ALMUATAZBELLAH BOKER, and ARANYA CHAKRABORTTY, Weisberg Division of Engineering, Marshall University, Huntington, WV, 25755, Electrical Engineering, North Carolina State University, Raleigh, NC 27695. **Distributed control of cyber-physical systems.**

Systems that share a communication network are ubiquitous in this day and age. Examples of such systems include sensor networks, swarms of robots and power grids. In this work, we design a distributed control system for networks that have multiple dense cluster with sparse interconnection structure. The sparsity pattern in such networks naturally gives rise to a time-scale separation in its dynamics, whereby nodes inside a cluster synchronize over a fast time-scale while the areas themselves synchronize over a slow time-scale. Our goal is to design state-feedback controllers for each cluster so that all cluster controllers can cooperate to shape the closed-loop response of the network. A key feature in our design is that every cluster controller needs to design only one aggregate control law to satisfy this objective for the slow system. Applying results from singular perturbation theory, we show that when these individual controllers are implemented on the actual network model, the closed-loop response is close to that obtained from the approximate models, provided that the clustering is strong. The design procedure is demonstrated by a simulation example.