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.

$$
\begin{align}
a_E &= \frac{F_E}{M_E} = -G\frac{M_{sun}}{r^2} \tag{1}\\
&= \frac{v^2}{r} \tag{2}\\
GM_{sun} &= v^2 r = 4\pi^2 \frac{(1 \text{ Au})^3}{(1 \text{ year})^2} \tag{3}\\
\frac{\mathrm{d}\tilde{v}}{\mathrm{d}\tilde{t}} &= -\frac{4\pi^2}{\tilde{r}^2} \tag{4}
\end{align}
$$

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 relations:

$$
\begin{align}
\frac{\mathrm{d}v_x}{\mathrm{d}t} &= -\frac{4\pi^2 r\cos\theta}{r^3} = -\frac{4\pi^2 x}{r^3} \tag{5}\\
\frac{\mathrm{d}v_y}{\mathrm{d}t} &= -\frac{4\pi^2 r\sin\theta}{r^3} = -\frac{4\pi^2 y}{r^3} \tag{6}\\
\frac{\mathrm{d}x}{\mathrm{d}t} &= v_x \tag{7}\\
\frac{\mathrm{d}y}{\mathrm{d}t} &= v_y \tag{8}\\
& \tag{9}
\end{align}
$$

3 Method

4 Result

5 Discussion

6 Conclusion

References