CSEE 4840

Embedded Systems

Final Project Proposal

Target-Driven Smoke Simulator

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Our group proposes to implement a target-driven smoke simulator as our final project. Specifically, the system will generate a smoke that has a sequence of different states and it will exhibit natural-looking smoke-like behavior [1]. Moreover, the smoke will be in its initial state, and then diffuse towards the shape that we define in the system.

The algorithm will be based on Raanan Fattal and Dani Lischinski's paper published in 2004 [1]. The paper claims that typical smoke animations are generally created by the inviscid Euler equations:

$$u_t = -u \cdot \nabla u - \nabla p + f \tag{1}$$

$$\nabla u = 0 \tag{2}$$

In above equations, u_t is the smoke fluid velocity vector's temporal derivative. P is the hydrostatic pressure and f is the external forces. Equation (1) is basically Newton's second law. Although this describes smoke behavior well, it does not provide good control of it. The paper brings an improved algorithm based on the previous one and allows us to control the movement of smoke animation.

$$u_t = -u \cdot \nabla u - \nabla p + v_f F(\rho, \rho^*) - v_d u \tag{3}$$

In equation (3), we have a new term F, which is the driving force term to carry the smoke to the defined target density ρ^*. v_f and v_d are control parameters that tune the strength of the driving force and attenuate momentum.

In this project, we will write Matlab or C code to simulate and prove this

algorithm. Next we will be writing Systemverilog and start testing on board. We will also use a computer monitor to display the result. Figure 1 is the simulation result by Raanan Fattal and Dani Lischinski.

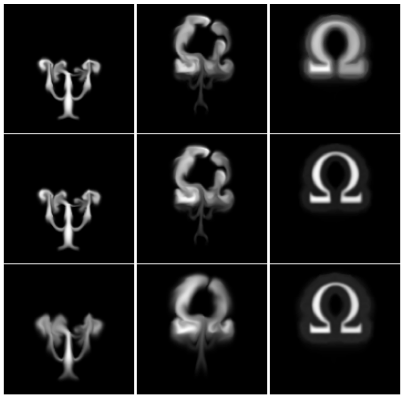

Figure 1: Simulation result

Reference

[1] Fattal, Raanan, and Dani Lischinski. "Target-driven Smoke Animation." ACM Transactions on Graphics 23.3 (2004): 441. Print.