How to Get Usable Data from a State Vector

When your application receives its location information from the Station Support Computer (SSC), it can come in in either State Vector or TLE format. Both of these formats will require a conversion into a different format so the data can be more readily used by your program. In order to get the location data from the State Vector Format into usable data (LLA or Latitude, Longitude, Altitude), a conversion process has to take place. The format the state vector is requested in (displayed as Cartesian) can also be referred to more commonly as earth-centered earth-fixed (ECEF). This ECEF format needs to be converted into LLA format so the data is in relation to the rotation of the Earth. A basic translator between the two formats is shown in the link below.

<http://www.oc.nps.edu/oc2902w/coord/llhxyz.htm>

 This application will convert any State Vector into usable data. Your program should include a conversion like this one that will be able to convert ECEF to LLA. It is not necessary to code this by hand if you are able to find a way to incorporate a converter like this one into the code, but original code that accomplishes the same process is just as readily accepted. However, the code cannot rely upon a converter that requires a connection to the internet. The connection can be unstable on the ISS and we want for the astronauts to be able to use this app regardless of internet reliability.

 We are open to alternate ideas as to how to get the proper location information into the correct format, but regardless, the information needs to eventually end up in LLA format before your application plots position coordinates. This way, we can guarantee the coordinates are in relation to Earth’s orbital rotation.

Below is an example of a State Vector in ECEF/Cartesian format and how to use the converter in the above link to get it into LLA format.



State Vector in ECEF/Cartesian Format



The ECEF – X value, ECEF – Y value, and ECEF – Z value are filled in with the X, Y, and Z values obtained from the State Vector above.

(Note that the XDOT, YDOT, and ZDOT data from the SV is not included. These are velocity components that are not needed in the conversion of an ECEF to LLA).



Once ECEF to LLA has been input as the command, a Latitude, Longitude, and Altitude value has been generated. This information is now usable in your program to generate a location over Earth.

Your converter from ECEF to LLA should work similarly to the one above, the main difference being, when your program receives the State Vector in Cartesian/ECEF format from the SSC via a TCP/IP connection, it should automatically convert the data into LLA format, and then plot the coordinates accordingly.

It would be beneficial in the development of your app to conduct further research into the conversion process before attempting to write the converter. The converter should be in the same language as the application you develop to display the data obtained from this conversion process.

If you have any questions regarding the ISS Location App, please feel free to contact john.l.sammons@nasa.gov for further assistance.