On the complexity of feedback set problems in signed digraphs

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Abstract

Given a directed graph $G = (V, E)$ and $w : E \to \{-1, +1\}$ a sign function on the arcs of G, we study the complexity of positive (resp. negative) feedback vertex set problem, denoted by PFVS (resp. NFVS), which consists on finding a minimum cardinality set of vertices that meets all the cycles with an even (resp. odd) number of negative arcs, and the analogous problems for arc sets. PFVS is closely related with the number of steady states of Regulatory Boolean Networks. In particular, we prove that all of these problems are NP-complete, even fixing the in-degree of all vertices of G in at most 2. Moreover, we prove that exists a different complexity between NFVS and PFVS when fixing the amount of negative arcs. Finally, we study these problems in particular regulatory networks: Networks with local monotone functions and Kauffman's networks. We prove that PFVS and NFVS are NP-complete in all of them.