

MULTI-AGENT BASED FEDERATED CONTROL OF A CLASS OF NONLINEAR SYSTEMS

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Dedicated to Professor N.U. Ahmed on the occasion of his 75th birthday

Abstract. This paper introduces the general framework of an agent-based federated control motivated by the political structure where partially self-governing states are united by a federal government. A multi-agent based federated control system is composed of local autonomous subsystems (agent-based controllers) that cooperate to provide an overall large-scale system behavior. In this concept, each agent-based controller maintains its own control law for its local stability, and has partial observations of the state of other agents via communication networks. Each agent also locally executes a control law to satisfy the performance requirements at the overall system level. For implementation, we consider the class of mildly nonlinear systems. Overall large scale system stability is analyzed using the Lyapunov's method. Simulation results are presented on the general architecture of controller and the subsystem connectivity for local and global stability.

Keywords. Multi-agent control, federated systems, large scale systems, stability, nonlinear systems.

1 Introduction

Large-scale systems refer to systems that consist of many interconnected local systems requiring a large number of state variables. Systems of this kind appear, for example, in electric power systems, modern industrial applications, robotic systems, communication networks, economic systems, traffic networks and unmanned autonomous vehicles, etc. A large scale dynamic system is characterized by three factors, such as a) high dimensionality, b) high complexity of computation, and c) high search complexity of the control space. Conventional centralized control schemes are not suitable for such large-scale systems because scalability and computational overhead. As the number of subsystems in the large scale systems grows, computational burden for control design also grows accordingly. In addition, there are certain large scale systems that require