AEE-486
HW 02

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Q1

First of all the magnetic field vector was obtained using the transformation matrix A_{oi} which is the transpose of the following matrix:

$$A_{io} = [\overrightarrow{O_1} \quad \overrightarrow{O_2} \quad \overrightarrow{O_3}]$$

Where O_1, O_2, O_3 are column vectors of the size 3×1. The values of these column vectors can be found by calculating the below expressions:

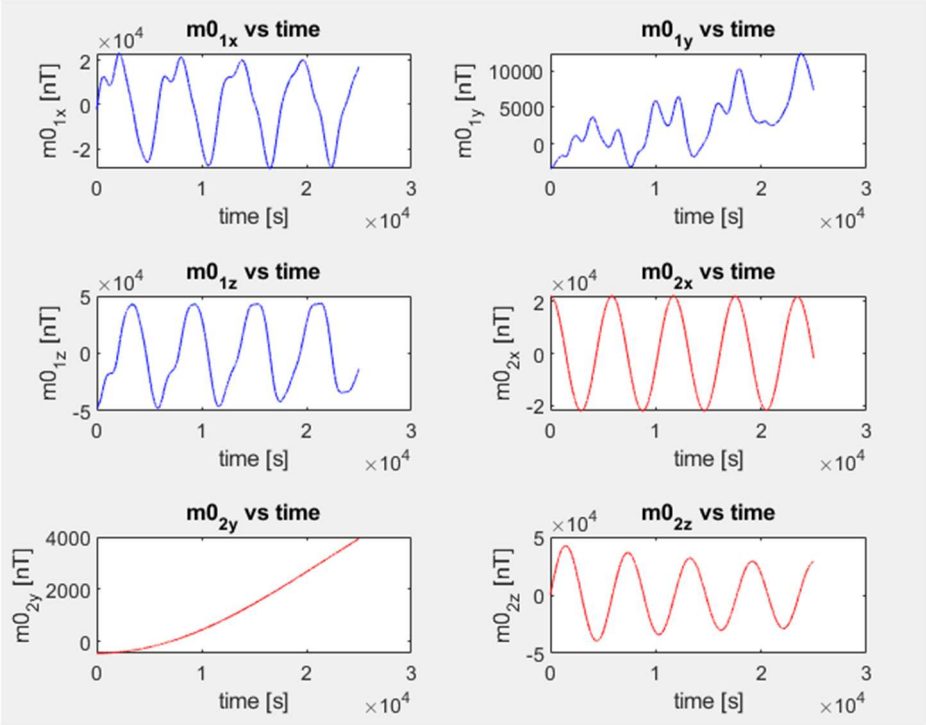
$$\overrightarrow{O_3} = \frac{-\vec{R}}{\|\vec{R}\|}$$

$$\overrightarrow{O_2} = \frac{-\vec{R} \times \overrightarrow{v_c}}{\|\vec{R} \times \overrightarrow{v_c}\|}$$

$$\overrightarrow{O_1} = \overrightarrow{O_2} \times \overrightarrow{O_3}$$

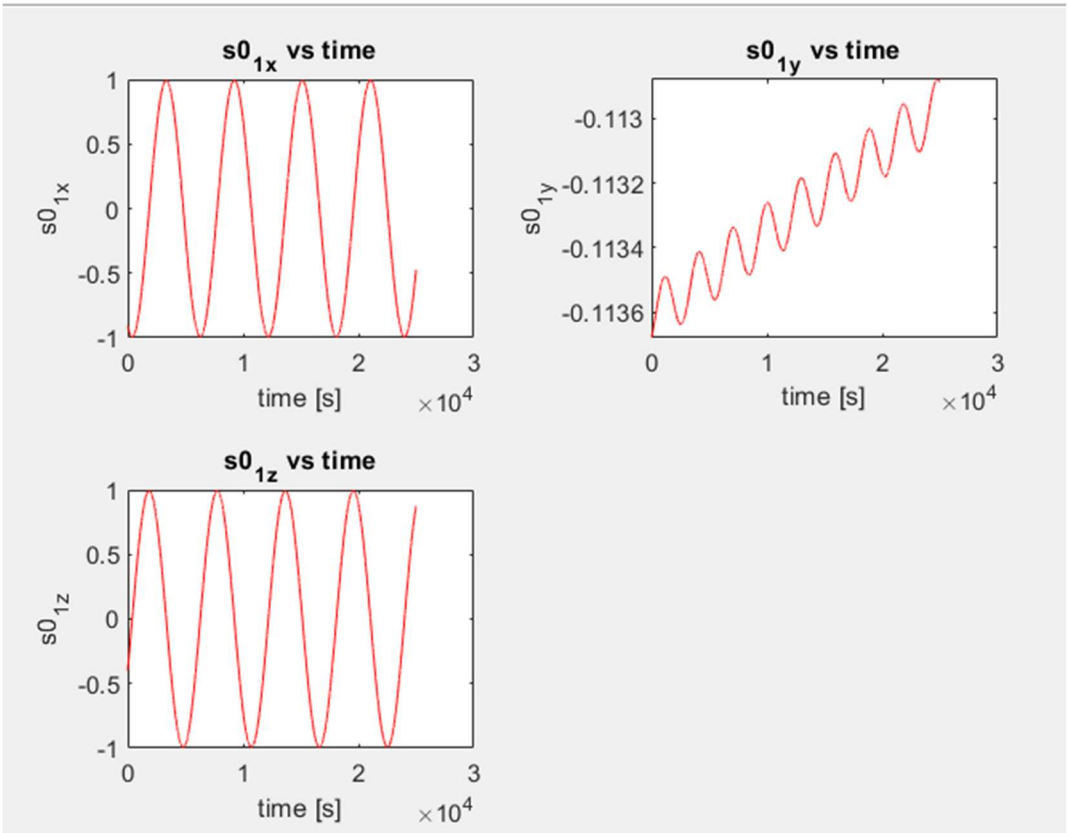
The transformation matrix A_{oi} was used to convert the magnetic field vector in the ECI frame to the orbit frame.

Then the dipole model was used to find the magnetic field vector in the orbit frame using the given constants.
The results are shown below for comparison: the blue plots indicate the magnetic field vector obtained through the transformation matrix and the red plots indicate the magnetic field vector obtained through the dipole model:



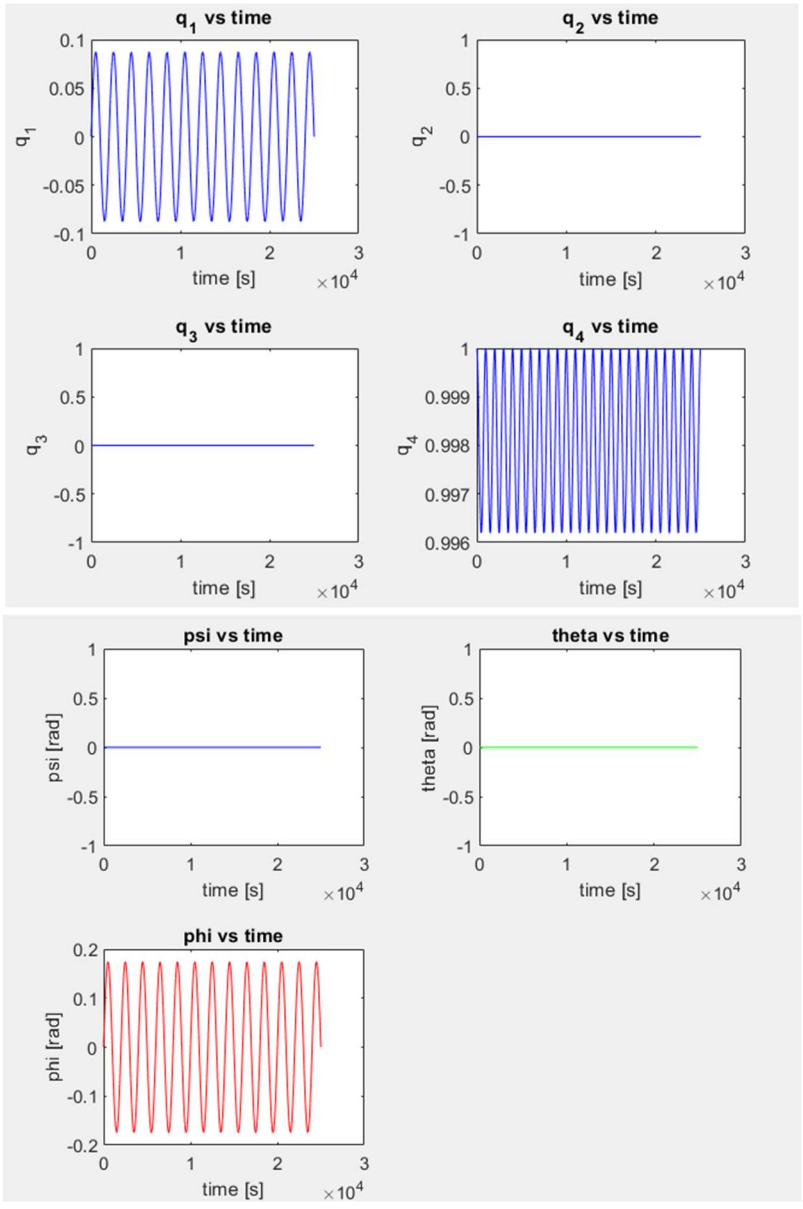
Q2

The sun vector in the orbit frame was found using the same transformation matrix used in Q1:



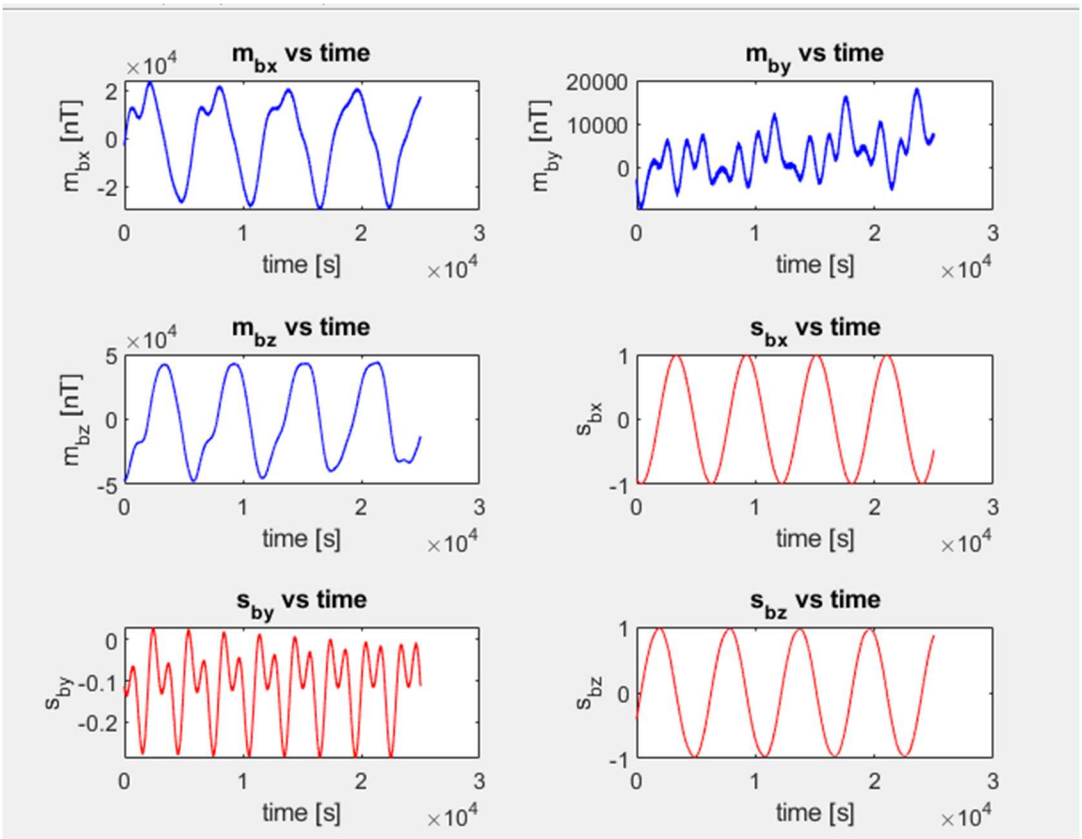
Q3

In this question the roll angle was fluctuated harmonically using a sine wave which had a maximum amplitude of 10 degree and a period of 2000 seconds.
The resulting plots of quaternion terms with respect to time and the Euler angles with respect to time are shown below:



Q4

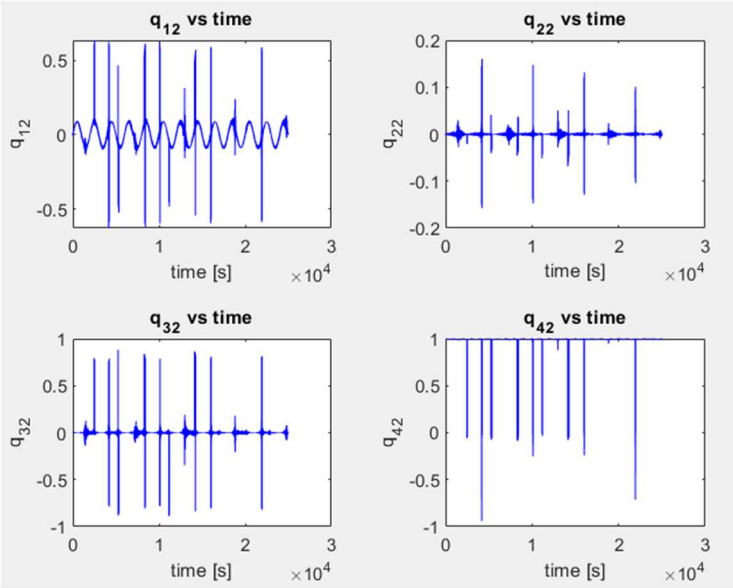
In this question the task was to use the above generated attitude matrices for each time step to model the variation of the sun direction vector and the magnetic field vector in the body frame. This was done using the formula and the variation given in the question multiplied by a random number generated between 1 and -1:



The red plots indicate the sun vector in body frame, and the blue plots indicate the magnetic field vector in body frame.

Q5

The QUEST algorithm was generated using the formulas provided in the notes. A function called quest was made. It was called for every time step in the calculation. The resulting plots are shown:



The left plots show the variation of each quaternion term with respect to time using the QUEST algorithm. There I some difference between the quaternions calculated in Q3. This is due the fact that QUEST is an attitude estimation algorithm.

The right plots show the variation of the Euler angles with respect to time. Again there is some difference between the plots from Q3, due to the estimation.