

ASEN 5050 – Homework #1

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1. Use the Heavens-Above service to compute the overflights of the International Space Station for the next 10 days.
 - a. (5 pts) What orbit is the ISS in? You'll find this toward the top of the "ISS" page.

Epoch (UTC):	30 August 2015 21:25:38
Eccentricity:	0.0001402
Inclination:	51.6445°
Perigee height:	399 km
Apogee height:	401 km
Right ascension of ascending node:	71.0166°
Argument of perigee:	92.5107°
Revolutions per day:	15.55574212
Mean anomaly at epoch:	48.5118°
Orbit number at epoch:	9596

- b. (10 pts) How many visible overflights are there in the next 10 days? For the visible overflight with the highest maximum elevation in the sky, report the azimuth, elevation, and time (MDT) of the starting and ending points of the pass.

Date	Brightness (mag)	Start			Highest point			End			Pass type
		Time	Alt.	Az.	Time	Alt.	Az.	Time	Alt.	Az.	
06 Sep	-0.3	05:47:43	10°	SE	05:48:35	11°	SE	05:49:35	10°	ESE	visible
08 Sep	-1.4	05:34:46	10°	SSW	05:37:29	25°	SE	05:40:14	10°	ENE	visible

Of the two visible overflights in the next 10 days, the 08 September 2015 overflight has the highest elevation in the sky (25 degrees). For this overflight:

Start Azimuth:	183 degrees
Start Elevation:	0 degrees
Start Time:	05:44:22
End Azimuth:	74 degrees
End Elevation:	0 degrees
End Time:	05:52:57

- c. (5 pts) You might have noticed that September's visible overflights are mostly in the early morning, for observers in Boulder. Start searching for the next visible overflight of the ISS that occurs in the evening, starting in September. Report the same information about this next evening visible overflight.

The next visible overflight that occurs in the evening is on 01 October 2015. The highest elevation achieved during this overflight is 11 degrees. For this overflight:

Start Azimuth:	229 degrees
Start Elevation:	0 degrees
Start Time:	20:53:40
End Azimuth:	228 degrees
End Elevation:	11 degrees
End Time:	20:55:48

2. (10 pts) Compute the time and sky location for the brightest "Iridium Flare" over Boulder during the next 7 days. For the brightest flare (smallest magnitude in the 2nd column), report the time (MDT), azimuth, elevation, Iridium satellite number, and magnitude.

The brightest "Iridium Flare" over Boulder during the next 7 days occurs on 05 September 2015 at 05:25:58. For this flare:

Time:	05:25:58
Azimuth:	209 degrees
Elevation:	58 degrees
Iridium Satellite Number:	Iridium 37
Magnitude:	-2.4

- (20 pts) Provide a short description of what Iridium Flares are and what causes them.

An Iridium Flare occurs when solar rays are reflected off of one of the Main Mission Antenna (MMA) on an Iridium satellite. Iridium satellites have three antennas (188 cm wide, 86 cm long, and 4 cm thick) positioned 120 degrees apart and angled 40 degrees away from the main bus. These antennas are highly reflective aluminum plates treated with silver-coated Teflon so, at certain angles, these antennas can reflect the solar disk like a mirror. The specular reflection width is on the order of tens of kilometers at the Earth's surface and can be as bright as -8 magnitude.

3. (20 pts) Compute the Boulder overflights for the "brightest satellites" (magnitude 3.5 and brighter) for any early morning or evening (tonight? If it's cloudy, keep trying!). When did you try? When did you succeed? Attempt to find one of these bright satellites in the sky using the overflight times, azimuths, and elevations, and report any success you have.

One of the brightest satellite with an overflight on the evening of 30 August 2015 is the Cosmos 1680 which has a brightness magnitude of 3.5. For this over flight:

Start Azimuth:	196 degrees
Start Elevation:	0 degrees
Start Time:	20:23:05
End Azimuth:	20 degrees
End Elevation:	0 degrees
End Time:	20:38:19

Attempted to observe the overflight on the evening of 30 August 2015 by looking SSW starting at approximately 20:20:00. A bright light was spotted in the approximate direction of the start azimuth (196 degrees) at 20:24:00 with trajectory matching that of the Cosmos 1680 satellite. The light disappeared behind thick cloud cover at approximately 20:26:00, preventing the observation of the end of the overflight event. Without any tools readily available, it was difficult to determine with high confidence that the celestial body was in fact the Cosmos 1680. Observations can be improved with a compass and telescope.

4. (10 pts) Which satellites are departing the Solar System?

Pioneer 10, Pioneer 11, Voyager 1, Voyager 12, and New Horizons are currently leaving the Solar System.

5. (20 pts) On the day that you attempted (and succeeded!?) to make satellite observations, compute the times of sunrise and sunset. In addition, compute the rise and set times for the moon, and the percent illumination of the lunar disk.

An attempt was made on 30 August 2015 to observe the Cosmos 1680 between 20:23:05 and 20:38:19. The attempt is believed to be successful but difficult to verify without additional tools. On this date, the sunrise occurred at 06:27 and the sunset occurred at 19:36. Moonrise occurred at 20:15 and moonset occurred at 07:28. On the evening of 30 August 2015, the illumination of the lunar disk was 98%.