Abstract

A motif is a small graph pattern, and a motif signature counts the occurrences of selected motifs in a network. The motif signature of a real-world network is an important characteristic because it is closely related to a variety of semantic and functional aspects. In recent years, motif analysis has been successfully applied for adapting topologies of communication networks: The motif signatures of very good networks (e.g., in terms of load balancing) are determined a priori to derive a target motif signature. Then, a given network is adapted in iterative steps, subject to side constraints and in a distributed way, such that its motif signature approximates the target motif signature. In this paper, we formalize this adaptation problem and show that it is $\mathcal{NP}$-hard. We present LoMbA, a generic approach for motif-based graph adaptation: All types of networks, all selections of motifs, and all types of consistency-maintaining constraints can be incorporated. To evaluate LoMbA, we conduct a simulation study based on several scenarios of topology adaptation from the domain of communication networks. We consider topology control in wireless ad-hoc networks, balancing of video streaming trees, and load balancing of peer-to-peer overlays. In each considered application scenario, the simulation results are remarkably good, although the implementation was not tuned toward these scenarios.