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Controlling Complex Networks with Compensatory Perturbations SEAN CORNELIUS, Northwestern University, Department of Physics and Astronomy, WILLIAM KATH, Northwestern University, Department of Engineering Sciences and Applied Mathematics, ADILSON MOTTER, Northwestern University, Department of Physics and Astronomy — The response of complex networks to perturbations is of critical importance in areas as diverse as ecosystem management, power system design, and cell reprogramming. These systems have the property that localized perturbations can propagate through the network, causing the system as a whole to change behavior and possibly collapse. We will show how this same mechanism can actually be exploited to prevent such failures and, more generally, control a network's behavior. This strategy is based on counteracting a deleterious perturbation through the judicious application of additional, compensatory perturbations—a prospect recently demonstrated heuristically in metabolic and food-web networks. Here, we introduce a method to identify such compensatory perturbations in general complex networks, under arbitrary constraints that restrict the interventions one can actually implement in real systems. Our method accounts for the full nonlinear time evolution of real complex networks, and in fact capitalizes on this behavior to bring the system to a desired target state even when this state is not directly accessible. Altogether, these results provide a new framework for the rescue, control, and reprogramming of complex networks in various domains.

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