Randomized zero forcing on directed graphs

Jesse Geneson*, San José State University; Illya Hicks, Noah Lichtenberg, Rice University; Alvin Moon, Nicolas Robles, RAND

We introduce randomized zero forcing (RZF), a stochastic color-change process on directed graphs in which a white vertex turns blue with probability equal to the fraction of its incoming neighbors that are blue. In this model, global propagation is not automatic: whether all vertices are eventually colored depends on directed reachability from the initial blue set. We study the expected propagation time of RZF, characterize when it is finite, and establish basic monotonicity properties. We obtain exact values or sharp asymptotics for several families of directed graphs, including complete graphs, stars, paths, and cycles, and we illustrate an application to a weighted input–output network.

Keywords: randomized zero forcing, expected propagation time, input-output graphs