status;
}

```

6.2 Program Data

```

/* Wavelet nag_morlet test data */
5          /* wavenum */
201       /* n = length(x) */
-8.0 8.0   /* lower and upper bounds for evaluation */

```

6.3 Program Results

nag_morlet Example Program Results
Wavelet values

```

-8.0000 -8.4462e-15
-7.9200 -7.7599e-15
-7.8400  3.1412e-15
-7.7600  3.8004e-14
-7.6800  1.1895e-13
-7.6000  2.7391e-13

```

-7.5200	5.2252e-13
-7.4400	8.3872e-13
-7.3600	1.0745e-12
-7.2800	8.3225e-13
-7.2000	-7.0823e-13
-7.1200	-4.9471e-12
-7.0400	-1.3844e-11
-6.9600	-2.9386e-11
-6.8800	-5.2006e-11
-6.8000	-7.7232e-11
-6.7200	-8.9962e-11
-6.6400	-5.6456e-11
-6.5600	8.3954e-11
-6.4800	4.2182e-10
-6.4000	1.0640e-09
-6.3200	2.0855e-09
-6.2400	3.4246e-09
-6.1600	4.6993e-09
-6.0800	4.9490e-09
-6.0000	2.3492e-09
-5.9200	-5.9540e-09
-5.8400	-2.3613e-08
-5.7600	-5.4024e-08
-5.6800	-9.7920e-08
-5.6000	-1.4918e-07
-5.5200	-1.8887e-07
-5.4400	-1.7854e-07
-5.3600	-5.5607e-08
-5.2800	2.6412e-07
-5.2000	8.6934e-07
-5.1200	1.8129e-06
-5.0400	3.0418e-06
-4.9600	4.2986e-06
-4.8800	5.0114e-06
-4.8000	4.2119e-06
-4.7200	5.5286e-07
-4.6400	-7.4821e-06
-4.5600	-2.1076e-05
-4.4800	-4.0217e-05
-4.4000	-6.2519e-05
-4.3200	-8.1923e-05
-4.2400	-8.7738e-05
-4.1600	-6.4719e-05
-4.0800	4.9415e-06
-4.0000	1.3690e-04
-3.9200	3.3680e-04
-3.8400	5.8993e-04
-3.7600	8.5021e-04
-3.6800	1.0324e-03
-3.6000	1.0128e-03
-3.5200	6.4386e-04
-3.4400	-2.1194e-04

-3.3600	-1.6289e-03
-3.2800	-3.5506e-03
-3.2000	-5.7230e-03
-3.1200	-7.6501e-03
-3.0400	-8.6019e-03
-2.9600	-7.7013e-03
-2.8800	-4.1074e-03
-2.8000	2.7130e-03
-2.7200	1.2661e-02
-2.6400	2.4708e-02
-2.5600	3.6723e-02
-2.4800	4.5543e-02
-2.4000	4.7370e-02
-2.3200	3.8530e-02
-2.2400	1.6518e-02
-2.1600	-1.8855e-02
-2.0800	-6.4489e-02
-2.0000	-1.1356e-01
-1.9200	-1.5589e-01
-1.8400	-1.7937e-01
-1.7600	-1.7236e-01
-1.6800	-1.2663e-01
-1.6000	-4.0454e-02
-1.5200	7.9145e-02
-1.4400	2.1571e-01
-1.3600	3.4481e-01
-1.2800	4.3778e-01
-1.2000	4.6737e-01
-1.1200	4.1422e-01
-1.0400	2.7281e-01
-0.9600	5.5193e-02
-0.8800	-2.0867e-01
-0.8000	-4.7464e-01
-0.7200	-6.9200e-01
-0.6400	-8.1342e-01
-0.5600	-8.0548e-01
-0.4800	-6.5716e-01
-0.4000	-3.8415e-01
-0.3200	-2.7742e-02
-0.2400	3.5207e-01
-0.1600	6.8785e-01
-0.0800	9.1812e-01
0.0000	1.0000e+00
0.0800	9.1812e-01
0.1600	6.8785e-01
0.2400	3.5207e-01
0.3200	-2.7742e-02
0.4000	-3.8415e-01
0.4800	-6.5716e-01
0.5600	-8.0548e-01
0.6400	-8.1342e-01
0.7200	-6.9200e-01

0.8000	-4.7464e-01
0.8800	-2.0867e-01
0.9600	5.5193e-02
1.0400	2.7281e-01
1.1200	4.1422e-01
1.2000	4.6737e-01
1.2800	4.3778e-01
1.3600	3.4481e-01
1.4400	2.1571e-01
1.5200	7.9145e-02
1.6000	-4.0454e-02
1.6800	-1.2663e-01
1.7600	-1.7236e-01
1.8400	-1.7937e-01
1.9200	-1.5589e-01
2.0000	-1.1356e-01
2.0800	-6.4489e-02
2.1600	-1.8855e-02
2.2400	1.6518e-02
2.3200	3.8530e-02
2.4000	4.7370e-02
2.4800	4.5543e-02
2.5600	3.6723e-02
2.6400	2.4708e-02
2.7200	1.2661e-02
2.8000	2.7130e-03
2.8800	-4.1074e-03
2.9600	-7.7013e-03
3.0400	-8.6019e-03
3.1200	-7.6501e-03
3.2000	-5.7230e-03
3.2800	-3.5506e-03
3.3600	-1.6289e-03
3.4400	-2.1194e-04
3.5200	6.4386e-04
3.6000	1.0128e-03
3.6800	1.0324e-03
3.7600	8.5021e-04
3.8400	5.8993e-04
3.9200	3.3680e-04
4.0000	1.3690e-04
4.0800	4.9415e-06
4.1600	-6.4719e-05
4.2400	-8.7738e-05
4.3200	-8.1923e-05
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5.1200	1.8129e-06
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7.6000	2.7391e-13
7.6800	1.1895e-13
7.7600	3.8004e-14
7.8400	3.1412e-15
7.9200	-7.7599e-15
8.0000	-8.4462e-15