Project 3 FYS4150

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Abstract

The program used in this project can be found at Github.

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2 Theory

Sentrifugal: $a = \frac{v^2}{r}$.

We know that the earth needs one year to orbit the sun, meaning that $v = \frac{2\pi r}{1\text{ year}}$. This can be rewritten with $v = \tilde{v}v_0$ and $r = \tilde{r}r_0$. The units of r and v are contained in $v_0 = \frac{1\text{Au}}{1\text{ year}}$ and $r_0 = 1$ Au, giving that $\tilde{v}^2\tilde{r} = 4\pi^2$. In the same way $t = \tilde{t}t_0$, with $t_0 = 1$ year.

$$a_E = \frac{F_E}{M_E} = -G\frac{M_{sun}}{r^2} \tag{1}$$

$$= \frac{v^2}{r} \tag{2}$$

$$GM_{sun} = v^2 r = 4\pi^2 \frac{(1\text{ Au})^3}{(1\text{ year})^2} \tag{3}$$

$$\frac{\mathrm{d}\tilde{v}}{\mathrm{d}\tilde{t}} = -\frac{4\pi^2}{\tilde{r}^2} \tag{4}$$

For the rest of the paper we will assume all variables to be dimensionless. In a two dimensional system $r = (x, y) = (r\cos\theta, r\sin\theta)$. This gives the following parametrized relations :

$$\frac{\mathrm{d}v_x}{\mathrm{d}t} = -\frac{4\pi^2 r\cos\theta}{r^3} = -\frac{4\pi^2 x}{r^3} \tag{5}$$

$$\frac{\mathrm{d}v_y}{\mathrm{d}t} = -\frac{4\pi^2 r\sin\theta}{r^3} = -\frac{4\pi^2 y}{r^3} \tag{6}$$

$$\frac{\mathrm{d}x}{\mathrm{d}t} = v_x \tag{7}$$

$$\frac{\mathrm{d}y}{\mathrm{d}t} = v_y \tag{8}$$

$$\tag{9}$$

3 Method

4 Result

5 Discussion

6 Conclusion

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