15-464/15-664 Reference List for March 22, 2023

Eulerian finite difference based approach to solving Navier-Stokes equations

We began by talking about the Navier-Stokes equations, and a very straightforward approach to solving them using a grid-based approach and finite differences:

Foster, Nick, and Dimitri Metaxas. "Realistic animation of liquids." Graphical models and image processing 58, no. 5 (1996): 471-483.
http://www.cbim.rutgers.edu/dmdocuments/gmip96%20Foster.pdf

Making it stable

The next big development was to make this algorithm fast and stable, through straightforward innovations introduced by Jos Stam.   The original paper is "Stable Fluids" from SIGGRAPH 1999. However, the paper below is quite clear in walking through the algorithm, providing detailed diagrams and pseudocode.   The resulting system is still very usable today and produces nice looking smoke.

Stam, Jos. "Real-time fluid dynamics for games." In Proceedings of the game developer conference, vol. 18. 2003.   http://graphics.cs.cmu.edu/nsp/course/15-464/Spring11/papers/StamFluidforGames.pdf
https://www.youtube.com/watch?v=t-erFRTMIWA
https://www.youtube.com/watch?v=fFl0FOiR3Nc

This blog page walks through how the 3D effects shown in the second video were created:
https://softologyblog.wordpress.com/2019/02/28/jos-stams-fluid-simulations-in-3d/