

GIVEN:

Assumptions: GPS receiver on surface of spherical Earth of radius 6370 km. All clocks are synchronized.

Data from satellites in view of receiver at time of measurement, columns are latitude (degrees), longitude (degrees), altitude above Earth's surface (km), distance from receiver (km):

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27, -119, 20529, 21689
49, -86, 20218, 21207
48, 116, 20392, 24330
36, -42, 20394, 24307
47, -57, 19988, 22331
11, -148, 20337, 22849
50, 159, 19980, 21841
7, 172, 20191, 24636
35, 133, 20181, 24415
```

Distance from receiver was computed by the GPS receiver from the speed of light and the time delay of satellite signal reception: time received minus time sent, where the time sent is part of the signal. What is the time delay for the closest satellite?

FIND:

The latitude and longitude of the GPS receiver. This will locate one of the towns I visited this Summer on vacation. What town was it?

PROCEDURE:

Use arrays and the "vectorization" power of Matlab in your computations. Start by loading the data given above into an array.

Convert satellite latitude and longitude to x,y,z coordinates, where the Earth's center is at 0,0,0. You may use the functions attached to the assignment.

The common intersection of four spheres is a point. Earth is one sphere. For the GPS ground receiver to compute its location on the surface of Earth, it also needs to use the signal from three or more satellites.

Solve the simultaneous linear algebraic equations we developed in lecture to determine the x,y,z location of the common intersection point. Convert that location into latitude and longitude. See lecture blackboards for August 29, 2019 at ReactorLab.net > Resources > Matlab > CENG 15 - NANO 15.

Try using the minimum number of satellites and then try using all satellites. Do you get different results from the two methods? The result using data from all satellites should be a more accurate estimate.

EXPLORE: Optional. You may wish to try 3D plotting using Matlab standard functions surf (for Earth) and mesh (for satellite spheres). Search Matlab Documentation for these functions to see syntax and examples. The San Diego company Qualcomm, founded by Irwin Jacobs of UCSD's Jacobs Hall, supplies chips to Android phones which handle GPS, see

<https://www.qualcomm.com/news/onq/2013/06/27/top-gps-based-apps-everything-traffic-travel>