GREC'09 Arc Segmentation Contest: A Proposition

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Abstract

Empirical performance evaluation of raster to vector methods is an important topic in the area of graphics recognition. By studying automatic vectorization methods we can reveal the maturity of the tested methods whether as a research prototype or a commercial software. Arc Segmentation Contest held in conjunction with the eighth IAPR International Workshop on Graphics Recognition (GREC'09) is an excellent opportunity for researchers to present the results of their proposed raster to vector methods. The contest provides a uniform platform where the output of different methods can be analyzed. The relevance of the contest is further revealed by the creation of new test images with their ground truth data. Hence, researchers with raster to vector methods are encouraged to participate in this contest. This paper presents the plan and suggestions for the intended contest.

Keywords: Performance Evaluation, Graphics Recognition, Raster to Vector Methods, Line Drawings.

1 Introduction

The Arc Segmentation Contest 2009 is the fifth in the series of contests and to be held during GREC'09, City University of La Rochelle, France, July 22-23, 2009. It will be organized by School of Computer Sciences, Universiti Sains Malaysia, Malaysia. The most recent contest was held during GREC'07, Curitiba, Brazil, September 20-21, 2007 and was organized by Image Understanding and Pattern Recognition (IUPR) research group, University of Kaiserslautern, Germany.

In the next paragraphs a short synopsis for each of the previous reports of arc segmentation contests are presented. Note that, the first two contests were called dashed-line detection contests rather than arc segmentation contests.

GREC'95: Bin Kong et al. [1] performed dashed-line detection contest on a set of synthetic images.

GREC'97: Chhabra and Ihsin [2] evaluated the performance of participating methods in dashed-line detection contest. Solid and dashed lines, solid and dashed circular arcs, and segmentation of text were evaluated in the contest. Only synthesized images were used. Many performance matrices were used to judge the performance of the segmentation/detection.

GREC'99: Chhabra and Ihsin [3][4] evaluated the performance of four vectorization software: one research prototype (VrLiu) and three commercial software (Scan2CAD, Vectory, TracTrix). Ten real scanned images are used in the test (five mechanical engineering drawings and five architectural drawings). $EditCost\ Index$ was used as the criterion of the performance. Continuous straight lines, circular arcs, and text regions were evaluated.

GREC'01: Liu et al. [5] evaluated the performance of two research prototypes (TIF2VEC and RANVEC). Seven images were tested (four synthesized and three real scanned). Different types of noise are used (Gaussian noise, high frequency, hard pencil, geometrical noise). Vector Recovery Index (VRI) is used to measure the performance of the methods. Only solid circular arcs were included in the test.

GREC'03: Liu [6] evaluated two research prototypes (Elliman's and JiQiang's algorithms). Twelve images were used (eight real scanned images, four synthesized images created by adding noise to the real scanned images). VRI was used to measure the performance of the methods. Only solid circular arcs were tested.

GREC'05: Liu [7] evaluated three research prototypes (TIF2VEC, RANVEC, and Keysers & Breuel methods). Eighteen test images were used in the test (six real scanned and twelve synthesized images created by

adding salt and pepper noise to the six real images). The VRI was also used but with slightly modified formula ($VRI = \sqrt{D_v * (1 - F_v)}$) to avoid the case of scoring when no (or very small) arcs could be detected. Only continuous circular arcs were considered in this contest.

GREC'07: Shafait et al. [8] evaluated the performance of four vectorization methods: one research prototype (Wenyin's methods) and three commercial software (VPstudio, Scan2CAD, Vectory). Five real scanned images (with no artificial noise) were used in the contest. A recent performance evaluation method ($vectorial\ score$) is the criterion used to judge the quality of vector detection. The calculation of $vectorial\ score$ required the ground truth data be represented in color pixels. Only solid circular arcs were considered in this contest.

This paper presents what we have planned for the contest and other possible suggestions and recommendations. The rest of the paper is organized as follows. Section 2 shows how ground truth images are created. Section 3 provide the two suggested methods to degrade test images. In Section 4, the method of participation in this contest is provided. Section 5 shows the criterion to be used for performance evaluation. Section 6 shows the type of running the contest. Section 7 presents the summary and suggestions.

2 Generating Ground Truth Data

Ground truth data are generated for the contest by selecting a set of mechanical engineering drawings are selected from two text books [9][10]. Color images are obtained by scanning the paper drawings using 450 DPI each. The images are then converted to grey level images using ImLab imaging software [11]. A total of 12 binary images are obtained by thresholding the grey images. Seven images are selected as test images (to be provided to the contestants), five images will be used as training images. Training images are shown in Figure 1 and could be downloaded with their corresponding ground truth data using this link `{http://www.cs.usm.my/arcseg2009/ArcSeg2009-train.zip}`. The ground truth images for test and training images are created by manual measurement of the primitives' parameters. Only circles and circular arcs were included in the ground truth files. The attributes (centers and radii) of the arcs are measured in pixels. The images are diverse in terms of graphics complexity as well as in the number of graphical entities. However, images with high complexity are selected as test images.

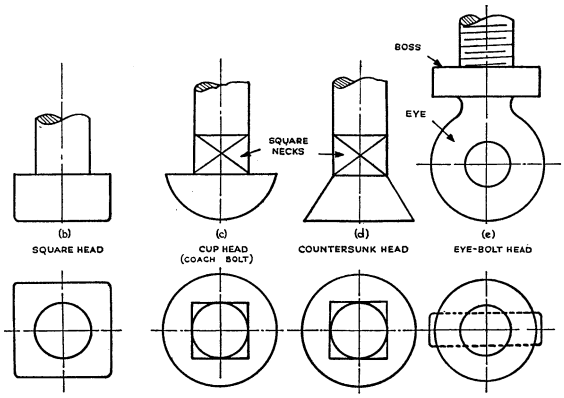
3 Degradation of Test Images

Although there is no full agreement among researchers on using degradation models (see comments of Karl Tombre [12]). However, artificial noise may be used in this contest. Kanungo degradation [13] (by means of Qgar software [14]) or Gaussian noise (by means of ImLab software) may be used to distort the source images.

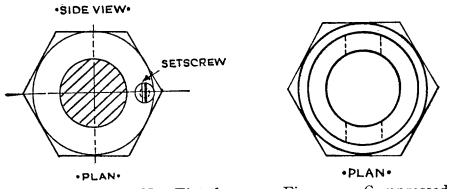
4 Method of Participation

Research prototypes as well as commercial software are accepted in this contest. The participants is preferably provide us the output of the vectorization methods in VEC format [15]. However, output in DXF format is also acceptable. Interested parties may contact the authors of this paper via e-mails. More information on the contest is provided on the accompanying website (`http://www.cs.usm.my/arcseg2009/`). At present, we have one research prototype [16] and three commercial software (VPstudio 8 [17], Scan2CAD 7.5d [18], Vectory 5.0 [19]).

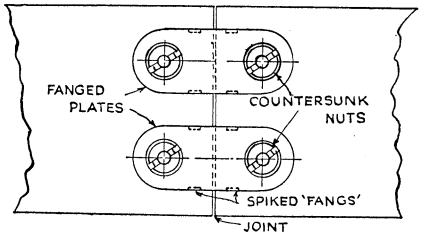
We are particularly interested in performing within-method comparison i.e. studying the performance of different versions of the same method (developed over time) to gauge the improvement in the performance of line detection. Therefore, participants are strongly encouraged to submit results that are based on various versions of their methods.



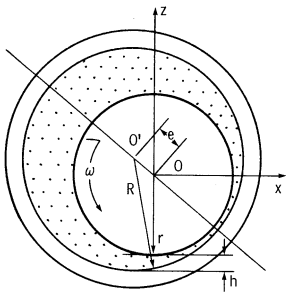
(a) Image P013.tif



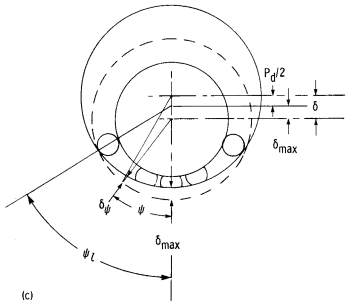
(b) Image P037.tif



(c) Image P166.tif



(d) Image P469.tif



(e) Image P537b.tif

Figure 1: Training Images.

5 Performance Evaluation Method

VRI is the performance evaluation [20] of choice in this contest. This index is used in previous Arc Segmentation Contests [7], [6], [5]. It was also the criterion of choice used by many authors when reporting the performance of their proposed raster to vector methods [21], [22].

VRI is calculated as follows:

$$VRI = \sqrt{D_v * (1 - F_v)} \tag{1}$$

The performance evaluation tool (ArcEval2005.exe) to be used in this contest could be downloaded from its author webpage (`http://www.cs.cityu.edu.hk/%7Eliuwy/ArcContest/ArcContest2005.zip`). We may use detection rate D_v only rather than the combined index (i.e. VRI) to focus on the detection ability of the participating methods.

6 Contest

Depending on the level of participation, the contest may be performed onsite (during the workshop) or offsite (before or after). The earlier we get participations the more likely for the contest to be onsite. In the case of onsite contest, the participants will be given the test images several hours before the start of the contest.

7 Summary and Suggestions

In this paper we have described the overall plan for the Arc Segmentation Contest 2009 to be held in conjunction with GREC'09 that includes preparation of ground truth data, degradation of test images, method of participation, and performance evaluation. We have also come up with some suggestions and recommendations in performing the contest.

Acknowledgment

We would like to to express our gratitude to Abdul Halim Ghazali for his contribution in preparing ground truth images. The first author is supported by USM fellowship.

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