OUTPUT FEEDBACK ADAPTIVE FUZZY DECENTRALIZED CONTROL OF COOPERATIVE ROBOTS

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By development of different industries that utilize robots for complicated tasks, the need for multi-robot systems is increasing in nuclear reactors, environments that are not safe for human activities, assembly application in electronic industries, space robotic applications, underwater applications and other complex tasks.
In cooperation of robots for holding a common object we often seek for two goals: first to move the object center of mass along the desired trajectory and second to exert suitable forces on the object at the contact points.

In another way, according to undesirable effects of using the velocity sensors in the robot structure we use output feedback methods for control of robots.
We propose a decentralized control scheme that uses only the sensory information of each robot to control it without the need for the information of other cooperating robots, and also introduce a control input to achieve the desired performance of the system.
Most of the researches in multi-robot systems have focused on the control of cooperative robots with the exact knowledge of the dynamics equation of each robot introducing the control inputs that are directly dependent on these dynamic vectors and matrices, so it is impossible from practical views because of the structured and unstructured uncertainties in the robot structure. Other methods have considered the robot uncertainties and have introduced control inputs that depend on measuring the velocity and also the acceleration terms that is too expensive and probably impossible from practical points.

So in this paper we introduce a control input that consists of a fuzzy adaptive term to compensate the unknown dynamics of the system and a PD term to improve the transient response of the system and a third term to regulate the force exerted on the object by each robot. Also to avoid the use of velocity sensors in the robot structure we use a nonlinear observer to estimate the velocity of each robot.

Then we propose a theorem indicates using the control input introduced before we can achieve the desired performance in the object center of mass tracking and force regulating problem with the observation error that tends to zero as time increases.
The effectiveness of the control algorithm is illustrated by simulation of a cooperative robot system with two planar and three degree of freedom robots manipulating a common object in a two degree of freedom task space.

Main References

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