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Observability and Controllability of Networks: Symmetry in Representations of Brains and Controllers for Epidemics[1]

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Observability and controllability are essential concepts to the design of predictive observer models and feedback controllers of networked systems. We present a numerical and group representational framework, to quantify the observability and controllability of nonlinear networks with explicit symmetries that shows the connection between symmetries and nonlinear measures of observability and controllability. In addition to the topology of brain networks, we have advanced our ability to represent network nodes within the brain using conservation principles and more accurate biophysics that unifies the dynamics of spikes, seizures, and spreading depression. Lastly, we show how symmetries in controller design can be applied to infectious disease epidemics.