A Fixed Parameter Tractable Approximation Scheme for the Optimal Cut Graph of a Surface

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Abstract: Given a graph G cellularly embedded on a surface Σ of genus g, a cut graph is a subgraph of G such that cutting Σ along G yields a topological disk. We provide a fixed parameter tractable approximation scheme for the problem of computing the shortest cut graph, that is, for any $\varepsilon > 0$, we show how to compute a $(1+\varepsilon)$ approximation of the shortest cut graph in time $f(\varepsilon, g)n^3$.

Our techniques first rely on the computation of a spanner for the problem using the technique of brick decompositions, to reduce the problem to the case of bounded tree-width. Then, to solve the bounded tree-width case, we introduce a variant of the surface-cut decomposition, which may be of independent interest.