A2.8. Great Circle Planning:

Variables:

L_1 = Departure Latitude (N and W = +)

L_2 = Destination Latitude (S and E = –)

λ_1 = Departure Longitude

λ_2 = Destination Longitude

L_i = Intermediate Latitude

λ_i = Intermediate Longitude

H_i = Initial True Heading

D = Distance

H = Heading Angle

Δt = Time between positions

GS = Groundspeed

TC = True Course

$$D = 60\cos^{-1}\left[(\sin L_1)(\sin L_2) + (\cos L_1)(\cos L_2)\cos(\lambda_2 - \lambda_1)\right]$$

Distance=60 * acos ((sin (Departure Latitude) * sin (Destination Latitude))+(cos (Departure Latitude) * cos (Destination Latitude) * cos (Destination Longitude – Departure Longitude)))

$$H = \cos^{-1}\left[\frac{\sin L_2 - \sin L_1 \cos\left(\frac{D}{60}\right)}{\sin\left(\frac{D}{60}\right)\cos L_1}\right]$$

or Heading Angle = acos ((sin (Destination Latitude) – sin (Departure Latitude) * cos (Distance /60)) / (sin (Distance /60) * cos (Departure Latitude)))

$H_i = H$ $\quad \sin(\lambda_2 - \lambda_1) < 0$

$H_i = 360 - H$ $\quad \sin(\lambda_2 - \lambda_1) \geq 0$

This formula computes the latitude of L_i where λ_i intersects the great circle defined by (L_1, λ_1) and (L_2, λ_2). This formula can be very useful when matching charts of different projections or scales.

$$L_i = \tan^{-1}\left[\frac{(\tan L_2)\sin(\lambda_i - \lambda_1) - (\tan L_1)\sin(\lambda_i - \lambda_2)}{\sin(\lambda_2 - \lambda_1)}\right]$$

or Intermediate Latitude = atan ((tan (Destination Latitude) * sin (Intermediate Longitude – Departure Longitude) – tan (Departure Latitude) * Sin (Intermediate Longitude – Destination Longitude)) / Sin (Destination Longitude – Departure Longitude))

A2.9. Computing Position By Dead Reckoning:

$$L_2 = \left(\frac{(\Delta t)(GS)(\cos TC)}{60}\right) + L_1$$

or DEST Latitude = (Elapsed Time * Ground Speed * cos (True Course)) / 60 + Departure Latitude

$$\lambda_2 = \lambda_1 - \left(\frac{(\Delta t)(GS)(\sin TC)}{60 \cos L_1} \right) \qquad TC=90°, 270°$$

or DEST Longitude = Departure Longitude – ((Elapsed Time * Ground Speed * sin (True Course)) / (60 * cos (Departure Latitude)))

Otherwise:

$$\lambda_2 = \lambda_1 - \frac{180}{\pi} \left\{ (\tan TC) \left[\left(\mathrm{Ln} \tan(45 + ½L_2) \right) - \left(\mathrm{Ln} \tan(45 + ½L_1) \right) \right] \right\}$$

or DR Longitude = Departure Longitude – (180 / 3.14159) * (tan (True Course) * Ln (tan (45 + 0.5 * Destination Latitude)) – Ln (tan (45 + 0.5 * Departure Latitude))

NOTE: The flight path may not cross either pole.

For long distances, use formula below:
DR Latitude = 90.0 – acos (sin (– Departure Latitude) * cos (Distance/60.0) + cos (– Departure Latitude) * sin (Distance /60.0) * cos (True Course))
DR Longitude = Departure Longitude +/– acos ((cos (Distance /60.0) –sin (– DR Latitude) * sin (– Departure Latitude)) / (cos (– DR Latitude) * cos (– Departure Latitude)))
NOTE: Distance can be replaced with (Ground Speed * Elapsed Time) where Elapsed Time is in hours

A2.10. Rhumb Line Planning:

Variables:
Δt = Time between positions
C = Rhumb line True Course
D = Rhumb line Distance
π = Pi (»3.14159)

$$C = \tan^{-1} \left[\frac{\pi(\lambda_1 - \lambda_2)}{180 \mathrm{Ln} \tan(45 + ½ L_2) - \mathrm{Ln} \tan(45 + ½ L_1)} \right]$$

or True Course = atan((3.14159 * (Departure Longitude – Destination Longitude)) / (180 * Ln (tan (45 + 0.5 * Destination Latitude)) – Ln (tan(45 + 0.5 * Departure Latitude)))

$$D = 60(\lambda_2 - \lambda_1)\cos L_1 \qquad C = 0$$

or Distance = 60 * (Destination Longitude – Departure Longitude) * cos (Departure Latitude)

$$D = \frac{60(L_2 - L_1)}{\cos C} \qquad C \neq 0$$

or Distance = 60 * (Destination Latitude – Departure Latitude) * cos (Rhumb line True Course)