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Non-linear oscillation of a Satellite in elliptic orbit under magnetic torque

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The earth's magnetic field is predominantly that of a magnetic dipole such as that produced by a sphere of uniform magnetization or a current loop. The dipole strength is decreasing by 0.05% per year. This secular drift implies a possible field reversal in several thousand years. The instantaneous magnetic disturbance torque, [$\underline{N}_{mag}$ in N.m] due to the spacecraft effective magnetic moment m (in A.m^2) is given by $\underline{N}_{mag} = m \times B$, where B is the geocentric magnetic flux density (in Wb/m^2) and m is the sum of the individual magnetic moments caused by permanent and induced magnetism and the spacecraft generated current loops. In this paper, we studied the non-linear oscillation of a satellite in elliptic orbit under magnetic torque. By using Melnikov's method, we have shown that the equations of motion are non-integrable. Using BKM method, it is observed that the amplitude of the oscillation remains constant up to the second order of approximation. The main and parametric resonances have been shown to exist and have been studied by BKM method. The analysis regarding the stability of the stationary planar oscillation of a satellite near the resonance frequency shows that discontinuity occurs in the amplitude of the oscillation at a frequency of the external periodic force which is less than the frequency of the natural oscillation. The half width of chaotic separatrix has been estimated by Chrikov's criterion. Through surface of section method, it has been observed that the magnetic torque parameter, the eccentricity of the orbit and the mass ratio play an important role in changing the regular motion into the chaotic one.