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NOMENCLATURE

θ_i	Generalized coordinates of joints i.
$\theta_i^{\min}, \theta_i^{\max}$	Free rotation range of joint i (minimum and maximum of θ_i).
θ_2^{lb}	Maximum of rotation range of the joint stop in a clockwise direction.
θ_2^{ub}	Maximum of rotation range of the joint stop in an anticlockwise direction.
$\tau_i^{\max}, \tau_i^{\min}$	Maximum and the minimum active torque of joint i.
t_0, t_f	Time of initial and final position.
$\Gamma_{1,2}$	Driving torque vector.
τ_i	Active torque of joint i.
$\theta_i, \dot{\theta}_i, \ddot{\theta}_i$	Angle, angular velocity and acceleration of joint i.
$M(\theta)$	Inertia matrix.
$N(\theta, \dot{\theta})$	Centrifuge and Coriolis matrix.
$G(\theta)$	Gravity vector.
k_w	Stiffness scalar.
c_w	Damping scalar.
τ_2^{\min}	Minimum passive torque of joint 2.
τ_2^{\max}	Maximum passive torque of joint 2.
\hat{x}_i	Estimated state of x_i .
\bar{x}_1	State estimation errors.
Λ_1, Λ_2	Positive definite constant diagonal matrices.
λ_1, λ_2	Positive constants.
$\ddot{\theta}_r, \dot{\theta}_r, \theta_r$	Angular reference acceleration, angular reference velocity and angular reference position trajectories.
k_p	Diagonal positive definite matrices for proportional gain.
k_v	Diagonal positive definite matrices for derivative gain.
$\dot{\theta}$	Angular velocity tracking error.
$\tilde{\theta}$	Angular position tracking error.