

CE 506 Homework 7 GPS Pseudorange Solution

Assigned 29 November, due 8 December

Solve for the coordinates of Station WLCI using the data provided in file `hw7dat.mat`, variables and data are described on next page. It will be an indirect observation problem, with condition equation:

$$F = PR - \left[(x - x_s)^2 + (y - y_s)^2 + (z - z_s)^2 \right]^{1/2} - c \cdot DT$$

As a minimum solve the problem for 1 epoch, extra credit if you solve using all 4 epochs. PR is a refined observation, parameters will be x,y,z plus one DT for each epoch that is used. (one epoch total 4 parameters, 4 epochs total 7 parameters)

You may find some hints and code from '04 and '05 but I would recommend just doing from scratch. For units use kilometers and microseconds. Make sure and show the usual model elements: n , n_0 , and r .

After solution make 2-sided global test at $\alpha=0.05$. Based on outcome then make a 99% confidence interval for X, and a 99% confidence region for X,Y. Show the numerical dimensions, but you may just sketch any graphics by hand.

Use an *a priori* sigma of 25 meters for the observations.

observation and orbit data extracted from rinex files
 wlci3050.06o (observation file) and
 igrl3993.sp3 (orbit position & dt file)
 (rinex = receiver independent exchange format)
 archived by ngs (cors: continuously operating reference stations)
 at <http://www.ngs.noaa.gov/CORS/>
 station WLCI is at wolcott, white county, indiana
 receiver is trimble 4000ssi
 first epoch is 2006, November 1, 00:00:00 GPS time
 subsequent epochs are each 15 minutes later
 approximate coordinates of station: 248645.0,-4828261.0,4146460.0 (meters, ECF)
 data tabulated below, joined by sat# between obs file and orbit file
 ep: epoch number, interval=15 min
 prc: pseudorange (c/a code) (meters)
 prp: pseudorange (p code) (meters)
 sat: satellite number
 xs: satellite position x-coordinate (km, ECF)
 ys: satellite position y-coordinate (km)
 zs: satellite position z-coordinate (km)
 dt: satellite clock error, correct by $pr_refined = pr_raw + c*dt$

note: speed of light 299792458 m/sec or 0.299792458 km/usec
 usec = microsecond ($1*10^{-6}$ seconds)
 problem has better conditioning if you use units: km and usec
 use prc for the homework problem
 ** if you use multiple epochs you must estimate a receiver clock offset for
 each epoch **
 file prepared for ce506, fall 2006, by purdue university geomatics

ep	prc (m)	prp (m)	sat	xs (km)	ys (km)	zs (km)	dt (usec)
1	20699927.4384	20699927.2624	2	-7326.303768	-19731.560499	16102.157748	50.285170
1	20713278.0634	20713280.2664	4	6926.113830	-14035.016339	21382.883516	331.076832
1	21664069.0474	21664071.2734	5	-13459.224860	-12689.031732	18889.194990	364.149166
1	25215247.7274	25215251.9574	9	-20925.815537	-16453.814164	-2546.603530	42.685336
1	23794205.9144	23794210.5784	10	-1781.549510	-25227.158006	-7666.614464	92.078784
1	22571639.1804	22571640.5984	17	19171.570830	-15566.147570	9627.547603	91.139643
1	20563331.6174	20563334.4064	24	1653.019712	-17168.579549	20350.052520	48.701945
1	24215007.4924	24215011.0784	30	-15496.760878	1467.777720	21211.167514	15.019904
2	20723751.2714	20723750.7674	2	-5599.166559	-18753.086325	17824.574464	50.288347
2	21218818.1534	21218819.7824	4	8953.347610	-12620.554103	21543.003634	331.081224
2	21694892.7084	21694895.0874	5	-13299.914464	-14810.883535	17432.424421	364.149166
2	23338433.3174	23338436.7744	10	-1471.238636	-25911.086474	-4892.892984	92.079387
2	24970705.4504	24970706.3884	13	24466.452396	-5417.646191	8653.007761	108.529808
2	23203717.1224	23203718.6814	17	20139.514843	-15749.151405	6984.380953	91.138819
2	25298309.7394	25298307.8064	23	19722.880089	3338.177951	17485.896451	139.620589
2	20919357.3414	20919360.1654	24	3560.337766	-15810.291812	21222.969980	48.703558
2	23896480.4584	23896482.8024	30	-15398.466167	-1033.803119	21316.792782	15.020268
3	20810252.3564	20810252.0994	2	-3669.735336	-17769.266841	19237.162955	50.291575
3	21768290.5674	21768292.3134	4	11043.179053	-11312.655753	21330.939528	331.085984
3	21827164.2084	21827166.7514	5	-13233.173429	-16753.248511	15672.250257	364.145988
3	22916954.5134	22916957.8174	10	-1211.317136	-26289.803593	-2033.531685	92.080168
3	24860860.6144	24860862.7714	13	23514.486338	-4757.327498	11263.529247	108.533096
3	23873348.1854	23873349.2744	17	20827.101722	-15835.573393	4220.228900	91.137417
3	25455887.1304	25455885.5604	23	17947.586837	4461.620565	19052.046140	139.621376
3	21327872.2554	21327875.2434	24	5597.292169	-14511.203475	21736.527428	48.706402
3	23642046.3024	23642047.2394	30	-15421.971858	-3526.448113	21045.396782	15.020683
4	20957964.2054	20957963.6784	2	-1564.801848	-16816.864423	20314.340133	50.294965
4	22353504.8854	22353506.7604	4	13153.492459	-10134.356019	20751.439596	331.090510
4	22062973.9084	22062976.2994	5	-13234.579767	-18480.852485	13640.029708	364.144225
4	22544321.9864	22544324.9634	10	-964.416966	-26353.403458	861.471992	92.081192
4	24824088.2684	24824088.2214	13	22355.880740	-3896.265758	13678.949019	108.537062
4	24577607.1194	24577608.1274	17	21240.468806	-15787.789022	1382.959506	91.136576
4	21781449.8384	21781452.9904	24	7728.501236	-13303.151800	21883.051755	48.709816
4	23464793.1044	23464794.5214	30	-15562.911606	-5961.101243	20402.252027	15.023161