Safety-Critical Path-Guided Coordinated Control of Nonlinear Strict-Feedback Multi-Agent Systems via Neurodynamic Optimization*

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***Abstract*—This paper investigates the path-guided coordinated control problem for nonlinear multi-agent systems in strict-feedback form subject to unknown input gains, safety constraints, and limited communication recourse. A safety-critical model-free control approach is proposed to achieve collision-free path-guided coordinated control employing data-driven learning, command optimization, and dynamic event-triggered mechanism. Specifically, an extended-state-observer-aided learning neural predictor is designed to approximate unknown input gains and system nonlinearities without relying on state time derivatives. Then, control barrier functions are formulated as safety constraints to guarantee system safety. A neurodynamic-based command optimization method is developed to generate optimal control signals within safety constraints. Furthermore, a communication mechanism based on dynamic event-triggered is designed to reduce unnecessary communication times, particularly during the transient phase. By utilizing the presented path-guided coordinated control approach, a safe formation is ensured for input-to-state safety. Simulation results are provided to validate the effectiveness of the proposed safety-critical path-guided coordinated control strategy for nonlinear strict-feedback multi-agent systems.**

***Index Terms*—Path-guided coordinated control, data-driven learning, control barrier functions, neurodynamic optimization, dynamic event-triggered communication**

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