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Abstract

1 Introduction

For thousand of years humankind have looked up to the beyond and wondered. Specifically our race has wondered about the motion of our solar system. Finally after Newton the mystery was solved. Newton developed the gravitational law, which made it possible to predict the motion of the planets. After a couple of centuries Einstein came with the thoery of general relativity and made a small refinement to the law of motion that Newton proposed.

These laws are not enough to solve the motion of the planets. The laws makes differential equation which are not trivial or even impossible to solve. This is where a our computational physics course comes in . With the tools developed in this course we can make a prediction to the motion of the planets in our solarsystem.

REF KURSETS HJEMMESIDE

In this project we will make an object oriented code to solve the solar system with Forward Eulers method and Velocity Verlet. Both method will be derived, discussed, implemented and benchmarked for the Earth-Sun system.

WRITE ABOUT THEIR PERFORMANCE

Finally, a relativistic correction was made.......

NEED TO IMPLEMENT THIS AND GET FACTS

2 Theory

2.1 Gravitation

$$\vec{F_G} = \frac{GmM}{\left|\vec{r}\right|^3}\vec{r} \tag{1}$$

$$\sum_N^{i=1} \vec{F_i} = \frac{Gm_iM_i}{\left|\vec{r_i - r_j}\right|^3}r_i \vec{-} r_j$$

2.2 Units

2.3 Numerical methods

2.3.1 Forward Euler

2.3.2 Velocity-Verlet

3   Method

$2458045.500000000 = A.D.2017{-}Oct{-}1900 : 00 : 00.0000TDBX = 2.213296131976958E{-}03Y = 5.740795718142255E{-}03Z = -1.30033836064062E{-}04VX = -5.236918819978495E{-}06VY = 5.487345385589584E - 06VZ = 1.229796132639033E - 07$

4   Result

4.1   Earth-Sun system

4.1.1   Stability

4.1.2   Conserved quantities

4.1.3   Escape velocity

4.2   Three body system

4.2.1   Fixed mass for jupitur

4.2.2   Varying mass for jupitur

4.3   Solar system

4.3.1   Three planets and all moving

4.3.2   Solar system all moving

4.4   The perihelion precession of Mercury

4.4.1   missing this part

5 Discussion

6 Conclusion

7   Appendix