Orbit Determination of Space Objects

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Space surveillance is desired to catalogue the many thousands of objects in Earth orbit. Radar sensors detect sequences of noisy returns and process those, with object tracking algorithms, to estimate position and velocity of each object. The dynamics constraints of object position and velocity, **R**(t), and **V**(t), respectively, are approximated by:

$$d\mathbf{R}/dt = \mathbf{V}$$

$$d\mathbf{V}/dt + (\mu/R^3)\mathbf{R} = \mathbf{0}$$

That together with a model of random, radar-observation error enables the statistically optimized estimation of an object's motion time history, and thus its orbit, in space.

The dynamics of orbital motion, above, will be developed from Newton's central force formulation, and its solution will be shown to lead to motion along elliptic contours. Characteristics of its solution, some invariance properties and numerical implementation will be discussed