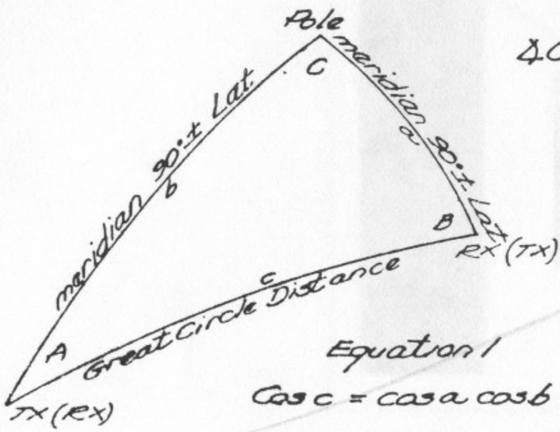
More Great Circle Calculations

Richard Corry

Shortly after joining IRCA, I sent to Phil Bytheway for a bundle of reprints. After having perused DX Mathematics (IRCA reprint T-8) by de Ghoti, I decided I could set forth a much less confusing array of equations and procedures for the solution of Great Circle Distances and related problems. Herewith, the results of that study. When the comprehension of a spherical triangle is mastered, constant designations for 6 functions (3 angles and 3 sides) can be used, making the solution much simpler and practically unavoidable.

Since a great many IRCA members either own or have access to electronic programmable calculators, I have written a program for the HP-25 for the solution of Equation 1. If need be, I assume it can be transposed to fit a TI-58. If the bearing to TX from RX is desired, use equation 2. Of course, this will first require the solution of Equation 1, and the establishment of either the meridian, or a reference line with a known bearing. Naturally, if no calculator is available, solution may be made by long hand.

These equations, with some algebraic juggling and/or substitution can be rearranged so as to be a basis for celestial navigation (with the aide of a couple of WWV time ticks). Just in case anyone wants to run the Great Circle from Cape Flattery (48°24'N, 124°44'W) to Diamond Head (21°16'N, 157°49'W)---2615.30 miles, S56°00'W, initial course.



ΔC = dLo = difference in longitude.

Equation 1

$$\cos c = \cos a \cos b + \sin a \sin b \cos C$$

$\cos c \times 69.1$ = result in statute miles

If ∡ A or B are required, use

Equation 2

$$\frac{\sin a}{\sin A} = \frac{\sin b}{\sin B} = \frac{\sin c}{\sin C}$$

* * * * * * * * * * * * * * * * *

TYPIST'S COMMENTS: The above method of calculating distances and loop bearings is definitely easier than most I've seen. However, when calculating loop bearings, the answer given by equation (2) has to be added or subtracted from 180 or 360 to give the correct answer; i.e. - from Seattle, Europeans are between 0 and 90°, most Latins 90-180°, Down Unders 180-270°, Asians 270-360°. A better equation to use for finding loop bearing would be: cosb = cos(a)cos(c) + sin(a)sin(c)cos(B), which after a bit of manipulation becomes

$$\cos(B) = \frac{\cos(b) - \cos(a)\cos(c)}{\sin(a)\sin(c)}$$

If the station is east of you, the great circle bearing is B. If the station is west of you, the great circle bearing is (360-B).

--- Bruce Portzer

HP-25 Program Form

Title: Great Circle Distance. Page ____ of ____

Switch to PRGM mode, press [f] [PRGM], then key in the program.

Display Line	Display Code	Key Entry	X	Y	Z	T	Comments
00			cos c = cos a cos b + sin a sin b cos C				
01		RCL1					
02		g→H					
03		f cos					
04		STO4					
05		g cos⁻¹					
06		f sin					
07		STO5					
08		RCL2					
09		g→H					
10		f cos					
11		STO×4					
12		g cos⁻¹					
13		f sin					
14		STO×5					
15		RCL3					
16		g→H					
17		f cos					
18		STO×5					
19		RCL4					
20		RCL5					
21		+					
22		g cos⁻¹					
23		6					
24		9					
25		.					
26		1					
27		×					
28		R/S					
29		GTO 00					
30							
31							
32							
33			5280 / 6080.20 = .868392				
34							
35							
36							
37							
38							
39							
40							

Program for Equation 2 is straight proportion, due regard being given to latitude of TX.

Registers	
R_0	
R_1	side a
R_2	side b
R_3	dLo
R_4	
R_5	
R_6	
R_7	

INTERNATIONAL RADIO CLUB IRCA