Reference List 15-464 / 15-664 Mar 1, 2023

Today we had a look at a number of final project examples from earlier classes. I thought it might be useful to list some of the major references that were inspiration for these projects. If you have any questions about specific details or how a project was carried out, please let me know.

I began by mentioning two projects for which I did not have videos. One related to motion matching. You can find resources for learning more about motion matching here: http://graphics.cs.cmu.edu/nsp/course/15464-s21/www/lectures/lecture07MotionMatching.pdf

The other related to Motion Doodles – a sketch-based interface for creating character performances.

Thorne, Matthew, David Burke, and Michiel van de Panne. "Motion doodles: an interface for sketching character motion." *ACM Transactions on Graphics (ToG)* 23, no. 3 (2004): 424-431. https://www.cs.ubc.ca/~van/papers/doodle.pdf
https://www.youtube.com/watch?v=RAlWSyV0nDI

We then looked at a contact modeling project. (Remember the bouncing and inverting mesh dragon?) This project was built on Vega FEM
https://viterbi-web.usc.edu/~jbarbic/vega/

The paper that inspired the contact modeling technique was this one:

Perez, Alvaro G., Gabriel Cirio, Fernando Hernandez, Carlos Garre, and Miguel A. Otaduy. "Strain limiting for soft finger contact simulation." In 2013 World Haptics Conference (WHC), pp. 79-84. IEEE, 2013.
https://ieeexplore.ieee.org/abstract/document/6548388

Next we looked at an exploration of height fields. If you are interested in exploring height fields, here are some resources, including one that covers breaking waves:

Müller-Fischer, Matthias. "Fast water simulation for games using height fields." In Proceedings of the Game Developer's Conference. 2008.
http://twvideo01.ubm-us.net/o1/vault/gdc08/slides/S6509i1.pdf

Miklós, Bálint, and M. Müller. "Real time fluid simulation using height fields." Semester thesis (2004).
http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.138.5153&rep=rep1&type=pdf

Thurey, Nils, Matthias Muller-Fischer, Simon Schirm, and Markus Gross. "Real-time breaking waves for shallow water simulations." In 15th Pacific Conference on Computer Graphics and Applications (PG'07), pp. 39-46. IEEE, 2007.
https://ieeexplore.ieee.org/abstract/document/4392714

We then looked at a PIC/FLIP fluid simulator, which was constructed bit by bit by rewriting and replacing modules in a Houdini implementation. The PIC/FLIP solver was introduced to computer graphics by this paper. However, by now, there are many tutorials and implementations available online.

Zhu, Yongning, and Robert Bridson. "Animating sand as a fluid." ACM Transactions on Graphics (TOG) 24, no. 3 (2005): 965-972.
https://dl.acm.org/doi/10.1145/1073204.1073298
Implicit skinning was the topic of the next project, and is covered in the following paper:

Vaillant, Rodolphe, Loïc Barthe, Gaël Guennebaud, Marie-Paule Cani, Damien Rohmer, Brian Wyvill, Olivier Gourmel, and Mathias Paulin. "Implicit skinning: real-time skin deformation with contact modeling." ACM Transactions on Graphics (TOG) 32, no. 4 (2013): 1-12.
http://rodolphe-vaillant.fr/permalinks/implicit_skinning_project.php

We saw a pure motion capture project, where the technical component was to work with the full motion capture pipeline from start to finish, incorporating some straightforward physics.

We saw an example of a snow implementation using the Material Point Method (MPM) from this paper, which was quite successful in 2D. One feature of this paper was its comparisons of different parameter settings used to explore performance of the algorithm. The paper is the following. For more MPM references, however, see later in this document, when I describe another MPM project.

Stomakhin, Alexey, Craig Schroeder, Lawrence Chai, Joseph Teran, and Andrew Selle. "A material point method for snow simulation." ACM Transactions on Graphics (TOG) 32, no. 4 (2013): 1-10.
http://www.andyselle.com/papers/21/

We then saw a second skinning paper which used the idea that we could use different joint centers of rotation for each vertex of the skin mesh. Here is the reference:

Le, Binh Huy, and Jessica K. Hodgins. "Real-time skeletal skinning with optimized centers of rotation." ACM Transactions on Graphics (TOG) 35, no. 4 (2016): 1-10. https://dl.acm.org/doi/abs/10.1145/2897824.2925959

The next project attempted to duplicate performance of the phase-function neural network developed by Komura's group. Here is the paper:

Holden, Daniel, Taku Komura, and Jun Saito. "Phase-functioned neural networks for character control." ACM Transactions on Graphics (TOG) 36, no. 4 (2017): 1-13. https://dl.acm.org/doi/10.1145/3072959.3073663

We saw a paper on smoke control. The smoke control project was based on a sophisticated approach described in the following paper, but there are other approaches which are more straightforward. Contact me if you would like to find those references.

McNamara, Antoine, Adrien Treuille, Zoran Popović, and Jos Stam. "Fluid control using the adjoint method." ACM Transactions On Graphics (TOG) 23, no. 3 (2004): 449-456. https://dl.acm.org/doi/10.1145/1015706.1015744

The next project we saw was on spatial keyframing (the dancing bear). Here is the paper:

Igarashi, T., T. Moscovich, and J. F. Hughes. "Spatial keyframing for performance-driven animation." In Proceedings of the 2005 ACM SIGGRAPH/Eurographics symposium on Computer animation, pp. 107-115. 2005. https://www-ui.is.s.u-tokyo.ac.jp/~takeo/research/squirrel/index.html

The next paper related to creature design and automatically forming creature gaits. This paper was inspired by two main papers. The first of these can be considered a revisiting of the Motion Doodles paper:

Dvorožňák, Marek, Daniel Sýkora, Cassidy Curtis, Brian Curless, Olga Sorkine-Hornung, and David Salesin. "Monster mash: a single-view approach to casual 3D modeling and animation." *ACM Transactions on Graphics (ToG)* 39, no. 6 (2020): 1-12. https://ai.googleblog.com/2021/04/monster-mash-sketch-based-tool-for.html

It looks like they even have a demo online!
https://monstermash.zone/

The second paper is from the game Spore and relates to how it was designed to have the artists "code" their animations so that they would work for any user created character.
Hecker, Chris, Bernd Raabe, Ryan W. Enslow, John DeWeese, Jordan Maynard, and Kees van Prooijen. "Real-time motion retargeting to highly varied user-created morphologies." *ACM Transactions on Graphics (TOG)* 27, no. 3 (2008): 1-11.
https://www.chrishecker.com/Real-time_Motion_Retargeting_to_Highly_Varied_User-Created_Morphologies

We then saw a project example towards simulating curly hair. This one was motivated by a paper authored by the researchers working on simulation of hair for the movie Brave. Another paper on maintaining hair style in the Incredibles was also inspiration for this project.

Soares, Olivier, Samantha Raja, Rich Hurrey, and Hayley Iben. "Curls gone wild: hair simulation in brave." In *ACM SIGGRAPH 2012 Talks*, pp. 1-1. 2012.
https://dl.acm.org/doi/10.1145/2343045.2343076

Iben, Hayley, Jacob Brooks, and Christopher Bolwyn. "Holding the shape in hair simulation." In *ACM SIGGRAPH 2019 Talks*, pp. 1-2. 2019.
https://dl.acm.org/doi/pdf/10.1145/3306307.3328166

We then had a look at another MPM project (remember the MPM tetris and jello?). This project utilized a number of references, which seem to be very useful:

This online Unity-based tutorial by nialltl:
https://nialltl.neocities.org/articles/mpm_guide

This 2018 SIGGRAPH paper:
Hu, Y., Fang, Y., Ge, Z., Qu, Z., Zhu, Y., Pradhana, A., & Jiang, C. (2018). A moving least squares material point method with displacement discontinuity and two-way rigid body coupling. *ACM Transactions on Graphics (TOG)*, *37*(4), 1-14.
https://yzhu.io/publication/mpmmls2018siggraph/paper.pdf

This 2016 SIGGRAPH course on MPM:
Jiang, C., Schroeder, C., Teran, J., Stomakhin, A., & Selle, A. (2016). The material point method for simulating continuum materials. In *ACM SIGGRAPH 2016 Courses* (pp. 1-52). https://www.seas.upenn.edu/~cffjiang/research/mpmcourse/mpmcourse.pdf

We next saw a couple of particle based fluid simulation papers. The relevant references are these:

Macklin, Miles, and Matthias Müller. "Position based fluids." *ACM Transactions on Graphics (TOG)* 32, no. 4 (2013): 1-12.
https://dl.acm.org/doi/abs/10.1145/2461912.2461984
https://www.youtube.com/watch?v=F5KuP6qEuew

Müller, Matthias, David Charypar, and Markus Gross. "Particle-based fluid simulation for interactive applications." In *Proceedings of the 2003 ACM SIGGRAPH/Eurographics symposium on Computer animation*, pp. 154-159. 2003.
https://matthias-research.github.io/pages/publications/sca03.pdf
https://www.youtube.com/watch?v=6CP5QvfuD_w

Class assignment in Doug James' Computer Graphics course:
http://graphics.stanford.edu/courses/cs348c/PA1_PBF2016/index.html
http://graphics.stanford.edu/courses/cs348c-20-winter/HW_PBF_Houdini/index.html

Finally, we saw a project that involved creating behaviors for a flock of butterflies. This page of references can get you started on thinking about flocks, schools, and herds, as well as human behavior in crowds, which often starts from similar ideas of interaction forces.
http://graphics.cs.cmu.edu/nsp/course/15464-s20/www/lectures/lecture23Crowds.pdf