PATH-COST ANALYSIS & REAL-TIME PATH COMPUTATION IN WEIGHTED REGIONS



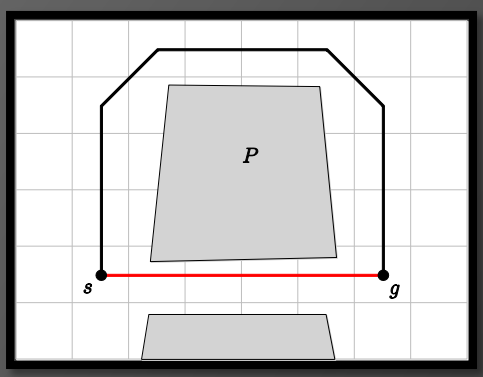
Norman Jaklin
Mark Tibboel
Roland Geraerts

http://www.uu.nl/staff/NSJaklin

Universiteit Utrecht

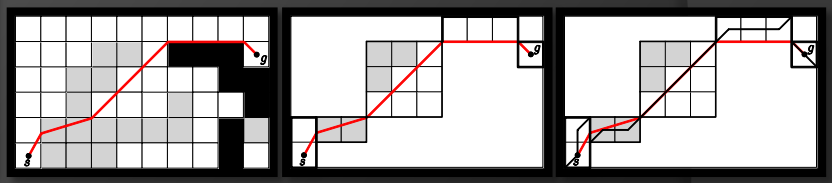
COMMIT/

The *Weighted Region Problem* is defined as the problem of finding a cost-optimal path in a weighted planar polygonal subdivision. Searching for paths on a grid representation of the scene is fast and easy to implement. However, grid representations do not capture the exact geometry of the scene. Hence, grid paths can be inaccurate or might not even exist at all. Methods that work on an exact representation of the scene can approximate an optimal path up to an arbitrarily small ε-error. However, these methods are computationally inefficient and thus not well-suited for real-time applications.



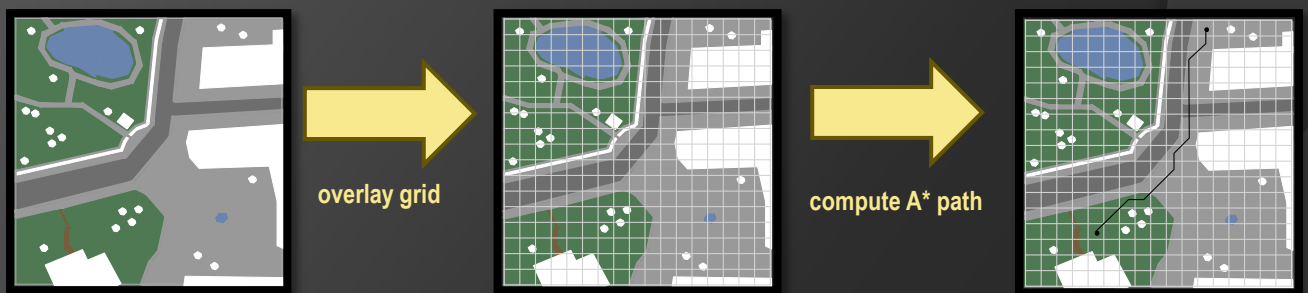
General case: Arbitrarily high cost ratio

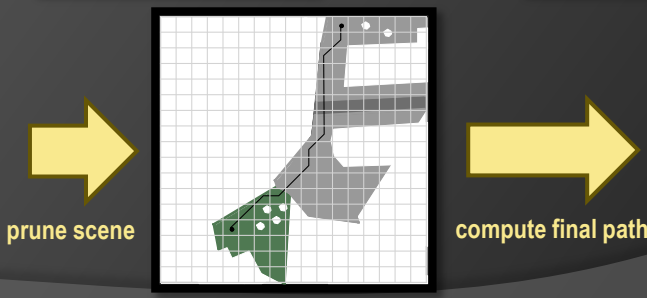
We analyze the quality of optimal paths on a 8-neighbor-grid. We prove that the costs of such a path in a scene with weighted regions can be arbitrarily high in the general case. If all regions are aligned with the grid, we prove that the costs are at most $4 + \sqrt{4 - 2\sqrt{2}}$ times the costs of an optimal path.



All regions aligned with the grid: Bounded path-cost ratio

In addition, we present a new hybrid method called *Vertex-based Pruning* (VBP). VBP computes paths that are ε-optimal inside a pruned subset of the scene. Experiments show that VBP paths can be computed at interactive rates, and are thus well-suited as an input for advanced path-following strategies in robotics, crowd simulation or gaming applications.





Constr. time	Query time
163325.0	1141.1
16857.2	**224.6**
9638.0	127.8
1049.6	**26.8**
1794.7	34.3
351.9	**7.8**
600.6	13.4
245.0	**3.1**
300.4	6.4
225.4	**1.4**

n.s.jaklin@uu.nl mark.tibboel@nspyre.nl r.j.geraerts@uu.nl