CPSC 679: Physics Simulation for Movies and Games	April 5, 2022 Final Project

1 Final Project

You will have the opportunity to explore one of the topics from class as a final project. The project can be an implementation of a non-trivial technique from the literature (see the paper list from the presentation PDF), or your own technique.

The most important thing is to **decide the specific visual result you want to achieve.** What visually compelling phenomenon do you want to capture, and how will you achieve it? You are welcome to build on existing simulation code, including the `HOBAK`, `HOTTEOK`, and Wavelet Turbulence codes from your assignments.

You can also extend other open-source projects, such as:

- Bullet Physics - This was originally a rigid body physics package, but now it has lots of other features
- MantaFlow - Tobias Pfaff and Nils Thuerey's fluid simulation code
- Shiokaze - Ryoichi Ando's fluid simulation code
- ARGUS - Jie Li's adaptive cloth simulation code
- Sand 6 - Gilles Daviet and Florence Bertails-Descoubes' sand simulation code
- SPlisHSPlasH - Jan Bender's Smoothed Particle Hydrodynamics code
- PBD - Jan Bender's Position-Based-Dynamics code
- SCISim - Breannan Smith and Danny Kaufman's rigid body dynamics code
- Tai Chi - Yuanming Hu's Material Point Method (MPM) solver
- SOFA - Simulation Open Framework Architecture
- IPC - Minchen Li and Zachary Ferguson's deformation code
- My students and I have also written other codes:
  - Cube for simulating flesh the Pixar way
  - EulerSF for solid-fluid coupling
  - Closest Point Turbulence for liquid up-res
  - Eigenfluids for spectral fluid simulation
  - Zephyr for subspace fluid simulation

  - Cubica++ for subspace deformable bodies
  - LumosQuad for lightning simulation

Some project ideas, including ones from past offerings of this course are:

- Implement Smoothed Particle Hydrodynamics (SPH), a Lagrangian method for simulating liquids. Solenthaler's early works are a good starting point here.
- Implement Continuous Collision Detection (CCD) and response, in order to handle severe collisions that occur over a single timestep.
- Implement 3D cloth, such as from the original Baraff and Witkin 1998 paper.
- Implement 3D strands, rods, super-helices or the Taz model.
- Implement Global Intersection Analysis (GIA) from the Untangling Cloth paper. This is a notoriously tricky algorithm to get right, if you are looking for a challenge.
- Throw an existing algorithm onto the GPU.
- I do caution you against this:

2 Deliverables

2.1 Project Proposal

Submit a PDF that describes in 500 words or more what you would like to do.

- Give your project a *title*.
- Describe the *visual result* that you want to achieve. Supporting images from Google Image search, with Photoshop arrows pointing to the specific features you care about, are highly recommended.
- Describe the *simulation method* you will be using, and why it is reasonable to expect that it will yield the visual result (e.g. the paper achieves that result).

- Break the method down into *weekly milestones*. You will probably not know if you have achieved your goal until the very end. In the interim, how will you know that you are making progress? What preliminary test cases will you try on your way to a complete implementation?[1]

If you are unsure what you want to do for your project, let me know and we can meet to discuss. It can be hard to tell if a project is too small or too ambitious, but the top priority is to minimize the risk that you end up with nothing. *If you have any doubts about this, come to office hours.*

2.2 Progress Report

Submit a PDF that describes in 500 words or more the current status of your project.

- Show a preliminary image or movie.
- Describe where you are spending most of your time. Is this effort showing up in the image?
- Describe whether you have hit your milestones, and provide a revised timeline.

If you are running into significant roadblocks[2], describe them.

2.3 Final Presentation

You will give a 10 minute presentation on your project to the class.

- While slides are not required, they are encouraged, as they will help you structure your results.
- State what your visual goal was, and whether you achieved them.
- You must display an animation you have generated.

2.4 Final Report

Submit a conference-style report of 500 words or more of your results

- Summarize again the visual goal your project.
- Did you achieve the goal? If so, describe what you found to be the most important component to achieving the goal. If not, did the method itself not provide the results you expected?

[1] These do not count as milestones: "1. Make a prototype. 2. Debug it. 3. Debug it some more." Plan specifics up front, and it will mitigate the probability of failure later.

[2] "I was really busy and haven't done anything yet" does not count as a roadblock.

- What was the *biggest* roadblock you encountered?
- Include images and video of your results. YouTube links are encouraged.
- Include implementation details, and suggest future work.

3 Project Timeline

- **20 points** Project proposal: Due 11:59 PM, the evening of April 12th, 2022.
  - **5 points**: PDF meets length requirement (500 words) and has a title
  - **5 points**: describes visual result
  - **5 points**: describes method in detail
  - **5 points**: provides weekly milestones
- **20 points** Progress report: Due 11:59, the evening of April 26th, 2022.
  - **5 points**: PDF meets length requirement (500 words)
  - **5 points**: preliminary image or movie
  - **5 points**: effort breakdown
  - **5 points**: revised timeline
- **30 points** Final presentation: Due at final exam time, 2 PM, May 6th, 2022.
  - **5 points**: Presentation meets length requirement (10 minutes), and does not go too long or too short
  - **5 points**: Presentation materials are well-prepared
  - **10 points**: Oral presentation clearly conveys goals, methods, and results.
  - **10 points**: Animation of final result
- **30 points** Final project write-up: Due at 5:30 PM, May 12th, 2022.
  - **5 points**: PDF meets length requirement (500 words)
  - **10 points**: images and videos of results
  - **5 points**: summary of visual goals
  - **5 points**: analysis of whether goals were achieved
  - **5 points**: implementation details and future work