The code ./find\_specular\_points.c, written by Pr Aaron Ridley, calculates the position of the specular points between a constellation of n satellites and the constellation of GPS satellites.

A specular point is the location on the surface of the Earth of the reflection point on the surface of a signal from a GPS satellite to another satellite.

./find\_specular\_points.c takes for inputs (among others) the positions of the constellation of the n satellites and the positions of the constellation of GPS satellites.

To compute the specular points:

1. run SpOCK with the n satellites and the constellation of GPS satellites (please refer to the document main\_input\_file). This will create two files in the output folder of the run: one that includes the positions of the n satellites and one that includes the positions of the GPS satellites. The files are named with the prefix CONSTELLATION\_CYGNSS\_for\_run\_ and CONSTELLATION\_GPS\_for\_run\_.

mpirun –np 1 spock name\_of\_spock\_main\_input\_file

1. Run the code ./src/find\_specular\_points.c:

mpirun -np 8 find\_specular\_points name\_of\_spock\_main\_input\_file -lon=0 -rot=0 -min

This code creates n binary files in the output folders of each satellite.

1. To convert these bin files into txt files, run:

mpirun -np 8 run\_storm name\_of\_spock\_main\_input\_file 0

This will create n txt files in the output folders of each satellite. Each file starts with the prefix specular\_. It will also create n txt files that include the interpolated positions of the n satellites every second. These files start with the prefix interpolated\_position\_LLA\_ECEF\_

Script that includes all 3 steps in one:

A script allows the specular point trajectories to be predicted in one step. To run this script:

1- cd ./srcPython

2- python spock\_cygnss\_spec.py start\_date end\_date  
where start\_date and end\_date are the start and end dates of the simulation, with the format YYYY-MM-DD (for example python spock\_cygnss\_spec.py 2017-03-03 2017-03-05)

SpOCK downloads the CYGNSS and GPS TLEs corresponding to the start date from space-track.org to initialize the CYGNSS and GPS constellations. Then it propagates them and computes the specular point positions.

If the CYGNSS or GPS TLEs have not been published yet on space-track.org then SpOCK downloads the latest ones and starts the propagation at that time.