High Performance Manipulation

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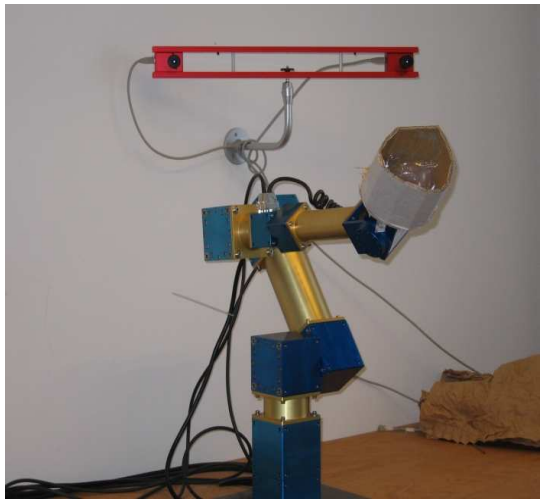
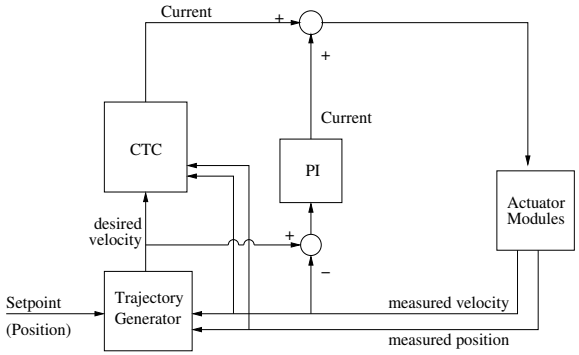
In order to perform experiments with dynamic manipulation, such as ball-catching, we have implemented a system with advanced dynamic performance.

Mechanism Design

Available robots from industry or research institutions are often lacking in terms of end effector acceleration. We have designed and constructed a manipulator using commercial off-the-shelf actuators from Amtec robotics. This is specially designed for high acceleration and highly dynamic manipulation tasks.



Manipulator and camera setup



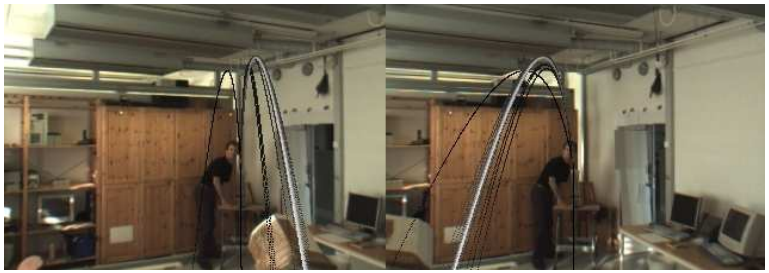
Schematic of controller

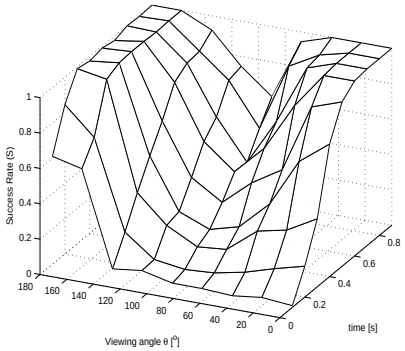
Summary specifications

Total reach	0.91m
Max payload	5 kg
Max end effector velocity	7 m/s
Max end effector acceleration	140 m/s^2
Max power consumption	5 kW
Moving mass	10.6 kg
Control bus	CAN (4 channels)
Control frequency	600/1200 Hz
External connection	UDP/IP
Control space	Joint/Cartesian
Control types	Position/Velocity
Camera resolution	320 x 240 px
Camera frequency	50 Hz

Vision system for tracking

We have examined the impact of camera placement on the performance of an autonomous ball-catching task. Using a Kalman filter to track the ball, we simulate tracking performance with different placements of a stereo camera system and find that the optimal placement is either behind the thrower or behind the catcher (angle 0 or 180 degrees). The system has been verified to track 75% of benevolent throws well enough to catch using our manipulator.





View from the stereo camera system with predictions of ball trajectories overlaid (above).
Success rate of trajectory prediction as a function of angle and time (left).

References:
Mattias Bratt, Christian Smith and Henrik I Christensen. *Design of a Control Strategy for Teleoperation of a Platform with Significant Dynamics,* IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS 2006)

For further information, visit:
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