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Basic Concepts

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1 Orbital Elements

In this section we explain some orbital element sets and how to convert to and from different sets.

1.1 Cartesian Elements

The Cartesian elements are

$$\vec{r}(t), \vec{v}(t). \tag{1}$$

They define position and velocity at a given time.

1.2 Keplerian Elements

The Keplerian elements are

$$a, e, i, \omega, \Omega, f(t). \tag{2}$$

They define semimajor axis, eccentricity, inclination, right ascension of the ascending node, argument of periapsis, and true anomaly. Notice that only true anomaly varies with time.

In order for the previously mentioned elements to correctly describe an orbit, it must meet two conditions: The orbit must be osculating, and elliptical.

Osculating Orbits An orbit is said to be osculating if the orbiting body has only one attractor, without the preturbation of any other gravitational force force, and thus follows a kepler orbit.

Elliptical orbits TODO: Explain why the given elements only apply to elliptical (non-circular, non-parabolic, non-hyperbolic) orbits.

1.3 Cartesian-Keplerian Conversion

TODO: How to get from Cartesian to Keplerian elements.

1.4 Keplerian-Cartesian Conversion

TODO: How to get from Keplerian to Cartesian elements.

2 Basic Vector Algebra

TODO: Add basic vector algebra

3 Drawing Conic Sections

TODO: Explain how would one go about drawing a conic section (which is in a plane) in some three-dimensional frame.