Abstract

The dual representations of planar graphs have many applications in real life world. Among planar graphs, rectangularly dualizable graphs (RDGs) realize very nice geometric representations. An RDG is a planar graph that admits a rectangular partition where a rectangular partition (also called rectangular dual) is a partition of a rectangle into n-rectangles. The use of RDGs can be seen in cartogram maps, floorplans for VLSI circuits and building architecture. In this thesis, we study planar graphs which can rectangularly be dualized, i.e., can be realized by rectangular partitions. We mainly develop various methods of transformations among rectangular duals.

Constructing an optimal rectangular floorplan (rectangular partition) for VLSI circuits or for complex building structures is a challenging problem due to their large sizes. A VLSI system structure or a floorplan can be described by a graph where vertices correspond to component rectangles and edges correspond to their required connections. The theory of rectangular dualizable graphs helps in deciding whether a rectangular floorplan can be realized from a given graph and therefore in this thesis, we study rectangularly dualizable graphs and derived a necessary and sufficient condition for a plane triangulated graph to be an RDG.

We further introduce techniques for transforming a rectangular dual into another using the notion of graph theory. It is done by introducing the concept of edge-reducible RDGs and irreducible RDGs. We have derived a necessary and sufficient condition for an RDG to transform to an edge-reducible RDG and also proposed a necessary and sufficient condition for an RDG to be edge-irreducible RDG. We also present a polynomial time algorithm for their constructions. In this direction, we have also presented a necessary and sufficient condition for an RDG to admit a unique rectangular dual upto combinatorial equivalence.

Cartograms have several natural abstract settings. Among them, the most common is the proportional contact graph representations in which areas of some geographic regions of a land are assigned to its vertices and neighborhood relations of the regions are represented by its edges. A rectangular cartogram can represent more than one quantities if it is an area-universal rectangular dual of a plane graph. It is suspected that the problem of constructing an area-universal rectangular dual for an arbitrary plane graph (if it admits) is NP-hard.

At the end, we have identified an important class of planar graphs wherein each

planar graph admits an area universal rectangular dual in polynomial time. Every RDG of this class is characterized by the fact that every induced subgraph of each of RDGs can be realized by an area-universal rectangular dual upto combinatorial equivalence.