Radio Location Scavenger Hunt
Supplementary Document

DeterminAtor(s)
Georgia Institute of Technology

December 6, 2006

This document contains answers some interesting questions which are a part of the deliverables to the group assignment.

1. How did you solve the range equations?

The unknowns are U_x, U_y, U_z and τ. Given are the three pseudo-ranges, PR_i from the 3 satellites and the coordinates of the satellites (X_i, Y_i, Z_i). The equation $(X_i - U_x)^2 + (Y_i - U_y)^2 + (Z_i - U_z)^2 - (PR_i - c\tau)^2 = 0$ for $i = 1, 2, 3$ is used to arrive at the solution. U_x,U_y and U_z are actually converted to polar form and hence we compute the unknowns namely, latitude, longitude and the τ. The actual computations are shown in the HTML file.

2. Are there any ambiguities in your technique? How did you address them?

A number of possible solutions exist due to cosine and sine being in our equations (quadrant mapping ambiguity) along with the squared terms. However, we know that we shouldn't have to travel too far to get to the restaurant, so we can say a good answer will be the one a. in Atlanta b. and if there remains any more ambiguity, the closer solution to Georgia Tech. Van Leer is located at (Lon: -1.4730, Lat: 0.5895) so the solution is easily chosen as the highlighted one above. It provides a best guess solution, and in this case the best guess solution was good enough to correctly predict the location of

the restaurant.

3. Can you place a confidence interval on your position estimate?

The computed coordinates were $(33.771330°, -84.389230°)$. This mapped to Varsity, a restaurant in Downtown Atlanta. The actual coordinates of the restaurant were found (one could use MapQuest for this purpose) and the distance between the two points (in kms)on the surface was computed. This number was the deviation from the actual position and there was a position error of 11 meters. This is just one set of position estimation, but the strategy gives a solution close to the GPS error range of 10 meters.

4. What factors that we did not consider might affect a realistic GPS ranging estimate?

A realistic GPS ranging estimate is a.ected by satellite clock, Ephemeris error, selective availability, Ionospheric delay, Tropospheric delay, receiver noise and errors due to multipath propagation. The latter factor plays a major role in degrading the GPS estimate, since the decoded location is in Midtown Atlanta, where high-rise buildings increase the multipath effects.