Dimension sets detection in technical drawings*

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Abstract

This paper is primarily devoted to an algorithm for detecting dimension sets in engineering drawings that are drawn to ISO drafting standards. Our approach joins those starting with detection of dimension text while most methods are started with the detection of arrowheads. First, we detect among the segments and arcs resulting from the vectorization process those that fulfill some location constraints. A number of segments and arcs are chosen to be candidate parts of dimension lines according to the position and the geometry of their presumed witness lines. We establish the link between the candidates and the detected primitives which are in correspondence with text blocks. Complete dimension lines are found using tracking and fusion processes. Arrowheads are then located thanks to the position of witness and dimension lines. Experimental results are presented.

1 Introduction

A very important research topic in Computer-Aided Design (CAD) is the recognition and understanding of engineering drawings. Primitives such as straight line, arc, circle, etc., are used in engineering drawings to describe the shape and structure of an object. Dimension is an essential part of an engineering drawing that provides the exact size of the object and other important technical information. Therefore, recognizing dimension sets in an engineering drawing is a prerequisite for the recognition and understanding of engineering drawings.

Wesley [17], Lysak [12] and Haralick [9] have given some approaches for the 3D rebuilding of an object starting from a 2D set of sights. Their approaches were already based on the assumption that the separation of dimension elements from an object of a document is already operational.

In the field, one particularly notices the work of D. Dori and A. Pnueli [7] on a web grammar for dimension sets. A morphological and functional classification of dimension sets is presented there. Dimension sets are represented there in the form of web grammars described by undirected graphs whose nodes are labeled. These grammars describe the relationships between the graphic sub-elements of various types of dimensional entities. Later, the need for a basic classification of the lines (including dimension lines) was clearly felt in [6]. In addition, a more formal structure was used to represent a potential dimension set in an image. This structure contains some recording of completude, standard, regularity, symmetry and the type of dimension set, and aims to match between the grammar and the geometry of the drawing.

Tang *et al.* [14] proposed a system, similar to the one of Dori, based on a web grammar as well. They proposed parallel detection of arrow using a matching process with several models. Matching arrows have been also adopted for an interpretation of dimension sets strongly inspired by the work of D. Dori on the dimension sets in conformity with ANSI standard. Indeed S. Collin [3, 4, 1] has taken the same approach again and applied it on dimension sets in conformity with ISO standard. However, one notes her choice for a plex-grammar suitable for the definition given to dimension sets as being a whole of under-form connected by one or more particular points. In addition she described a model of arrows for the technical drawings. The angle between two lines of the model is evaluated and used to find small pairs of segments having a similar angle in the whole image. The confirmation of the assumption of membership of these segments to arrows is made thanks to *a priori* knowledge on the vicinity.

Lai and Kasturi [10] presented a method operating on technical drawings which respect ANSI standard. After the analysis of components and the application of the Hough transform to find the alignment of characters and thus to reconstitute the string, the result is then filtered according to some rules to reduce the detection error rate. Exploiting the fact that the thickness of an arrow varies in an increasing or decreasing way according to the direction one moves, Lai and Kasturi were able to calculate the parameters of their model. Starting from each detected arrow, the

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