AlienGLRenderer: “Real-time” Cloth Simulation

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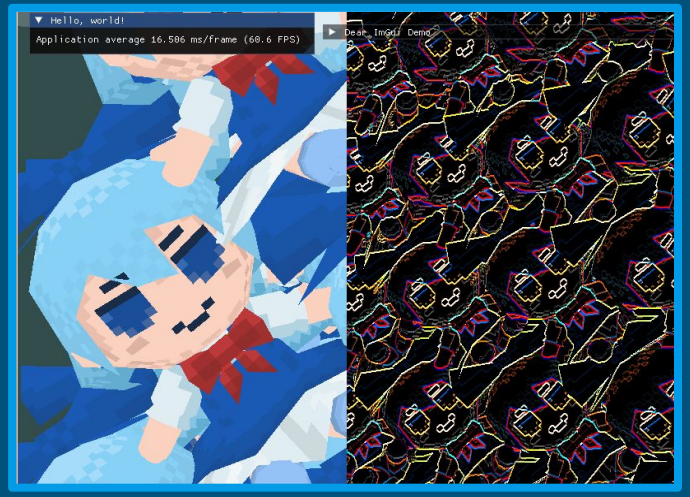
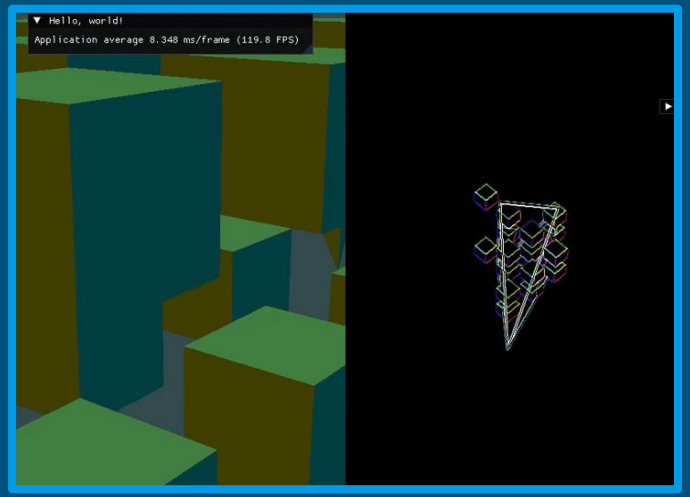
Link: https://docs.google.com/presentation/d/1tnc3lAQ7V3QQYlSeE2pQyQKVBwjRusShwNoIkE4MN5U/

Inspiration

AlienGLRenderer

- A sandbox renderer in OpenGL
  - Streamline creation of simple scenes
  - Help me reinforce CG concepts
- Current features:
  - Post-processing
  - Instancing
  - Frustum culling
  - Gltf Model Loading
  - Scene Loading





I occasionally post my progress here: https://x.com/isacsac2017

Idea

Perfect for a capstone project...

New feature: Real-time Cloth Simulation!

- Implies a collection of features
  - Essential: Physics-based animation, particle systems, lighting / texture mapping, offline rendering
  - Focus: **Real-time Deformable Mesh Simulation**
    - Discrete Elastic Plates/Shells Algorithm
    - **Making this "real-time"** (offline rendering is fair game)
- Room for extra features:
  - Collision
  - Interactable features
  - Simulation of material/environment
    - Destruction
    - Dynamic environment

Questions

How do we simulate a cloth effectively and efficiently?

- What algorithms exist other than DEP/S?
  - Are they reasonable to implement?
- How does implicit/explicit integration differ (in real-time)?
  - Could we benefit from offline rendering?

What technical problems arise when simulating cloth?

- Could we optimize our computations?
- How do we render a cloth with good visuals?

Plan

Week 1-2: Proposal

- Implement a simple particle system and DEP algorithm in C++
- Spend time optimizing algorithms (Answer: online or offline rendering?)
- Prepare midterm report / presentation

Week 3-4: Midterm

- Present current results and determine what is left
- Add interaction and polish visuals and aesthetics
- Prepare final report / presentation

Week 5: Final

- Present results (and what's next)

References

[1] J. Weil, “The synthesis of cloth objects,” ACM Siggraph Computer Graphics, vol. 20, no. 4, pp. 49–54, 1986.

[2] X. Provot et al., “Deformation constraints in a mass-spring model to describe rigid cloth behaviour,” 1995.

[3] D. Terzopoulos, J. Platt, A. Barr, and K. Fleischer, “Elastically deformable models,” SIGGRAPH Comput. Graph., vol. 21, p. 205–214, Aug. 1987.

[4] D. Baraff and A. Witkin, Large Steps in Cloth Simulation. New York, NY, USA: Association for Computing Machinery, 1 ed., 2023.

[5] Y. J. Oh, T. M. Lee, and I.-K. Lee, “Hierarchical cloth simulation using deep neural networks,” in Proceedings of Computer Graphics International 2018, pp. 139–146, Association for Computing Machinery, 2018.

References

[6] H. Bertiche, M. Madadi, and S. Escalera, “Neural cloth simulation,” ACM Trans. Graph., vol. 41, Nov. 2022.

[7] J. Bolz, I. Farmer, E. Grinspun, and P. Schr¨oder, “Sparse matrix solvers on the gpu: conjugate gradients and multigrid,” ACM Trans. Graph., vol. 22, p. 917–924, July 2003.

[8] R. Tamstorf and E. Grinspun, “Discrete bending forces and their jacobians,” Graph. Models, vol. 75, p. 362–370, Nov. 2013.

[9] M. Fisher, “Matt’s webcorner,” 2014. Available at https://graphics.stanford.edu/mdfisher/cloth.html

Any Questions?