universität Wien Faculty of Physics

We are going to study the orbit of a satellite in Earth's gravitational field. Due to symmetry our problem can be solved in 2 dimensions. We start with a satellite in a geostationary orbit (distance from earth center  $r = 42\,157\,\mathrm{km}$ ). The graviational force is given by

$$F = -G \frac{m \, m_e}{r^3} \vec{r}$$

with the gravitational constant  $G=6.674\,08\times 10^{-11}\,\mathrm{m^3kg^{-1}s^{-2}}$ , Earth mass  $m_e=5.972\times 10^{24}\,\mathrm{kg}$ , mass of the satellite m and the distance vector  $\vec{r}$ .

The following questions should be answered:

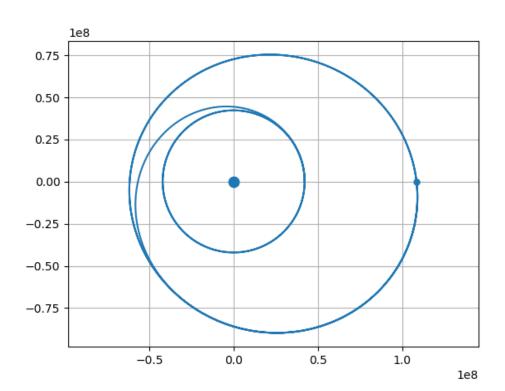
■ the corresponding (linear) system of first order ODEs needs to be determined:

$$\dot{x} = f(t, v)$$
 $\dot{v} = g(t, x)$ 

compare the explicit Euler with the following symplectic Euler method and compare the performance and stability:

$$x_{n+1} = x_n + \Delta t f(t_n, v_n)$$
  
$$v_{n+1} = v_n + \Delta t g(t_n, x_{n+1})$$

- $\blacksquare$  determine the period time T of the satellite in the geostationary orbit
- **a** assume that in the interval t = [2T...3T] the engine is fired and creates a tangential force f = 0.01m
- visualize the stable solution



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