Abstract: Realistic Animation of Clouds

Malina Meher Prabhu Charan, 130050067
Vishnu Theja Rachakonda, 130050065

Problem Statement:

Clouds are an important part of flight simulators, movies, games etc. But rendering realistic looking clouds with real atmospheric phenomena (like shafts of light) in real time (on a relatively normal PC) is an extremely difficult thing. The paper tries to solve this problem.

Challenges in Solving the Problem:

The main challenges involved in this problem are:

1) Anything that can be done in real time on a normal PC is not very realistic.
2) Anything that is realistic (using actual physics) is extremely slow in rendering.
3) Atmospheric phenomena usually need to be generated using raytracing which is a slow rendering process and is not suitable for real time rendering.

Key Idea(s):

The paper uses cellular automata to speed up the simulation. Each cell (which represents a voxel) has 3 logical variables representing vapour, cloud and phase transition. All processes related to clouds (growth, extinction etc.) can be simulated from these variables using simple boolean operations which are extremely fast. This saves on space also since we need only 3 bits per voxel. To achieve a density distribution of clouds, the cloud variable is averaged over the neighbouring voxels.
To increase the speed of rendering (in order to achieve real time rendering), clouds are rendered using a method called splatting. The method is described in great detail in the paper. Shafts of light are rendered using shells and shadow textures.

Result Summary:

As mentioned in the results section of the paper, rendering of a 256x128x20 grid takes about 0.3s per time step and 80KB of storage space overall. Rendering of a 256x256x20 grid with shafts of light, shadows etc., takes 0.5s per time step and 160KB of storage space. This was on quite old machines. The current machines are much more powerful and the whole process can be done at a much faster rate producing real time animations.

Implementation Approach:

Initially, we will start by implementing the simulations since we are not well versed with OpenGL. Near the end of the simulation part, we will start working on the rendering part. Initially, we will render only the clouds. Rendering shafts of light and any other extra work will be done based on availability of time.