

Using the notation and sign convention adopted in *The Nautical Almanac*, the basic equations that have to be solved are:

$$\cos Z \cos Alt = \sin Dec \cos Lat - \cos Dec \sin Lat \cos (GHA + Long)$$

$$\sin Z \cos Alt = -\cos Dec \sin (GHA + Long)$$

$$\sin Alt = \sin Dec \sin Lat + \cos Dec \cos Lat \cos (GHA + Long)$$

The third equation determines altitude uniquely. The first and second equations have to be solved simultaneously to determine azimuth.

There are many ways of ringing the changes on solving these basic equations. I recommend using only those methods that are the simplest and which avoid bad programming techniques such as inverting a cosine function to find the azimuth angle when a tangent of the variable is available. Also I recommend including an error trap to prevent the division by zero when the tangent of the azimuth is being calculated. Some computer languages, like Fortran, have a built-in function called ATAN2 which inverts a tangent and places the answer in the correct quadrant, without requiring this error trap. Likewise calculators with rectangular to polar conversion keys can be used to find the azimuth angle in its correct quadrant, without this error trap.

#### REFERENCES

<sup>1</sup> Pepperday, M. (1994). *The Nautical Almanac's* faulty calculator instructions. *This Journal*, 47, 89.

<sup>2</sup> de Wit, C. (1975). Optimal estimation of a multi-star fix. *Navigation*, Vol. 21, No. 4, pp. 320–325. US Institute of Navigation.

<sup>3</sup> Sharpey-Schafer, J. M. (1994). 'The *Nautical Almanac's* faulty calculator instructions'. *This Journal*, 47, 446.

<sup>4</sup> Parker, J. B. (1996). Whither astro? *This Journal*, 49, 270–274.

#### KEY WORDS

1. Almanacs.    2. Astro.    3. Computers.    Reduction and plotting.

## \*Editor's Note

As a matter of policy, papers in the main body of the *Journal* are refereed. Contributions to the Forum section are not generally refereed, and are included purely at the discretion of the editor. Forum pieces are sometimes controversial and need not always be entirely sound, but they may still be published if they could initiate, or contribute to, a useful discussion of a particular topic.