

1. Constraints:

- Describe 4 different approaches (that we covered in class) of enforcing constraints on particles in a particle system (for example constrain a particle to move along a specified line). List advantages and disadvantages of each approach.
- Suppose we had used constrained dynamics on the first project instead of particle spring forces and penetration penalty forces. What problems might we have run into which our soft constraint system did not encounter? How might we have solved these problems?
- Why would repulsion forces be more efficient at preventing self-intersections in cloth than exact intersection detection and resolution? Keep in mind that detecting and resolving penetrations between cloth and our skeleton was relatively trivial.

2. Integration:

- What are the problems with explicit integration?
- What is the order of the error term for mid-point method (show the derivation that supports your answer)?
- Why explicit integration does not work well for cloth simulation? (do not just simply state that system is stiff, please explain why it is stiff and why explicit integration methods can not handle stiff systems.
- In Baraff's notes on implicit methods, he uses a linear approximation of the forces on a particle, then solves that linear system. What would the benefits and drawbacks be of using a higher-order approximation of the forces and solving that instead?

3. Cloth:

- What is the main contribution of "Large Steps in Cloth Simulation" paper by Baraff and Witkin
- What is the main contribution of "Robust Treatment of Collisions, Contact and Friction for Cloth Animation" by Bridson, Fedkiw, Anderson.

4. Fluids:

- One problem with simulating the surface of a fluid as a free surface in a semi-Lagrangian simulator is that bubbles in the fluid are not stable (section 1.6, page 23 in Siggraph 2007 course notes). In water simulated with SPH, would bubbles in the fluid collapse? Why or why not? If so, what would be necessary to simulate bubbles in the fluid that would not collapse?
- Please compare methods for controlling fluids described in the following two papers (list advantages and disadvantages of each method):
 1. Target-Driven Smoke Animation by Raanan Fattal & Dani Lischinski
 2. Fluid Control Using the Adjoint Method by Antoine McNamara, Adrien Treuille, Zoran Popovic, Jos Stam