

A02AAF – NAG Fortran Library Routine Document

Note. Before using this routine, please read the Users' Note for your implementation to check the interpretation of bold italicised terms and other implementation-dependent details.

1 Purpose

A02AAF evaluates the square root of the complex number $x = (x_r, x_i)$.

2 Specification

```
SUBROUTINE A02AAF(XR, XI, YR, YI)
  real          XR, XI, YR, YI
```

3 Description

The method of evaluating $y = \sqrt{x}$ depends on the value of x_r .

For $x_r \geq 0$,

$$y_r = \sqrt{\frac{x_r + \sqrt{x_r^2 + x_i^2}}{2}}, \quad y_i = \frac{x_i}{2y_r}.$$

For $x_r < 0$,

$$y_i = \text{sign}(x_i) \times \sqrt{\frac{|x_r| + \sqrt{x_r^2 + x_i^2}}{2}}, \quad y_r = \frac{x_i}{2y_i}.$$

Overflow is avoided when squaring x_i and x_r by calling A02ABF to evaluate $\sqrt{x_r^2 + x_i^2}$.

4 References

- [1] Wilkinson J H and Reinsch C (1971) *Handbook for Automatic Computation II, Linear Algebra* Springer-Verlag

5 Parameters

- | | | |
|----|--|---------------|
| 1: | XR — <i>real</i> | <i>Input</i> |
| 2: | XI — <i>real</i> | <i>Input</i> |
| | <i>On entry:</i> x_r and x_i , the real and imaginary parts of x , respectively. | |
| 3: | YR — <i>real</i> | <i>Output</i> |
| 4: | YI — <i>real</i> | <i>Output</i> |
| | <i>On exit:</i> y_r and y_i , the real and imaginary parts of y , respectively. | |

6 Error Indicators and Warnings

None.

7 Accuracy

The result should be correct to *machine precision*.

8 Further Comments

The time taken by the routine is negligible.

9 Example

To find the square root of $-1.7 + 2.6i$.

9.1 Program Text

```

*   A02AAF Example Program Text
*   Mark 14 Revised.  NAG Copyright 1989.
*   .. Parameters ..
      INTEGER          NIN, NOUT
      PARAMETER       (NIN=5,NOUT=6)
*   .. Local Scalars ..
      real            XI, XR, YI, YR
*   .. External Subroutines ..
      EXTERNAL       A02AAF
*   .. Executable Statements ..
      WRITE (NOUT,*) 'A02AAF Example Program Results'
*   Skip heading in data file
      READ (NIN,*)
      READ (NIN,*) XR, XI
*
      CALL A02AAF(XR,XI,YR,YI)
*
      WRITE (NOUT,*)
      WRITE (NOUT,*) '  XR    XI    YR    YI'
      WRITE (NOUT,99999) XR, XI, YR, YI
      STOP
*
99999 FORMAT (1X,2F6.1,2F9.4)
      END

```

9.2 Program Data

```

A02AAF Example Program Data
-1.7 2.6

```

9.3 Program Results

```

A02AAF Example Program Results

```

```

  XR    XI    YR    YI
-1.7   2.6   0.8386  1.5502

```
