Noe Lepez Da Silva Duarte

AE 4361 – Assignment 6

1) a)

#bits per pixel = 2000 = 2^n-1 ➔ n = $\log_2 1999$ = 10.965062756745 = **11 bits**

b)

Monochrome:

pixels = 1024*14*1 = 14336 pixels

bits = 14336 * 11 = 157,696 bits

Visible:

pixels = 704*14*5 = 49,280 pixels

bits = 49,280 * 11 = 542,080 bits

UV:

pixels = 128*4*2 = 1,024 pixels

bits = 1,024 * 11 = 11,264 bits

Total required data length per WAC snapshot = 157,696 + 542,080 + 11,264 = **711,040 bits = 88,880 bytes**

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2) a)

a = 384400km, i = 0, e = 0, r_E=6371km, μ = 3.986*10^5

$$P = 2 \times \pi \sqrt{\frac{a^3}{\mu}} = 2 \times \pi \sqrt{\frac{384400^3}{3.986 \times 10^5}} = 2.372 \times 10^6 s$$

$$\omega_{moon} = \frac{2 \times \pi}{P} = \frac{2 \times \pi}{2.372 \times 10^6} = 2.6491 \times 10^{-6} rad/s$$

$$\omega_{Earth} = 7.2921 \times 10^{-5}\ rad/s$$

$$\alpha_{vis} = 180 - 20 - 20 = 140 = 2.4435 rad$$

$$\omega_{rel} = |\omega_E - \omega_M| = 7.0272 \times 10^{-5}\ \mathrm{rad/s}$$

$$t = \frac{\alpha_{vis}}{\omega_{rel}} = \frac{2.4436}{7.0268 \times 10^{-5}} = \boldsymbol{34773.5s}$$

b)

FD	SFID	MC1	MC2	V1	V2	V3	V4	V5	V6
FD	SFID	MC1	UV1	V1	V2	V3	V4	V5	V6
FD	SFID	MC1	MC2	V1	V2	V3	V4	V5	V6
FD	SFID	MC1	UV1	V1	V2	V3	V4	V5	V6
FD	SFID	MC1	MC2	V1	V2	V3	V4	V5	V6

Telemetry frame to send a compressed WAC snapshot with overhead included. Here, each block is 15000 bits (apart from FD and SFID block). Each line is a new visible filter and each UV block sent is a separate UV filter. All MC1s and MC2s combined make up a full monochrome image.

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3) a)

Time for a full revolution around Earth = $\frac{2\pi}{7.0272\times10^{-5}} = 89412.4s$

$$1\left[\frac{snapshots}{s}\right] \times 89412.4[\text{s}] \times 0.70 \times 1.05 \times 88880\left[\frac{bytes}{snapshot}\right] \times \frac{1[GB]}{1024^3[bytes]}$$
$$= \mathbf{5.4398\ GB}$$

b) Spacecraft sending throughout ½ of ground pass

Sending time: = $\frac{34773.5}{2} = 17398.7s$

Amount of data sent: $17398.7 \times 10^6 = 1.73868 \times 10^{10}\ bits$

bits of data will be erroneously decoded per ground pass:

$1.73868 \times 10^{10} \times 10^{-6} = \mathbf{173986.8bits}$

c) Number of bits to be sent: $5.4398[GB] \times \frac{1024^3[bytes]}{1[GB]} \times \frac{8[bits]}{1[byte]} = 4.6728 \times 10^{10}bits$

Amount of time required to send: $\frac{4.6728\times10^{10}}{10^6[bps]} = 46729s = 12.98hours$

However, there will be erroneous bits needed to be resent:

bits of data will be erroneously decoded: $4.6728 \times 10^{10} \times 10^{-6} = 4.6728 \times 10^4 bits$

Amount of time needed to resend bits assuming they are not erroneous upon arrival:

$$\frac{4.6728\times10^4}{10^6[bps]} = 4.6728 \times 10^{-2}s = 0.000013\ hours$$

Total amount of time required is 12.98 hours +0.000013 hours = **12.98 hours** (the amount of time to resend bits is negligible)