

NAG Toolbox

nag_complex_sqrt (a02aa)

1 Purpose

nag_complex_sqrt (a02aa) evaluates the square root of the complex number $x = (x_r, x_i)$.

2 Syntax

```
[yr, yi] = nag_complex_sqrt(xr, xi)
[yr, yi] = a02aa(xr, xi)
```

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 nag_complex_abs (a02ab) to evaluate $\sqrt{x_r^2 + x_i^2}$.

4 References

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

5 Parameters

5.1 Compulsory Input Parameters

- 1: **xr** – REAL (KIND=nag_wp)
- 2: **xi** – REAL (KIND=nag_wp)

x_r and x_i , the real and imaginary parts of x , respectively.

5.2 Optional Input Parameters

None.

5.3 Output Parameters

- 1: **yr** – REAL (KIND=nag_wp)
- 2: **yi** – REAL (KIND=nag_wp)

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 nag_complex_sqrt (a02aa) is negligible.

9 Example

This example finds the square root of $-1.7 + 2.6i$.

9.1 Program Text

```
function a02aa_example
fprintf('a02aa example results\n\n');

xr = -1.7;
xi = 2.6;
x = xr + i*xi;

[yr, yi] = a02aa(xr, xi);
y = yr+i*yi;
fprintf('The square root of ');
disp(x);
fprintf('          is ');
disp(y);
```

9.2 Program Results

```
a02aa example results

The square root of  -1.7000 + 2.6000i
                   is  0.8386 + 1.5502i
```
