Towards mapping and segmentation of very large scale spaces with intelligent virtual agents

Katrina Samperi, Nick Hawes, Russell Beale

School of Computer Science, The University of Birmingham, UK
[k.samperi][n.a.hawes][r.beale]@cs.bham.ac.uk *

1 Introduction

Intelligent virtual agents are increasingly required to generate and use maps in very large scale environments. One such environment is the virtual world Second Life [1]. Second Life is an ever growing large scale virtual environment where users can interact with, create objects and change the environment in a variety of ways. Creating a virtual agent that is able to build, maintain and use a map of an environment of this scale is a challenging problem.

In very large scale environments it can become necessary to segment the map used by the agent to improve performance. A single monolithic map will often be too large to fit in the memory the agent has available. Attempting to update or use this map for path planning will take more time as the map size increases. We want to segment this map intelligently to reduce the time required for the agent to plan a path between any two points in the environment.

Our hypothesis was that we could improve the segmentation of the map by using trails. Trails are a set of observations of how other avatars, human and AI controlled, move around an environment. It has been shown in previous work that the movement of other avatars can provide information about the structure of the environment [2] and that trail information can be used to help improve the generation of roadmaps in these types of environments [3]. This paper describes our preliminary findings on using this approach for segmentation.

2 Approach

To investigate our hypothesis we compared a single monolithic map with three different segmentation methods. The environment used was a combination of four regions in Second Life, a space 512m^2 in size. To evaluate we compared the time required to finish the segmentation, the planning time between two given points, and the length of the planned path. A good segmentation method would take a short period of time and allow for fast path planning. As segmentation restricts the options available for path planning, a route based on a segment

* The research leading to these results has received funding from the European Community's Seventh Framework Programme [FP7/2007-2013] under grant agreement No. 600623, STRANDS.

map will usually be longer than one planned using a single monolithic map. In these cases the route planned should still be as short as possible.

The four different segmentation methods compared were:

- No segmentation - the base case
- Regular segmentation at various resolutions
- Quadtree segmentation [5] at various resolutions
- Voronoi segmentation [4] using different seed points

Trails were used in conjunction with Voronoi Segmentation. We were able to identify cluster points in the trails, the places where many avatars gather together, and use these for seed points in the algorithm.

3 Results and Future Work

Using no segmentation the total time required to plan the route was 631.01s. The length of the planned route was 1299.11m and the success rate 95%.

We found that the fastest method for segmenting the map was to use regular segmentation. However, routes planned using these maps were nearly 50% longer than with no segmentation. Trail based segmentation generated the map and planned a route quicker than using no segmentation at all, taking 59.64s. These maps planned shorter routes than maps generated using regular segmentation, but the success rate was reduced to 70%. Quadtree segmentation took a long time to complete but, on average, planned the shortest routes.

These results are promising, but not conclusive as to whether trail based segmentation is better for dividing a large scale environment than other methods.

We will to investigate our results further and find out if trails become more useful as the size of the environment increases. Trail based segmentation may be especially useful in dynamic environments, as the environment structure being taken into account may lead to a reduction in the number of segments that need updating as the world changes.

References

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