A Two-Dimensional Nonlinear Oscillator in a Charged Rectangular Frame

Haiduke Sarafian   [has2@psu.edu]

The Pennsylvania State University, University College, York PA, USA

Motion characteristics of a point-like charged particle projected within the interior plane of a two dimensional electric field of an uniformly charged square and/or rectangular frame is intuitively unpredictable. This investigation quantifies its kinematics. Two scenarios are considered. First, the charged particle is projected along the frame's planar symmetry axis. Second, it is projected at an arbitrary direction within the frame. In both cases the equations of motion are challenging nonlinear differential equations. Applying Computer Algebra System (CAS), specifically Mathematica [1], equations are solved numerically. The first scenario results weak nonlinear oscillations along the symmetry axis. The second case is conducive to a two dimensional chaotic unpredictable oscillations sensitive to speed and orientation of the initial velocity. For visual comprehension of nonlinear oscillations, we utilize Mathematica's innate animation feature simulating the oscillations.

Keywords

Two-dimensional Nonlinear Oscillator, Computer Algebra System (CAS), Mathematica

References

[1] WOLFRAM, S. (1996) MATHEMATICA BOOK, 3RD EDITION, CAMBRIDGE UNIVERSITY PRESS, CAMBRIDGE.

[2] SARAFIAN, H. (2017) LEGENDRE POLYNOMIALS AND NONLINEAR OSCILLATING POINT-LIKE CHARGED PARTICLE. JOURNAL OF ELECTROMAGNETIC ANALYSIS AND APPLICATIONS, 9, 147-154. HTTPPS://DOI.OR/10.4236/JEMAA.2017.911013.

[3] SARAFIAN, H. (2011) NONLINEAR OSCILLATIONS OF A MAGNETO STATIC SPRING-MASS. JOURNAL OF ELECTROMAGNETIC ANALYSIS AND APPLICATIONS, (2011), 3, 133-139, DOI:10.4236/JEMAA.2011.35022.

[4] SARAFIAN, H. (2017)6TH INTERNATIONAL PHYSICS CONFERENCE, ATHENS-GREECE, JULY, 2018.

[5] SARAFIAN, H. (2015) MATHEMATICA GRAPHICS EXAMPLE BOOK FOR BEGINNERS. SCIENTIFIC RESEARCH PUBLISHING, WUHAN.