PARTITIONING TECHNIQUE FOR TRANSFORMATION OF CONNECTED GRAPHS INTO SINGLE-ROW NETWORKS

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ABSTRACT

In this paper, we present our work called Connected Graph Sequence (CGS) which transforms a partially dense graph into the single-row network. Partially dense graph is a graph where a number of connected components, namely subgraphs, are connected by some links and each subgraph has a higher density value compare to the graph. The transformation is necessary in applications such as in the assignment of telephone channels to caller-receiver pairs roaming in cells in a cellular network on real-time basis. In this channel assignment application, each caller and receiver in a call is treated as a node, while their pair connection is treated as the edge. A specific case of the graph in the form of a partially dense graph is then transformed into its corresponding single-row network for assigning the channels to the caller-receiver pairs.

Keywords: Partially dense graph, Single-row network, Transformation, Subgraph, Graph partitioning

INTRODUCTION

Single-row routing problem has been shown to be NP-complete problem (Ting et al., 1976). The optimum solution is not easy to be determined. For this reason, Kuh et al. (1979) had developed the necessary and sufficient condition for optimum single-row routing problem (Ting et al., 1976; Kuh et al., 1979). In Tarbg et al. (1984), a partitioning strategy was proposed to group the nets into zones which produces some reasonably good solutions for some restricted models. Bhattacharya et al. proposed a new approach based on graph theoretic representation in Bhattacharya et al. (1988) which relates the intervals of the single-row network with the overlap and interval graphs to solve the single-row routing problem.

A model called Enhanced Simulated Annealing Technique for Single-Row Routing (ESSR) was proposed in 2002 to optimize the network by minimizing both the congestion and number of doglegs (Salleh et al., 2002). Based on the simulated annealing technique (Kirkpatrick...
et al., 1983), the energy function in ESSR is a function of the height of the segments of the nets in the single-row network. The technique has been applied to produce optimal solutions to all net sizes.

Our present work focuses on a special type of graph called partially dense graph. Partially dense graph is a graph where a number of connected components, namely subgraphs, are connected by some links and each subgraph has a higher density value compare to the graph. We focus on the transformation of partially dense graph into its single-row representation before applying ESSR for optimal results.

**MAIN RESULTS**

A program has been developed based on the CGS model’s algorithms using Microsoft Visual C++ 6.0. The CGS model has been applied for partially dense graph with different sizes and graph densities. This specific type of connected graph has the property where it can be partitioned into a number of vertices sets and each set has a higher density value than the graph. The simulations are run and compared by two models from our previous works, STCGM and DSA.

The simulations show CGS model gives the best result compared with STCGM and DSA models for graph with sizes ranging from 10 to 30 and densities ranging from 0.1 to 0.6 except the case where the graph is a tree. The results for each size and density of graph from three different methods are being presented in Figure 1 accordingly. It is clear that the energy values are proportional related to the size and density of graph for all three methods.

![Results Comparison for graph n=10](image1)

![Results Comparison for graph n=20](image2)

**CONCLUSION**

Partially dense graph is a graph which can be partitioned into a number of vertices sets where each set has a higher density degree compare to the graph. Based on the properties of partially dense graph, our work proposes a new technique for transforming a partially dense graph into a single-row network. We proposed a new model called Connected Graph Sequence (CGS) which includes three steps, namely, the graph partitioning, and its arrangement. The nodes are then mapped to zones and terminals of the single-row network. The terminals produced from CGS are arranged optimally based on the properties of the partially dense graph, and this leads into the formation of intervals or nets in the single-row network. We then apply our earlier simulation model to the intervals called ESSR to produce an optimal single-row network by minimizing the energy. The simulations show CGS is outstanding in terms of results since it produces optimal results in each case for minimum energy in the final realizations.

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REFERENCES


NOTE on References:

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