Motion Planning for collaborative Environments

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An interesting motion planning category for me is safe planning in a human occupied environment. When working with collaborative robotic arms in previous manufacturing positions, these safety systems were based on limiting speed and torque limits of the arm [1]. These methods allowed for a verifiable and repeatable system to protect end users and passer-bys. The issue with this system is the limits. As the system is limited in its speed, its throughput is limited. To address this, there must be safety containment of the robotic units, using physical or virtual fencing, but this is expensive and negates the ability of a robotic system to work with a human.

An interesting possible solution to this is to use motion tracking to map and predict where obstacles(humans) are and where they are heading in the workspace. It then remaps the trajectory around the obstacle and continues, thus allowing it to finish its task[2]. This system works by intaking 3d data from cameras positioned around a workcell, then creating a collison field for the trajectory toi plan around. However This does involve moving the motion planning to the online controller, but the tradeoff is a guaranteed completion of the task. There are still risks and safety concerns with this system, including failsafes that should be built in.

This type of motion planning using visual cues may also be useful for mobile robotics applications. One example of this can be seen in Li et al[3] where there is work to extract 3d information from lidars and other sensor data for autonomous vehicles. In my current position, I work with autonomous quadruped robots, and developing safe paths for them to follow is an important and ever changing task. The robot has on board obstacle avoidance and other safety features, however when the robot malfunctions or is damaged there can be scenarios where these safety systems are rendered inert. The current solution to this is to implement administrative safety precautions , such as training and timed entry into zones for the robot, but a solution that could be used to ensure that even during a failure the robotic system would not have the ability to harm a human or other equipment would be invaluable.

Developing a reliable and safe motion planning strategy for robotic systems is complicated because of the human factor needed to ensure safety in all environments, but a robust solution would be invaluable in many fields.

Sources

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3. D. Li, B. Liu, Z. Huang, Q. Hao, D. Zhao and B. Tian, "Safe Motion Planning for Autonomous Vehicles by Quantifying Uncertainties of Deep Learning-Enabled Environment Perception," in *IEEE Transactions on Intelligent Vehicles*, vol. 9, no. 1, pp. 2318-2332, Jan. 2024, doi: 10.1109/TIV.2023.3297735.