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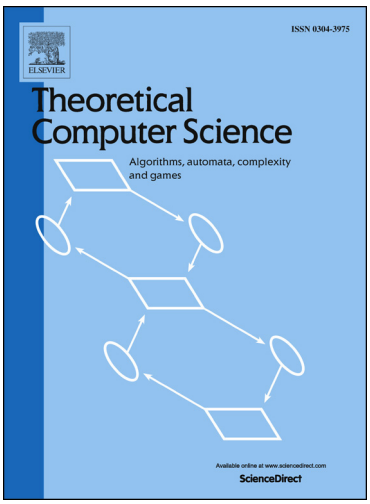

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A linear algorithm for a perfect matching in polyomino graphs

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Abtract In this paper, we present a linear algorithm to find a perfect matching in a polyomino graph or show that there are none.

1 Introduction

A polyomino graph is a connected finite subgraph of the infinite plane grid such that each finite face is surrounded by a regular square of side length 1 (called a cell) and each edge belongs to at least one cell. A *perfect matching* or 1-$factor$ of a graph G is a set of independent edges of G covering all vertices of G. An edge of a graph G is said to be *allowed* if it lies in some perfect matching of G and $forbidden$ otherwise. Given a matching M in a graph G, an M-alternating cycle is cycle in G whose edges are alternately in M and not in M.

A perfect matching is also called a Kekulé structure and plays an important role in resonance theory in chemistry. Problems such as determining the number of perfect matchings or deriving necessary and sufficient conditions for the existence of perfect matchings have been extensively studied for various types of molecular graphs. For example, Kostochka [7] and Zhang *et. al.* [6, 8], independently obtained necessary and sufficient conditions for the existence of perfect matchings in hexagonal systems. And later in [2], Hansen and Zheng have developed a linear algorithm for finding a perfect matching in hexagonal system. Zhang and Zhang [4] have obtained necessary and sufficient conditions for the existence of perfect matchings in polyomino graphs. Methods such as "Pfaffian method" and "Z-transformation" [5] may be used to determine the number of perfect matchings in a polyomino graph. However, at this stage, there is no linear algorithm for finding perfect matchings in a polyomino graph.

The following was defined in [4].