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Editing Graphs into Disjoint Unions of Dense Clusters

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In the Π-Cluster Editing problem, one is given an undirected graph G, a density measure Π, and an integer $k \geq 0$, and needs to decide whether it is possible to transform G by editing (deleting and inserting) at most k edges into a dense cluster graph. Herein, a dense cluster graph is a graph in which every connected component $K = (V_K, E_K)$ satisfies Π. The well-studied Cluster Editing problem is a special case of this problem with Π :="being a clique". In this work, we consider three other density measures that generalize cliques: 1) having at most s missing edges (s-defective cliques), 2) having average degree at least $|V_K| - s$ (average-s-plexes), and 3) having average degree at least $\mu \cdot (|V_K| - 1)$ (μ-cliques), where s and μ are a fixed integer and a fixed rational number, respectively. We first show that the Π-Cluster Editing problem is NP-complete for all three density measures. Then, we study the fixed-parameter tractability of the three clustering problems, showing that the first two problems are fixed-parameter tractable with respect to the parameter (s, k) and that the third problem is W[1]-hard with respect to the parameter k for $0 < \mu < 1$.

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