### **GPU Accelerated Cloth Simulator for Unity**

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**Overview**

[Unity](https://unity3d.com/) is the world’s most popular game engine for indie and mid-sized game developers. Though the engine and its user-created-content marketplace boasts an impressive collection of features, there exists very few solutions for GPU-accelerated cloth simulation. Both the engine’s default cloth solver and the most popular marketplace plugin are on the CPU, and the only GPU option is a port of NVIDIA’s own CUDA cloth solver, which runs slower than ideal due to the interfacing time required between C++ and C#. To address this need, my team has decided to implement a cloth simulation tool using Position Based Dynamics and Unity’s compute shaders. We chose Position Based Dynamics as the algorithm mainly because of its efficiency and flexibility. Though the original PBD paper was published in 2007, it has seen continuous improvements throughout the last decade, and we plan to use the latest techniques such as those those described by the 2017 survey on PBD linked below. After implementing cloth simulator, we would also like to expand our solver to handle soft-body and fluid simulation as well. Our final product will be a free plugin on the Unity marketplace that anyone can use.

**Goals**

* Implement a Cloth Simulator in Unity using Position-based Dynamics
  + Implement stretching and bending constraints as well as collision
  + Make sure the tool is well integrated into the engine and easily to use.
* Stretch goals:
  + Implement additional constraints for fluid and soft-body simulations
  + Make a simple game to demonstrate the power of this tool

**Milestones**

1. Build the skeleton of our tool in Unity. Figure out how to use compute shaders, and make a minimally working cloth sim in the engine on the CPU.
2. Finish implementing all constraints and collision-handling for cloth sim. Move all computations into compute shaders. Polish the interface of our tool in the engine.
3. Implement constraints for fluid and/or soft-body simulations.
4. Implementing additional constraints and unify all simulations under a single solver. Create simple demo to show off our tool.

**Resources**

* [Unite2016 Talk on GPU Accelerated Cloth Sim in Unity](https://www.youtube.com/watch?v=kCGHXlLR3l8)
* [A Survey on Position Based Dynamics, 2017](https://www.animation.rwth-aachen.de/media/papers/2017-EG-CourseNotes.pdf)
* [Unified Simulation of Rigid and Flexible Bodies using Position Based Dynamics](https://diglib.eg.org/handle/10.2312/vriphys20171083)
* [The Position Based Dynamics library](https://github.com/InteractiveComputerGraphics/PositionBasedDynamics)