Mechanical Engineering Master's Defense

Closed-form Inverse Kinematic Solution for Anthropomorphic Motion in Redundant Robot Arms

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abstract

As robots are increasingly migrating out of factories and research laboratories and into our everyday lives, they should move and act in environments designed for humans. For this reason, the need of anthropomorphic movements is of utmost importance. The objective of this thesis is to solve the inverse kinematics problem of redundant robot arms that results to anthropomorphic configurations. The swivelangle of the elbow was used as a human arm motion parameter for the robot arm to mimic. The swivel angle is defined as the rotation angle of the plane defined by the upper and lower arm around a virtual axis that connects the shoulder and wrist joints. Using kinematic data recorded from human subjects during every-day life tasks, the linear sensorimotor transformation model was validated and used to estimate the swivel angle, given the desired position and orientation of the end-effector. Defining the desired swivel angle simplifies the kinematic redundancy of the robot arm. The proposed method was tested with an anthropomorphic redundant robot arm and the computed motion profiles were compared to the ones of the human subjects. This thesis shows that the method computes anthropomorphic configurations for the robot arm, even if the robot arm has different link lengths than the human arm and starts its motion at random configurations.

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