On Minimal Cuts in Ladder Graphs

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Abstract

In this paper, we consider a *ladder graph*, denoted by L_n, which represents a planar graph with $2n$ vertices and $3n - 2$ edges. It can be visualized as a "ladder" with n rungs, formed by connecting two parallel paths of length n with n additional edges (the rungs). We study *minimal cuts (min-cuts)*, defined as minimal sets of edges whose removal disconnects the target from the source, in ladder graphs. The deletion of any edge from a min-cut turns it into a non-cut. We explore the structure of min-cuts in both directed and undirected versions of a ladder graph and estimate their number and sizes. We show that L_n has n^2 min-cuts of sizes from *2* to n and demonstrate the distribution of the min-cuts by their sizes. In addition, using the above results, we estimate the time complexity of the algorithm that computes *st-connectedness* for a probabilistic directed ladder graph (the probability that there exists a path of operating edges between the source and the target in the graph). The running time of this algorithm for a directed L_n *is* $O(n^5)$.

Keywords

Ladder graph, min-cut, probabilistic graph, st-connectedness.