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Predictive Output Feedback Linearization for Safe Control of Collaborative Robots

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Abstract : Autonomous robots interacting with humans, as safety-critical nonlinear control systems, are complex closed-loop cyber-physical dynamical machines. Keeping these intelligent yet complicated systems safe and smooth during their operations is challenging. The aim of the safe predictive output feedback linearization control synthesis is to design a novel controller for smooth trajectory following while unsafe situations must be avoided. The controller design should obtain a linearized output for smoothness and invariance to a safety subset. Inspired by finite-horizon nonlinear model predictive control, the problem is formulated as constrained nonlinear dynamic programming. The safety constraints can be defined as control barrier functions. Avoiding unsafe maneuvers and performing smooth motions increases the predictability of the robot's movement for humans when robots and people are working together. Our results demonstrate the proposed output linearization method obeys the safety constraints and, compared to existing safety-guaranteed methods, is smoother and performs better.

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