Cloth simulation using an enhanced Catmull-Clark subdivision scheme and collision detection in a virtual environment

ABSTRACT

Subdivision surface techniques smoothen the surface of any 3D object by splitting the polygons into smaller sub-polygons. However, most methods of subdivision encounter the same problem when dealing with extraordinary points. This project aims is to implement an enhanced Catmull-Clark subdivision scheme and simulated cloth that can detect and identify the collision of an object against the simulated cloth in a virtual environment. The original Catmull-Clark subdivision scheme was enhanced by manipulating the weights present in the original scheme while adhering to a few rules. The cloth used a mass-spring model to be initialised, and the enhanced subdivision scheme was integrated into this model. Then, the collision detection was performed based on the bounding volume approach, and an appropriate collision response was used to simulate the behaviour of the cloth in real life. Experiments and tests were conducted to evaluate the smoothness of the enhanced subdivision scheme and the computation time. The enhanced subdivision scheme was only able to create an acceptably smooth surface until the second iteration of the subdivision. On the third iteration, noticeable sharp points were present, which indicated that the enhanced subdivision scheme did not improve the original scheme. Additionally, the execution time for the enhanced subdivision scheme was insignificantly longer compared to the original scheme for all the levels of subdivision. The frame rate test showed that the cloth simulation ran at the average rate of 43.572 fps, which was within the acceptable range. In conclusion, this research focuses on creating a cloth simulation that implemented an enhanced Catmull-Clark subdivision scheme and collision detection. However, the proposed enhancement for this scheme can be improved to account for the subdivision at individual cases of extraordinary points.