Report

Motion Planning Applications in Swarm Robotics

Swarm Robotics is a field of robotics that deals with multiple robots working together to solve a common task. This field fascinates me a lot and I hope to work in this field someday. One of the problems Swarm Robotics is trying to tackle is to create various complex solid structures through self-transformation. Here various robots will assemble and connect with each other to make the desired structure. This problem deals with communication between individual robots, robot controls, and most importantly global motion planning. MIT has a project called MBlocks 2.0[1] in Computer Science and Artificial Intelligence Laboratory (CSAIL). They made these small robots in the shape of cubes that are capable of flipping from one face to another and thus moving. They could also jump. Their motion is based on the reaction wheel momentum braking mechanism. These robots(MBlocks) can attach to each other magnetically. A group of M-Blocks can be made to maka a pyramid, a vertical line, bigger cube, other complex structures. Motion Planning plays a very crucial role in this project. No papers have yet been published by them on detailed motion planning research. They are still working on the decentralized control of the robot phase.

Assuming a central computing unit is getting a constant feedback from the MBlocks with their current pose(i..e (x,y) coordinates and orientation), we can design a motion planning algorithm that take a complex structure requirement as an input and generate a motion plan for these individual MBlocks. This problem will all sorts of interesting Motion Planning Challenges. One of such challenges will be to build a vertical line structure we will have to create a temporary support structure using MBlocks as shown in the figure below.

Figure: MBlocks2.0[2]

References:

[1] J. W. Romanishin, K. Gilpin, S. Claici and D. Rus, "3D M-Blocks: Self-reconfiguring robots capable of locomotion via pivoting in three dimensions," *2015 IEEE International Conference on Robotics and Automation (ICRA)*, 2015, pp. 1925-1932, doi: 10.1109/ICRA.2015.7139450.
[2]https://news.mit.edu/2019/self-transforming-robot-blocks-jump-spin-flip-identify-each-other-1030
[3]https://www.youtube.com/watch?v=hI5UDKaWJOo