8k-ary Grid Graph Modeling of the Rectangular Dissections

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Abstract - Rectangular and rectangular piped dissections are commonly used as structures in information processing. Among them are tabular forms in document processing, tables in spread sheet processing, land forms in GIS and raster data in CG. We note that such transformation often include ruled line preserving transformations.

This paper deals with graph modeling of rectangular and rectangular piped dissections with respect to ruled line oriented transformation. We survey octal, hexadecimal and tetracosa grid graph representation of rectangular and rectangular piped dissections. Moreover, each cell unification of these grid graph representations runs in O(1) time, since the number of links around a node is bounded by 8, 16, 24, respectively.

Keywords: modeling of spreadsheets, rectangular dissections, rectangular piped dissections, ruled line oriented transformations

1 Introduction

This paper deals with graph modeling of rectangular and rectangular piped dissections with respect to ruled line oriented transformation such as the tabular form editing in document processing and LOD problems (see e.g. [6]). While, rapid rendering requires rapid transformation among multi resolution graphics.

Quadtrees and octrees are well known graph models for rectangular and rectangular piped dissections, respectively. Those data structures are originally introduced for information retrieval in CG. So, those require rather large computation time and rather complicated program structures for ruled line oriented transformation. In this paper, we survey octal, hexadecimal and tetracosa grid graph representation of rectangular and rectangular piped dissections.

2 Octgrids for the rectangular dissections

We introduced octal degree heterogeneous grid graphs, called octgrids (see e.g. [2, 5, 6]), that represent heterogeneous rectangular dissections, and provide efficient algorithms for ruled line preserving transformation of CG objects.

The octgrid for a rectangular dissection D is defined informally as follows: Each node in octgrid corresponds to one rectangle (cell) in D. Two nearest nodes are linked if the corresponding two cells in D are nearest and have a ruled line in common as in Figure 1. Figure 2 shows a rectangular dissection and the corresponding octgrid.

Figure 1. Links around a node in an octgrid.

Figure 2. A rectangular dissection (left) and its corresponding octgrid (right).

Accordingly, we obtain a cell unification algorithm that runs in O(1) time. From these properties, we obtain efficient resolution reduction algorithms that provide 3D maps with the appropriate resolution [6].

3 Hexadeci-grid for the multi-layer rectangular dissections

We generalized octgrids in order to represent multi-layer rectangular dissections and introduced hexadecimal grid graphs called hexadeci-grids (see, e.g. [4]), that are applied to multi-page books in spread sheet languages (see, e.g. [1]) and stratum maps in GIS for example. Two nodes in a hexadeci-grid are linked horizontally as in an octgrid, and linked vertically if corresponding two cells are nearest and have a corner in common. Figure 3 shows links around a node in hexadeci-grid. Figure 4 shows a multi-layer rectangular dissection and its corresponding hexadeci-grid [4]. Figure 5 shows a concept of the multi-layer rectangular dissection and a multi-page book.
4 Tetraicosa-grids for the rectangular piped dissections

Furthermore, we generalized hexadeci-grids and introduced 24-ary grid graphs called tetraicosa-grids (see, e.g. [3]) which represent the rectangular piped dissections for voxel representation. Two nodes in a tetraicosa-grid are linked if the corresponding two voxels are nearest and have a beam in common. Figure 6 shows links around a node in a tetraicosa grid. We show a rectangular piped dissection and the corresponding tetraicosa-grid in Figure 7.

5 Properties

Each cell unification of octgrids, hexadeci-grids and tetraicosa-grids runs in $O(1)$ time, since the number of links around a node is bounded by 8, 16, 24, respectively. From these properties, we can show that 8k-ary grid graph model provide rapid ruled line preserving algorithms (e.g. [3, 4, 6]).

6 Conclusion

We surveyed 8k-ary ($k=1, 2, 3$) grid graph models for the rectangular and rectangular piped dissections. The authors would like to thank Professors Kinio Sugita of Tokai University, Goro Akagi of Kobe University and Kensei Tsuchida of Toyo University for their valuable suggestions. They also thank Mr. Kenshi Nomaki, Mr. Yuki Shindo, and Ms. Chiaki Arai of Nihon University.

7 References


