Navigation and Nautical Astronomy

Seventh Edition

A Textbook on Navigation
and Nautical Astronomy

Prepared for the Instruction of Midshipmen
at the United States Naval Academy

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either away or toward the star, but not away from some and toward others. For any triangle there are four points equidistant from all three lines, one inside and three outside the triangle, found by laying the bisectors of the internal and external angles. Assuming the error of each line to be in the same direction from its star, the following method will determine the point representing the most probable position.

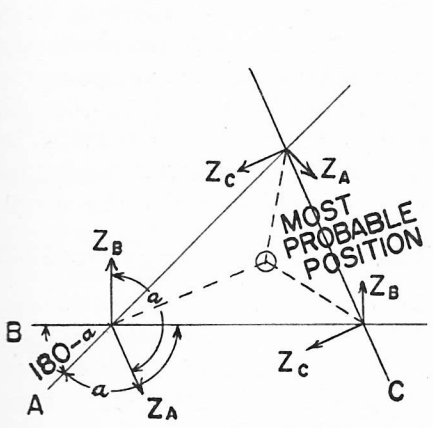

FIG. 911a

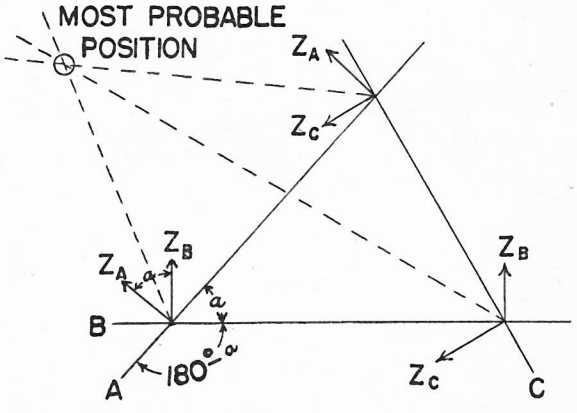

FIG. 911b

"In Figs. 911a and 911b, at the vertices of the triangles draw in the vectors Z_AZ_B and Z_C to represent the azimuth lines of the respective bodies. At each vertex bisect the smaller of the two angles formed by the azimuth lines. If this angle is called α, it will be noted that one of the angles of the triangle at that vertex equals α and the other $180°-\alpha$. The bisector will always bisect the angle equal to $180°-\alpha$.

"The mathematical proof for this method may be found in the Hydrographic Review, volume VIII, No. 2, of November, 1931, under the article 'Accurate Determination of the Position at Sea.'"

919. When a line of position, or a fix by lines of position, is obtained that does not agree with the D.R. position, the latter is assumed in error. It is customary to ascribe the difference between a D.R. position and the result of an observation to *current.*

920. Referring to Article 509, the term *current* is a very broad one. As a rule, it is held ascribable for everything that causes a discrepancy between the D.R. position for a given time and the fix or running fix at that time. It should be understood that observations at sea do not always have a high degree of accuracy. While a navigator may be so skillful that the results of his observations are usually no more than a mile in error, there may be circumstances which will introduce a much greater error. For instance, unusual atmospheric conditions may cause abnormal refraction. Again, a hazy horizon, or the rolling and pitching of the ship in a heavy sea, may greatly reduce the accuracy of his observations. Therefore, a part of the so-called current may be due to inaccurate observations. With this in mind, we shall now analyze current.

The *set* of the current is the direction in which it acts—i.e., the direction toward which it flows. Considering a D.R. position and a fix established at the same instant, *invariably* the current is considered as setting from the D.R. position to the fix.

The *drift* of the current is its velocity in knots. In other words, it is the speed in miles per hour that the ship is carried by the current in the direction of the set.

NO. 9

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AN EPITOME OF NAVIGATION AND NAUTICAL ASTRONOMY

ORIGINALLY BY

NATHANIEL BOWDITCH, LL. D.

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In figure 88, three stars, A, B, and C were observed successively at 0424, 0428, and 0430, and their position lines Aa, Bb, Cc were plotted from the 0430 D. R. position used in the computations for all stars. The triangle abc results which must now be corrected for the difference in time used. The point A is the computed point for the star A at 0424. Advance A parallel to the course line the distance AA′ equal to the run of the vessel at 15 knots for 6 minutes or 1.5 miles. Draw A′X parallel to Aa. A′X now represents the position line for the star A advanced to 0430. In the same manner advance B to B′ 0.5 mile for the 2-minute run between sights and B′X represents the position line for the star B advanced to 0430. All three lines are now adjusted to 0430, and are found to cross at X, which fixes the position for that time.

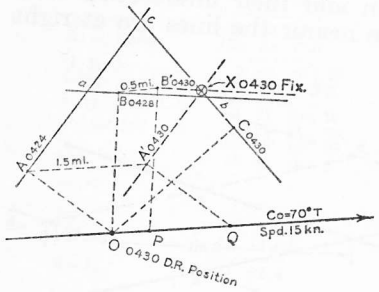

FIGURE 88.

The figure may be simplified by plotting the advanced position lines directly from the points P and Q, advanced from O for the run between sights. In doing this, however, it must be observed that when the time of the desired fix is later than the time of observation, the points P and Q are plotted from O in the direction of the course line and vice versa. There is frequently a tendency to plot P and Q as the D. R. positions at 0424 and 0428 instead of realizing that they are advanced points.

A triangle of position.—Due to the normal inaccuracy of sights, three plotted lines of position will usually form a triangle. In this event, it is most logical to assume that some type of error is mutual to all sights and therefore should be applied equally to all either away or toward the star, but not away from some and toward others. For any triangle there are four points equidistant from all three lines, one inside and three outside the triangle, found by laying the bisectors of the internal and external

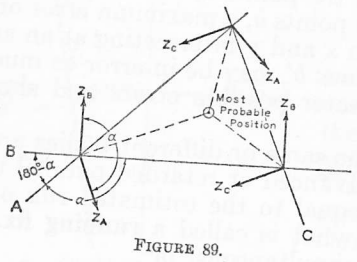

FIGURE 89.

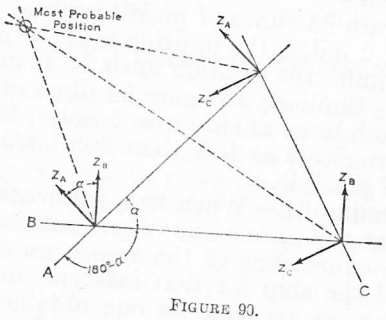

FIGURE 90.

angles. Assuming the error of each line to be in the same direction from its star, the following method will determine the point representing the most probable position.

In figures 89 and 90, at the vertices of the triangles draw in the vectors Z_AZ_B and Z_C to represent the azimuth lines of the respective bodies. At each vertex bisect the smaller of the two angles formed by the azimuth lines. If this angle is called α, it will be noted that one of the angles of the triangle at that vertex equals α and the other $180°-\alpha$. The bisector will always bisect the angle equal to $180°-\alpha$.

The mathematical proof for this method may be found in the Hydrographic Review, volume VIII, No. 2 of November 1931, under the article "Accurate Determination of the Position at Sea."

COMPUTING INTERSECTION OF POSITION LINES

The finding of the intersection of two position lines by computation is divided into two cases:

Case I. When one line lies in a 45°–225° direction, and the other in a 135°–315° direction, as shown in figure 91.

Case II. When both lie in a 45°–225°, or both in a 135°–315° direction, as shown in figure 92.

If each position line is defined by the latitude and longitude of one of its points and the azimuth of the celestial body at right angles to whose true bearing the line runs, then, by means of Table 35, find the longitude of any other point on such a line