Symbolic Segmentation of Handwritten Numerals with Robust Fuzzy Clustering.

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Abstract

This paper presents a new approach to symbolic handwritten numerals segmentation and pre-processing. It is based on recent developpments in robust fuzzy clustering. Adaptative linear shape detection is achieved taking into account noise caracterisation .

Introduction

This work is a part of more complete project of handwritten numerical amount of cheque interpretation. We will present work related to detection of linear shapes considered as fuzzy clusters.

The basic fuzzy clustering algorithm, FCM (Fuzzy C-Mean) [1] generates a fuzzy partition providing a measure of the membership degree of each pixel or "pattern" to a given region or cluster. Most applications in computer vision were in image segmentation [2]. Fuzzy models allows efficient contextual decision [3, 4].

Handwritten numerals segmentation and linear shape detection

In its basic version, FCM generates spherical filled clusters. If we are interested by specific shape detection, this algorithm becomes ineffective.

Recent development extend this algorithm to the case of linear or shell-like clusters performing segmentation and fitting simultaneously . It was proved that perfomance of these algorithms were more interesting than those of Hough transform. Furthermore, fuzzy modeling provides very rich and useful information, in our approach, of membership degrees.

Adaptative linear shape detection, takes into account the lenght and the extent of each linear cluster. We introduce a rejection linear cluster that collects noise and outliers. This idea of noise cluster was firstly introduced by [5].

Interpretation of handwritten numerical amount of cheque require some pre-processing, essentielly removing basic line of cheque on which we wrote the amount.This method allows us to detect and then to remove this line without damage to numerals. Membership degrees information allows efficient separation between numerals and this line providing efficient symbolic representation of numerals.

Fig1 shows symbolic segmentation of numerals that are compound of linear features. Number of clusters is not crucial since we can overestimate and achieve cluster merging according to fusion criterion Fig2. Fig3 shows ambiguous pixels (in light grey) that belongs to numerals and basic cheque line simultaneously in a synthetic case. This information of membership degree allows us to remove line without truncate numerals. Fig 4 shows result on real amount.

Conclusion

This paper presents an original and a promising way to handwritten numerical amount of cheque

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interpretation. Shared pixels gives a very useful information to handle uncertainty. More results are in progress.

Références

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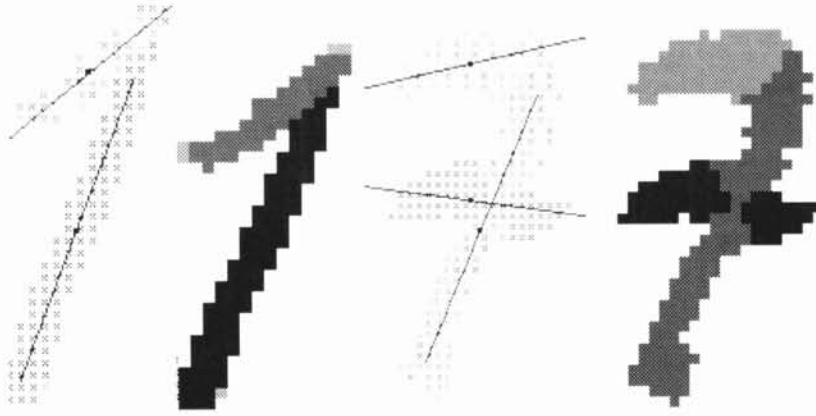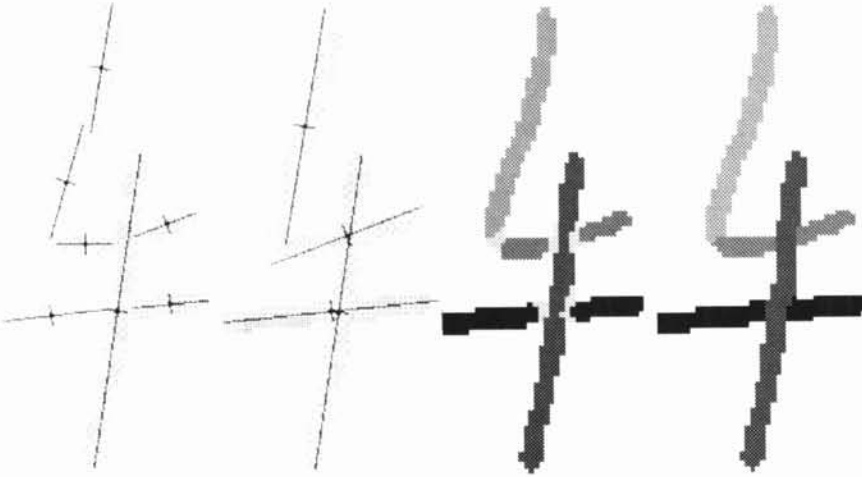
Fig.1 linear segmentation of numerals

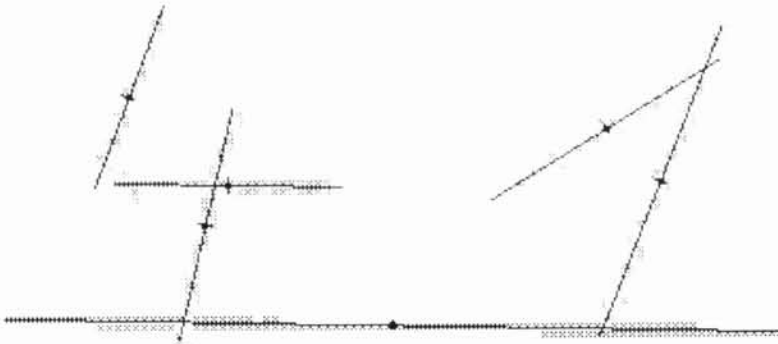Fig.2 Cluster merging result (Ambigous pixels are in light grey).

Fig3-a

Fig3-b

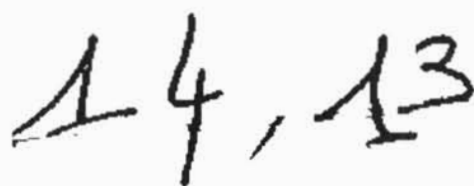Fig. 3 Linear protoypes and ambigous (shared) pixels visualisation
on synthetic amount

Fig. 4 Basic line supression on real amount