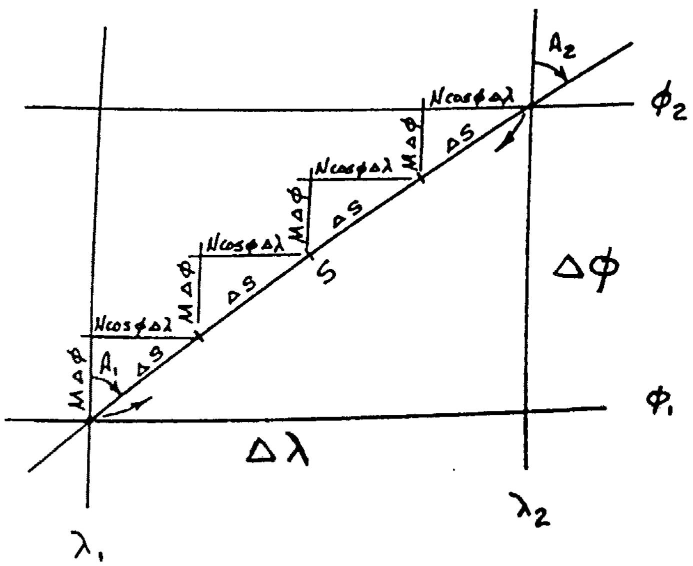
Geodetic Position Computation

A geodetic line can be used to compute latitude and longitude of a point given the distance and direction from a known point. The procedure is known as the *geodetic direct* computation. *Geodetic inverse* is used to compute the distance and direction between known points when the latitude and longitude of both are given. Details for performing both the "direct" and "inverse" geodetic position computations are presented by Jank & Kivioja (1980). Their method utilizes numerical integration of differential geometry elements shown below. Clairaut's constant is used to determine the correct geodetic azimuth of each geodetic line element.



Other methods for performing geodetic direct and inverse are easier to use than numerical integration and, for short lines, give very good results. But the advantage of numerical integration is the conceptual simplicity and that computers can be programmed to do the many repetitive calculations. Another advantage is that one can obtain any level of accuracy desired by choosing smaller and smaller line elements. A ds element of 200 meters will yield millimeter precision over very long lines (to other side of the world).

The following set of Puissant Coast & Geodetic Survey formulas, used for both direct and inverse computations are quite accurate for lines up to 60 miles long.

<u>Direct:</u> Given the latitude and longitude (ϕ_1,λ_1) of Point 1, a geodetic line azimuth from north through Point 1 (α_1), and the distance (S) in meters along the geodetic line to Point 2; find the latitude, longitude, and azimuth of the geodetic line at Point 2.

$\phi_2 = \phi_1 + \Delta\phi''$ where (in seconds of arc)

$\Delta\phi'' = S\,B\cos\alpha_1 - S^2\,C\sin^2\alpha_1 - D\,(\Delta\phi'')^2 - h\,S^2\,E\sin^2\alpha_1$ and

$B = \rho/M_1$ seconds per meter

$h = S\,B\cos\alpha_1$ seconds

$C = \rho\tan\phi_1\,/\,(2\,M_1\,N_1)$ seconds per meter^2

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