Introduction to Flight Simulation (List 4)

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1. We are going again to try to shoot a Saturn V rocket into circular orbit at 250km altitude. This turns out surprisingly hard. Not because of the simulation itself, which is easy, but because of the control problem.

2. Give a general formula, that describes which speed is necessary to maintain a circular orbit around earth at a given altitude. Use the law for gravity force:
$$F = \frac{Gm_1m_2}{r^2},$$
and the fact that $G = 6.67428.10^{-11}\mathrm{m}^3\mathrm{kg}^{-1}\mathrm{s}^{-2}$. Earth has a mass of $5.9736.10^{24}$kg, and a radius of 6378000m. Determine which speed is necessary for maintaining a circular orbit at 250km.

3. Give a general formula that describes the potential energy that a small mass m has, relative to a big point mass M, when it has distance x.

   What is the total energy (per mass) that is needed for a circular orbit at an altitude of 250 km around earth?

4. An Airbus 380 has a wing area of $850m^2$. Its maximum take off weight is 560000 kg. It takes off at a speed of $300km/hr$. Assume that $\rho = 1.225$.

   What is the lift coefficient during take off? Does this number fit with the graphic in Figure 3.13 of A.C. Kermode, Mechanics of Flight?