

**nag\_fresnel\_c (s20adc)****1. Purpose**

**nag\_fresnel\_c (s20adc)** returns a value for the Fresnel Integral  $C(x)$ .

**2. Specification**

```
#include <nag.h>
#include <nags.h>
```

```
double nag_fresnel_c(double x)
```

**3. Description**

This function evaluates an approximation to the Fresnel Integral

$$C(x) = \int_0^x \cos\left(\frac{\pi}{2}t^2\right) dt.$$

The function is based on Chebyshev expansions.

**4. Parameters**

**x**

Input: the argument  $x$  of the function.

**5. Error Indications and Warnings**

None.

**6. Further Comments****6.1. Accuracy**

Let  $\delta$  and  $\epsilon$  be the relative errors in the argument and result respectively.

If  $\delta$  is somewhat larger than the **machine precision** (i.e., if  $\delta$  is due to data errors etc.), then  $\epsilon$  and  $\delta$  are approximately related by  $\epsilon \simeq |x \cos(\pi x^2/2)/C(x)| \delta$ .

However, if  $\delta$  is of the same order as the **machine precision**, then rounding errors could make  $\epsilon$  slightly larger than the above relation predicts.

For small  $x$ ,  $\epsilon \simeq \delta$  and there is no amplification of relative error.

For moderately large values of  $x$ ,  $|\epsilon| \simeq |2x \cos(\pi x^2/2)| |\delta|$  and the result will be subject to increasingly large amplification of errors. However, the above relation breaks down for large values of  $x$  (i.e., when  $1/x^2$  is of the order of the **machine precision**); in this region the relative error in the result is essentially bounded by  $2/\pi x$ .

Hence the effects of error amplification are limited and at worst the relative error loss should not exceed half the possible number of significant figures.

**6.2. References**

Abramowitz M and Stegun I A (1968) *Handbook of Mathematical Functions* Dover Publications, New York ch 7 p 300.

**7. See Also**

nag\_fresnel\_s (s20acc)

**8. Example**

The following program reads values of the argument  $x$  from a file, evaluates the function at each value of  $x$  and prints the results.

### 8.1. Program Text

```

/* nag_fresnel_c(s20adc) Example Program
 *
 * Copyright 1990 Numerical Algorithms Group.
 *
 * Mark 1, 1990.
 */

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

main()
{
    double x, y;

    /* Skip heading in data file */
    Vscanf("%*[^\\n]");
    Vprintf("s20adc Example Program Results\\n");
    Vprintf("      x      y\\n");
    while (scanf("%lf", &x) != EOF)
    {
        y = s20adc(x);
        Vprintf("%12.3e%12.3e\\n", x, y);
    }
    exit(EXIT_SUCCESS);
}

```

### 8.2. Program Data

```

s20adc Example Program Data
      0.0
      0.5
      1.0
      2.0
      4.0
      5.0
      6.0
      8.0
     10.0
     -1.0
    1000.0

```

### 8.3. Program Results

```

s20adc Example Program Results
      x      y
  0.000e+00  0.000e+00
  5.000e-01  4.923e-01
  1.000e+00  7.799e-01
  2.000e+00  4.883e-01
  4.000e+00  4.984e-01
  5.000e+00  5.636e-01
  6.000e+00  4.995e-01
  8.000e+00  4.998e-01
  1.000e+01  4.999e-01
 -1.000e+00 -7.799e-01
  1.000e+03  5.000e-01

```

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