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Asymptotic Robot Manipulator Generalized Inverse Dynamics

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Abstract: The generalized inverse dynamics methodology is improved to yield asymptotic tracking control of robot manipulator's generalized coordinate trajectories. A scalar kinematic norm measure function of generalized coordinates deviations from their desired trajectories is defined, and a servo-constraint on robot kinematics is prescribed by zeroing the deviation function. A stable linear second-order differential equation in the deviation function is evaluated along trajectory solutions of manipulator's state space model equations, resulting in an algebraic relation that is linear in the control vector. The control law is designed by generalized inversion of the controls coefficient in the algebraic relation using a modified version of the Greville formula. The generalized inverse in the particular part of the modified formula is scaled by a dynamic factor that uniformly decays as steady state response approaches. This yields a uniform convergence of the particular part to its projection on the range space of controls coefficient's generalized inverse, and in asymptotically stable generalized coordinates trajectory tracking. Null-control vector in the auxiliary part of the formula is taken to be linear in manipulator's generalized velocities, and is constructed by means of a positive semidefinite control Lyapunov function that involves controls coefficient's nullprojector, providing asymptotic internal manipulator stability over a predetermined domain of attraction.

Keywords: *generalized inversion control; generalized inverse dynamics; asymptotic tracking; semidefinite Lyapunov function; null-control vector.*

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