Terrain Model acquisition by Robot Teams

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Abstract

The connectivity of the configuration space has been a valuable concept in the motion planning for single robots in both known and unknown terrains. We show here that n-connectivity plays a similar role for mobile robot teams in providing algorithms for terrain model acquisition in unknown terrains. A bound on the connectivity degree of the free space, reflected in that of a navigation course, provides us an estimate of the size of a robot team that is effective for the terrain. The robots are point-sized and equipped with visual sensors that acquire all visible parts of the terrain by scan operations executed from different locations. The performance is measured by the total number of scan operations performed by the robots. We employ the restricted visibility graph methods in a hierarchical setup. For terrains with convex obstacles and for teams of n (= 2, 3 or 4) robots, we prove that the total distance travelled is reduced by a factor of 1/n. For terrains with concave corners, the performance of the algorithm for the n (= 2, 3 or 4) robot team is expressed in terms of the sizes of n-connected components, and the sizes of the (n - 1)-or-less connected components.