1135-37-2294 **Stephen G. Eubank*** (eubank@vt.edu), BioInformatics Institute, 1015 Life Sciences Circle, Blacksburg, VA 24061, and **Madhurima Nath** (mnath@vt.edu) and **Yihui Ren** (yren2@vt.edu).
An extension of networked dynamical systems suitable for perturbative analysis. Preliminary report.

Networked dynamical systems contain an inherently discrete parameter – the interaction network itself. Deriving macroscopic behavior for networked systems from microscopic interactions is known to be intractable in general, but approximations with provably good error bounds are needed for solving parameter estimation, prediction, and control problems. Unfortunately, discrete problems do not satisfy the continuity constraints required for perturbative analysis. Here, we show how to extend any particular instance of a networked dynamical system $\mathcal{D}$ into a one-parameter family of systems $D(\xi)$ that is amenable to perturbative analysis. By construction, $D(\xi)$ is well-defined for all $\xi \in [0,1]$; $D(1/2) = \mathcal{D}$; $D(0)$ is a simpler system of non-interacting nodes; and $D(\xi)$ is self-dual under $\xi \leftrightarrow 1-\xi$. Solutions for $D(1)$ can be derived from $D(0)$. Solutions for finite systems are finite-degree polynomials in ξ with bounded coefficients. Taylor expansions around the solutions at 0 and 1 can be developed by analyzing minimal cuts and flows in configuration space. Although determining all coefficients exactly requires solving an intractable satisfiability problem, Monte Carlo sampling provides estimates that suffice for most purposes. (Received September 25, 2017)