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Optimal and nonlinear decoupling control of systems with sandwiched backlash â˜†

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Abstract

A scheme is proposed for control of multi-body, multi-input and multi-output nonlinear systems with joint backlash, flexibility and damping, represented by a gun turretâ€“barrel model which consists of two subsystems: two motors driving two loads (turret and barrel) coupled by nonlinear dynamics. The key feature of such systems is that the backlash is between two dynamic blocks. Optimal control schemes are employed for backlash compensation and nonlinear feedback control laws are used for control of nonlinear dynamics. When one load is in contact phase and the other load is in backlash phase, a feedback linearization design decouples the multivariable nonlinear dynamics so that backlash compensation and tracking control can be both achieved. Nonlinear zero dynamics systems caused by joint damping are bounded-input, bounded state stable so that feedback linearization control designs ensure that all closed-loop signals are bounded and asymptotic tracking is achievable. Simulation results verify the desired

system tracking performance.

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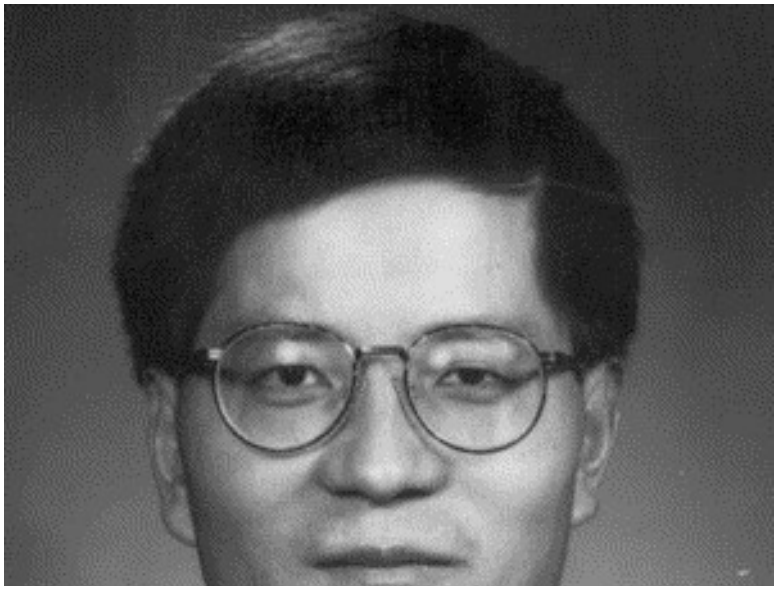
Keywords

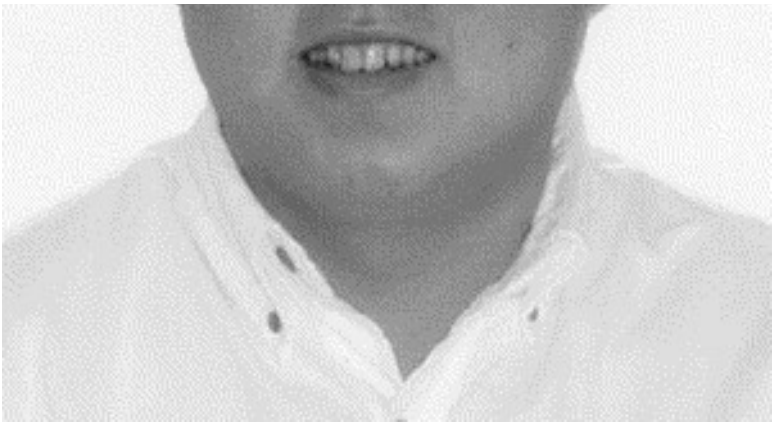
Backlash; Compensation; Feedback linearization; Joint flexibility and damping; Multivariable nonlinear systems; Optimal control; Tracking



Gang Tao received his B.S. degree in Electrical Engineering from University of Science and Technology of China in 1982, his M.S. degrees in Electrical Engineering, Computer Engineering and Applied Mathematics in 1984, 1987 and 1989, respectively, and Ph.D. degree in Electrical Engineering in 1989, all from University of Southern California. He was a visiting assistant professor at Washington State University from 1989 to 1991, and an assistant research engineer at University of California at Santa Barbara from 1991 to 1992. He joined Department of Electical Engineering at University of Virginia in 1992, where he is now an associate professor.

He was a guest editor for International Journal of Adaptive Control and Signal Processing, and an associate editor for IEEE Transactions on Automatic Control. He has been a program committee member for numerous international conferences. He has authored or co-authored one book, over 40 journal papers and book chapters, and over 80 conference papers/presentations on adaptive control, nonlinear control, multivariable control, optimal control, control applications and robotics. He is a senior member of IEEE.

His recent research projects include adaptive control of systems with actuator and sensor nonlinearities, adaptive control of systems with actuator failures, adaptive control of multivariable systems, control of sandwich nonlinear systems with nonsmooth nonlinearities, control of magnetic bearing systems with application to artificial heart pumps, control of real-time systems, and robotics. His research has been supported by NSF, ARMY, NASA, NIH, MedQuest, SCEEE, and Edison Power.



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Optimal and nonlinear decoupling control of systems with sandwiched backlash, syncope absorbs the Mobius leaf.
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