Qu, Zhihua; **Dorsey, John F.**; **Zhang, Xinfan**; **Dawson, Darren M.**

Robust control of robots by the computed torque law. (English) Zbl 0737.93052

Syst. Control Lett. 16, No. 1, 25-32 (1991).

A method is presented for the selection of feedback gains in order to make the computed torque control law, applied to robotic manipulators, robust under bounded, unknowns dynamics. The computed value of the inertia matrix is chosen to be either the estimate of the inertia matrix or any other positive definite matrix. The value of the nonlinear feedforward term is computed using the estimates of the nonlinear dynamics. The feedback gains are constant, and they depend only on the coefficients of a polynomial bound for the unknown dynamics. The resulting error system is shown via Theorem 2 to be uniformly ultimately bounded and stable if a certain constant gain is chosen large enough. Moveover, the tracking error is shown to approach zero asymptotically not only in the limit as the gains go to infinity, but also for the case of finite gains where the static balancing forque inputs are known. Finally a computed torque control law is presented that satisfies the outlined requirements and is simple and easily implementable.

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MSC:

93C85 Automated systems (robots, etc.) in control theory
93B35 Sensitivity (robustness)
70Q05 Control of mechanical systems

Keywords:

robot control; feedback gains; robotic manipulators; computed torque control law

Full Text: DOI

References:

[1] Y.H Chen, V.A. Eyo and H. Stalford, Robust computed torque control of mechanical manipulators: Non-adaptive vs. adaptive, \textit{Proceedings of 1988 American Control Conference}, 1327-1332.

[2] Corless, M.J.; Leitmann, G., Continous state feedback guaranteeing uniform ultimate boundedness for uncertain dynamic systems, IEEE trans. automat. control, 26, 1139-1144, (1981) · Zbl 0473.93056

[3] Craig, J.J., Adaptive control of mechanical manipulators, (1988), Addison-Wesley Reading, MA

[4] Craig, J.J., Introduction to robotics, (1986), Addison-Wesley Reading, MA

[5] Dawson, D.M.; Qu, Z.; Lewis, F.L.; Dorsey, J.F., Robust control for the tracking of robot motion, Internat. J. control., (1990), to appear · Zbl 0708.93057

[6] Gutman, S., Uncertain dynamical systems — A Lyapunov MIN-MAX approach, IEEE trans. automat. control, 24, 437-443, (1979) · Zbl 0416.93076

[7] Qu, Z.; Dorsey, J., Robust tracking control of robust by a linear feedback law, IEEE trans. automat. control, 36, (1991), to appear · Zbl 0754.93054

[8] Z. Qu and J. Dorsey, Robust control of dynamic systems with high order nonlinear uncertainties by using a linear feedback law, submitted to \textit{Internat. J. Robust and Nonlinear Control}.

[9] Samson, C., Robust nonlinear control of robotic manipulators, (), 1211-1216

[10] Samson, C., Robust control of a class of nonlinear systems and applications to robotics, Internat. J. adaptive control signal process, 1, 49-68, (1987) · Zbl 0731.93060

[11] Stewart, G.W., Introduction to matrix computations, (1973), Academic Press New York · Zbl 0302.65021

[12] Vidyasagar, M., Nonlinear systems analysis, (1978), Prentice Hall Englewood Cliffs, NJ · Zbl 0407.93037

[13] X. Wang and L.-K. Chen, Proving the uniform boundedness of some commonly used control schemes for robots, \textit{Proceedings of 1989 IEEE Conference on Robotics and Automation}, 1491-1496.