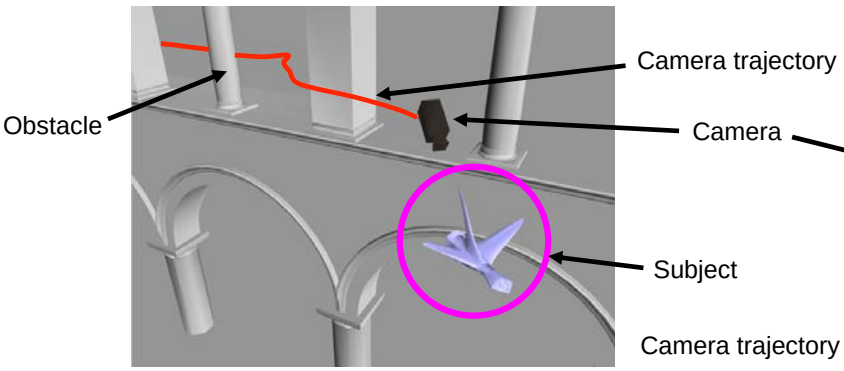
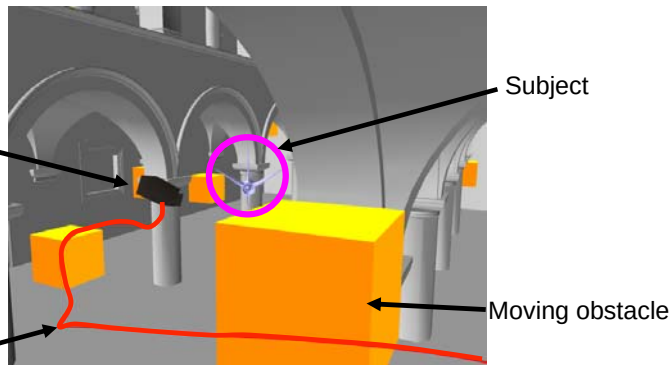
Osaka University

Collision-Free Chase-Camera Movement in a 3D Virtual Environment

Hirofumi Hamazaki[1], Shinya Kitaoka[1], Maya Ozaki[1], Yoshifumi Kitamura[1], Robert W. Lindeman[2], Fumio Kishino[1]
[1] Osaka University {hamazaki.hirofumi, kitaoka.shinya, ozaki.maya, kitamura, kishino} @ist.osaka-u.ac.jp
[2] Worcester Polytechnic Institute gogo@wpi.edu



Camera movement in a static environment

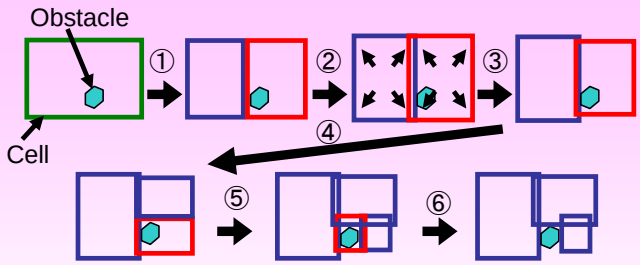


Camera movement in a dynamic environment

We propose a method of generating a camera movement that chases the subject using a hierarchical cell decomposition method. The method is composed of three steps.

STEP1: Creating a roadmap graph in static environments

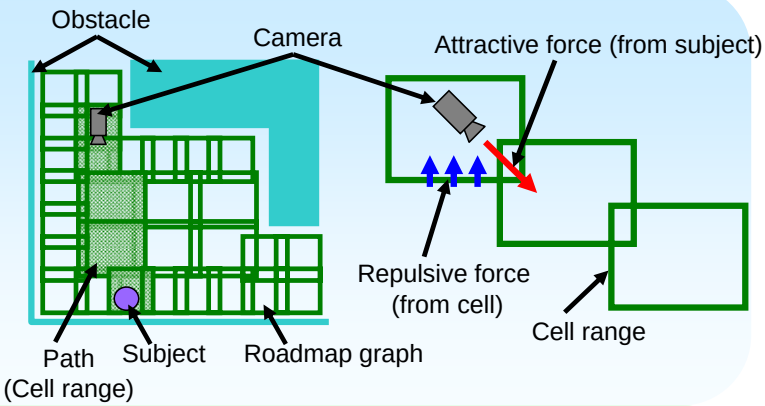
A roadmap graph that is collision-free is created as a set of cells by using hierarchical cell decomposition based on loose kd-tree.
By making the camera move on the roadmap graph, a camera movement that avoids collisions with obstacles is generated.



①Create new cells ②"Loosen" the new cells ③Restore the size of the intersected cell ④Create new cells again ⑤Repeat this process ⑥Remove the intersected cell when the depth of division reaches the maximum loose kd-tree depth

STEP2: Generating a camera movement in static environments

The cell range between camera and subject on the roadmap graph is found by path finding. Because the cell is a convex hull, we can be assured that the subject is in view of the camera when the camera reaches the cell that overlays the subject. And by using A* algorithm, we can find the shortest path. This leads to the attainment of camera movement that avoids occlusion.
Furthermore by applying forces based on Hooke's law to the camera, smooth camera movement is generated.



STEP3: Adapting to dynamic environments

The method for creating the roadmap graph and the method for generating camera movement are slightly modified.
The roadmap graph is changed by detecting any intersections between the graph created for the static environment and any moving obstacles in the scene. By excluding these intersected cells from graph, a roadmap graph that has no cells intersecting moving obstacles is maintained.
The camera movement changes according to a Hooke's law based repulsive force from moving obstacles.