

NAG Library Function Document

nag_struve_h1 (s17gbc)

1 Purpose

nag_struve_h1 (s17gbc) returns the value of the Struve function of order 1, $H_1(x)$.

2 Specification

```
#include <nag.h>
#include <nags.h>
double nag_struve_h1 (double x, NagError *fail)
```

3 Description

nag_struve_h1 (s17gbc) evaluates an approximation to the Struve function of order 1, $H_1(x)$.

Please consult the NIST Digital Library of Mathematical Functions for a detailed discussion of the Struve function including special cases, transformations, relations and asymptotic approximations.

The approximation method used by this function is based on Chebyshev expansions.

4 References

NIST Digital Library of Mathematical Functions

MacLeod A J (1996) MISCFUN, a software package to compute uncommon special functions *ACM Trans. Math. Software (TOMS)* **22(3)** 288–301

5 Arguments

1: **x** – double *Input*

On entry: the argument x of the function.

Constraint: $|x| \leq \frac{1}{\epsilon}$ where ϵ is the *machine precision* as returned by **nag_machine_precision (X02AJC)**.

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

The NAG error argument (see Section 3.7 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_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.

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

x is too large and the function returns zero.

7 Accuracy

The Chebyshev coefficients used by this function are internally represented to 20 digits of precision. Calling the number of digits of precision in the floating-point arithmetic being used t , then clearly the maximum number of correct digits in the results obtained is limited by $p = \min(t, 20)$.

Apart from this, rounding errors in internal arithmetic may result in a slight loss of accuracy, but it is reasonable to assume that the result is accurate to within a small multiple of the *machine precision*.

8 Parallelism and Performance

`nag_struve_h1 (s17gbc)` is not threaded in any implementation.

9 Further Comments

For $|x| > \frac{1}{\epsilon}$, $H_1(x)$ is asymptotically close to the Bessel function $Y_1(x)$ which is approximately zero to *machine precision*.

10 Example

This example reads values of the argument x from a file, evaluates the function at each value of x and prints the results.

10.1 Program Text

```

/* nag_struve_h1 (s17gbc) Example Program.
 *
 * Copyright 2017 Numerical Algorithms Group.
 *
 * Mark 26.1, 2017.
 */

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

int main(void)
{
    Integer exit_status = 0;
    double x, y;
    /* Nag Types */
    NagError fail;

    INIT_FAIL(fail);

    /* Skip heading in data file */
#ifdef _WIN32
    scanf_s("%*[\n]");
#else
    scanf("%*[\n]");
#endif
    printf("nag_struve_h1 (s17gbc) Example Program Results\n");
    printf("      x          Struve H1(x)\n");
#ifdef _WIN32

```

```

    while (scanf_s("%lf", &x) != EOF)
#else
    while (scanf("%lf", &x) != EOF)
#endif
    {
        /* nag_struve_h1 (s17gbc).
        * Struve function H1(x)
        */
        y = nag_struve_h1(x, &fail);
        if (fail.code != NE_NOERROR) {
            printf("Error from nag_struve_h1 (s17gbc).\n%s\n", fail.message);
            exit_status = 1;
            goto END;
        }
        printf("%12.3e%12.3e\n", x, y);
    }

END:
    return exit_status;
}

```

10.2 Program Data

```

nag_specfun_struve_h1 (s17gbc) Example Program Data
0.5
-1.0
3.0
-6.0
8.0
-10.0
1000.0

```

10.3 Program Results

```

nag_struve_h1 (s17gbc) Example Program Results
    x           Struve H1(x)
  5.000e-01    5.217e-02
 -1.000e+00    1.985e-01
  3.000e+00    1.020e+00
 -6.000e+00    4.782e-01
  8.000e+00    4.881e-01
 -1.000e+01    8.918e-01
  1.000e+03    6.118e-01

```

Example Program
Returns values for the Struve Function $H_1(x)$

