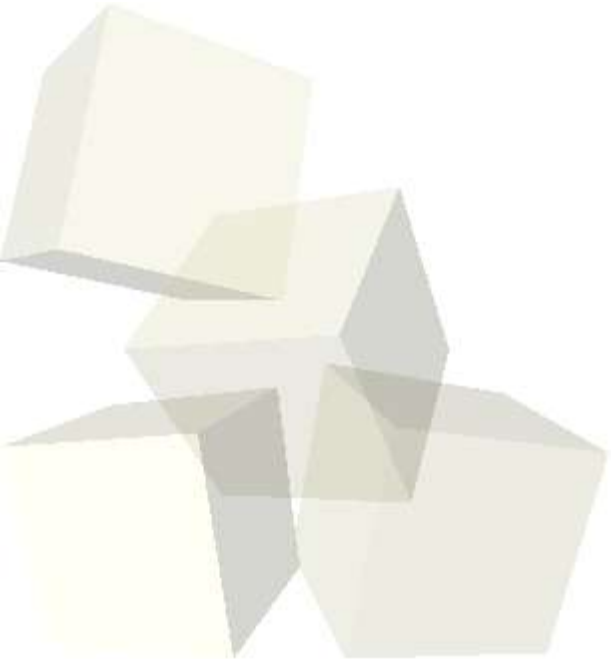
More Multibody Systems

10-10-2005

Opening Discussion

- What did we talk about last class?
- Have you looked at the project at all? Are you making any progress on it?



Finishing up Gravity Systems

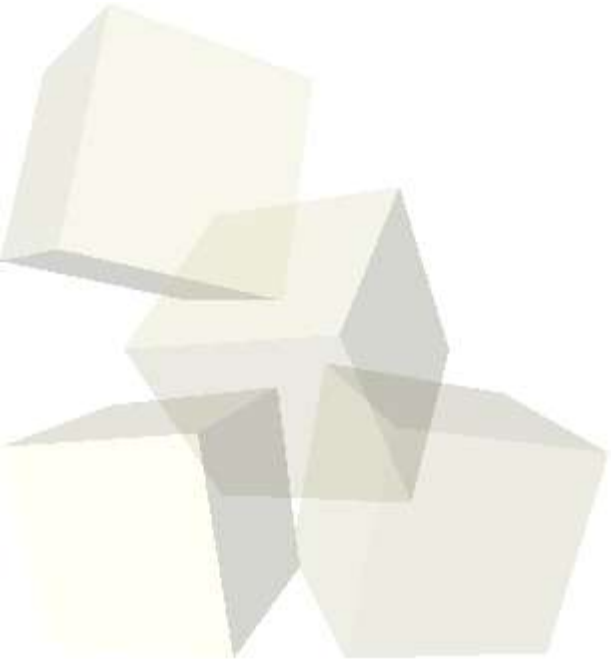
- Last time we started writing code that would allow us to solve gravitational systems as a system of ODEs.
- We want to go ahead and finish that code and see if it actually works.
- If you were to actually do this you would likely use a specialized tool like Swift, Mercury, HN-body, or other special purpose codes. You might also consider writing your own if you had special needs.
- The above all have the ability to use symplectic integrators. These conserve certain quantities that ode45 won't.

Tree and Multipole Codes

- If the number of particles being simulated is large, the approach we have taken is problematic because the force calculations scale as $O(n^2)$.
- For certain systems we can use approximations that treat more distant interactions as being collections instead of individual particles. This assumption gives rise to tree codes that scale as O(n log n).
- Similarly, some people approximate the field of groups of particles and estimate forces from those. These multipole methods can scale as O (n) in good situations.

Collisional and MD Systems

- The smooth nature of the gravity force and the fact that it goes over infinite distance make it well suited for an ODE style solution. Not all systems are like that.
- Molecular dynamics simulations have fairly smooth forces, but they go to zero at longer ranges. This makes it inefficient to calculate all interactions so spatial data structures are needed.
- Collisional dynamics is localized and typically has very poorly behaved forcing profiles. Often they are even discontinuous. These are better solved with object models than with systems of ODEs.

Reminders

- The midterm is next class. It will cover everything that we have done so far, mainly focusing on your ability to solve problems using Matlab. It will be run like the last two quizzes in that it is open book and open Matlab. Many questions will give you a problem to solve and ask for both the solution and how you solved it.