



2014 AASRI Conference on Circuit and Signal Processing (CSP 2014)

Three-Dimensional Reconstruction from Projections Based On Incidence Matrices of Patterns

Zakharov Alexei, Zhiznyakov Arkady*

Murom Institut, Vladimir State University, Murom, 602264, Russian Federation

Abstract

Task of automatic reconstruction of three-dimensional objects by drawing views presented. The algorithm based on a boundary representation of three-dimensional models. The algorithm consists of the following steps: automatic separation of the drawing per the views, determination of three-dimensional coordinates of vertices, definition and marking of wire model primitives, reconstruction of model faces and model elements. The fundamental concept of the algorithm is to find the structural elements of three-dimensional model with usage of pre-specified patterns. The templates are described by means of matrices. Matching algorithm uses invariants: the number of vertices, type of edges.

© 2014 The Authors. Published by Elsevier B. V. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/3.0/>).

Peer-review under responsibility of Scientific Committee of American Applied Science Research Institute

Keywords: three-dimensional reconstruction, CAD-system, incidence matrix.

1. Introduction

For the moment, a large number of the technical drawings, submitted in both paper and electronic form are accumulated in the archives of the enterprises. An additional point is that the development of many objects often begins with the drawing instead of three-dimensional model usage. Two-dimensional drawings are often

* Corresponding author. Tel.: 8(49234) 77236.

E-mail address: aa-zaharov@ya.ru.

difficult to understand, they are inconvenient to update and the ones can not serve as a basis for further developments with computer systems usage.

The three-dimensional computer model of the object, which can be used for development of supervisor programs, engineering analysis, visualization, etc., is one of the components of electronic model of product. The modern CAD-systems have the following bevy of tools to generate the three-dimensional models “with a clean slate”: Boolean operations, the operations of object-oriented modeling, 2.5D-operations, modification operations of vertices, edges and faces. Practically all CAD-systems allow the generation of drawings with usage of three-dimensional model. However, generation of three-dimensional model per drawing causes the designers difficulties, related to the lack of software.

2. Survey of algorithms of three-dimensional reconstruction per technical drawing

All algorithms of three-dimensional models regenerating per drawings can be divided into two groups: CSG- and B-rep approaches. CSG-oriented (constructive solid geometry) approach uses “top to bottom” regenerating strategy (Geng, 2002; Cicek, 2004; Lee, 2005; Wang, 2007; You, 2008; Xie, 2009). The approach is based on the fact that each three-dimensional object can be built with usage of specific two-dimensional primitive in a hierarchical manner. Patterns are found in the drawing, which will serve as a base and they will be used for transformation into three-dimensional model. That done, the designed primitives are collected in the resulting three-dimensional model, using the Boolean operations. The disadvantage of CSG-oriented approach is the fact that with its usage it is difficult to recognize the basic primitives on complex drawings. As well as, it is difficult to imagine the surfaces of complicated shape, when using the CSG-geometry.

B-rep-oriented (bounding representation) approach uses “ascending” technology. B-rep-oriented algorithms generally consist of the following steps: generation of possible three-dimensional vertices from drawing; edges synthesis per received coordinates of vertices; design of faces from edges, lying in plane; the formation of three-dimensional object from faces (Masuda, 1997; Shin, 1998; Watanable, 1998; Liu, 2001; Golovin, 2007).

Boundary representation provides considerable opportunities for modeling of object complex geometry, it is impossible to reach when using of CSG-approach. However, when using B-rep-representation the more storage space for storage and processing of data is required. An additional point is that, the created model is logically less stable, in other words it is possible to build controversial configurations.

The existing algorithms of reconstruction per drawings are characterized by the following characteristics: the degree of operator involvement in the reconstruction process, the surfaces geometry, the number of views on the drawing, the possibility of error correction, the sections processing, etc.

The analysis has shown that existing approaches are generally designed for the objects with sufficiently simple geometry. These algorithms often do not allow performing of reconstruction of polygonal surfaces, fillets, slots, holes. In this paper the algorithm, which allows recognizing these structural elements on the basis of predetermined patterns, is presented.

3. Automatic reconstruction algorithm using patterns

Presented algorithm is developed on the basis of B-rep-representation that provides the significant opportunities as to the description of the complex shape geometry. The fundamental concept of the algorithm is to find the structural elements of three-dimensional model with usage of pre-specified patterns. The templates are described by means of matrices. On the basis of the patterns, such elements as holes, slots, chamfers, etc. are described.

Download English Version:

<https://daneshyari.com/en/article/568225>

Download Persian Version:

<https://daneshyari.com/article/568225>

[Daneshyari.com](https://daneshyari.com)