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Obtaining High-Dimensional Configuration Space for Robotic Systems Operating in a Common Environment

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Abstract : In this research, a method is developed to obtain high-dimensional configuration space for path planning problems. In typical cases, the path planning problems are solved directly in the 3-dimensional (D) workspace. However, this method is inefficient in handling the robots with various geometrical and mechanical restrictions. To overcome these difficulties, path planning may be formalized and solved in a new space which is called configuration space. The number of dimensions of the configuration space comes from the degree of freedoms of the system of interest. The method can be applied in two ways. In the first way, the point clouds of all the bodies of the system and interaction of them are used. The second way is performed via using the clearance function of simulation software where the minimum distances between surfaces of bodies are simultaneously measured. A double-turret system is held in the scope of this study. The 4-D configuration space of a double-turret system is obtained in these two ways. As a result, the difference between these two methods is around 1%, depending on the density of the point cloud. The disparity between the two forms steadily decreases as the point cloud density increases. At the end of the study, in order to verify 4-D configuration space obtained, 4-D path planning problem was realized as 2-D + 2-D and a sample path planning is carried out with using A* algorithm. Then, the accuracy of the configuration space is proved using the obtained paths on the simulation model of the double-turret system.

Keywords : A* algorithm, autonomous turrets, high-dimensional C-space, manifold C-space, point clouds
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