HOOD-report

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Contents

Abstract

A report after reading HOOD [1]. Including 3 parts: the garment representation used in HOOD, the network architecture of HOOD, and possible improvements.

1 Innovations

- Using graph neural networks. Learning local states. Based on MeshGraphNets [2].
- Build a message-passing scheme over a hierarchical graph that interleaves propagation steps at different levels of resolution.
- Using physics-based loss function which is an incremental potential for implicit time stepping.
- Using a simple and efficient graph coarsening strategy which allowed the network implicitly learn transition between graph levels.

2 Garment Preprocessing

2.1 Build up basic graph and extensions

2.1.1

2.2 Hierarchical graph construction

3 Message Passing

3.1 Basic message passing

3.2 Multi-level message passing

4 Physical Supervision

4.1 Physical garment model

4.2 Novel terms in the loss function

4.2.1 Collision term

4.2.2 Friction

4.2.3 Vertex mass and canonical geometries

4.3 Vertex mass and canonical geometries

5 Conclusion

5.1 Enhancement

- Computationally cheap, compared to physics-based approaches.
- Train once, simulate every dynamic cloth, compared to other learning-based approaches.

- Be able to handle changes in topology and dynamic material parameters.
- Truly unsupervised, without the need of ground-truth data.
- State-of-the-art.

5.2 Problems remain

- Cannot simulate high speed animation, especially when body motions exceed the velocity seen at training time.
- Weak on solving garment self-collision.
- (Based on my observation) Low accuracy on prediction of inertia & creases in motion.
- Batch size was locked to 1, which means low reasoning speed.

6 Possible Improvements

6.1

References

[1] A. Grigorev, M. J. Black, and O. Hilliges, "Hood: Hierarchical graphs for generalized modelling of clothing dynamics," in *Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition*, 2023, pp. 16 965–16 974.

[2] T. Pfaff, M. Fortunato, A. Sanchez-Gonzalez, and P. Battaglia, "Learning mesh-based simulation with graph networks," in *International Conference on Learning Representations*, 2021.