Type	Note
Date Added	6/3/2019, 9:48:30 PM
Modified	6/11/2019, 5:48:35 PM

Tags:

navigation, gps, hyperbola, hyperboloid

B. Fang, “Simple Solutions for Hyperbolic and Related Position Fixes,” IEEE Transactions on Aerospace and Electronic Systems, vol. 26, no. 5, pp. 748–753, 1990
https://ieeexplore.ieee.org/abstract/document/102710

Abstract:
Navigation fixed from range differences to three stations and an additional piece of information are investigated. It is shown that if the additional information is the navigator altitude, or the range difference to a fourth station, the computation of the navigation fix is reduced to finding the roots of a quadratic. If the additional information is the range to another station, or that the navigator is on the Earth ellipsoid, the fix can be obtained by solving a quartic. By emphasizing the underlying geometric interpretations, these fixes and their simple solutions are made clear. The derivations also show that the same solution algorithms are applicable if the basic navigation measurements are range sums instead of range differences

NOTES: pretty interesting paper for getting navigation position from time differences of arrival TDOA of signals - equations reduce to quadratic solution (for receiver at known altitude above plane earth surface, or quartic solution (for receiver on ellipsoidal earth surface). This solutions can be used when the GPS receiver clock is not synchronized with the satellite clocks (but runs at same speed), and is a more complex navigation (i.c., math) problem than if satellite and receiver clocks are synchronized such that only intersection of 3 satellite distance spheres with earth surface is needed.

one thing he does to simplify solution is to use the three (satellite) positions to define the solution coordinate axes: the line between 2 of the 3 defines one axis, the plane of the 3 satellites and first axis defines the second axis, and 3rd axis is normal to this plane

author worked at an aerospace company (now TASC, was The Aerospace Company) that started out, at least, specializing in math for navigation