1145-VP-2785 **L Bookman***, 600 District Ave, Burlington, MA 01803, and **J Ubnoske** and **D Zwillinger**.
Classifying the difficulty of the k-clique problem.

Not all instances of NP-complete problems are equally difficult to solve. For example, the knapsack problem for a superadditive sequence of values (each value exceeds the sum of all preceding values) is solved in linear time using a greedy algorithm; the difficulty of solving an NP-complete problem is dependent on underlying structure in a given problem instance. In 2012, Ercsey-Ravasz and Toroczkai used a dynamical system to exactly solve NP-complete problems. Their difficulty metric (essentially, the log of convergence time) applied to Sudoku puzzles showed strong agreement with human difficulty ratings. Leveraging their approach, we apply machine learning to identify features that contribute to the computational difficultly of a certain NP-complete problem: k-clique. We analyzed nonisomorphic 6-node graphs and found specific graph spectral properties predicting clique problem difficulty; we are studying larger graphs to determine if the characterizations persist. Our goal is to identify features of a given NP-complete problem which are strong indicators of problem difficulty, guiding the appropriate choice of algorithm in each instance. (Received September 25, 2018)