

# A Study of Some Multi-expert Recognition Strategies for Industrial Applications: Issues of Processing Speed and Implementability

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## Abstract

Multiple expert decision combination strategies have been used extensively in designing very powerful classifiers for various image processing tasks. These approaches are generally very successful in enhancing the recognition performance of a system, but tend to be costly in terms of implementation and execution, making their application in real time processing environments difficult. This paper investigates the implications in terms of processing speeds and other implementability issues in relation to the incorporation of these multiple expert decision combination approaches in system design. It is demonstrated that selection of a particular multiple expert approach for a particular task domain is influenced by both the achievable recognition performance and the overall execution speed in terms of system throughput. A performance-cost profile has also been proposed to visualise and select the optimal decision combination approach for a specific task domain.

## 1 Introduction

In recent years, multiple expert decision combination strategies have been applied very successfully to the recognition of handwritten and printed characters. Various such approaches have been proposed, ranging from relatively simple to very complicated methods (Suen *et al.*[1, 2], Rahman and Fairhurst[3, 4], Ho *et al.*[5], Kittler *et al.*[6] etc.). In most cases, these approaches enhance the overall recognition performance of the system, but this enhancement is often achieved at the price of additional structural and implementation complexity. This arises because of the introduction of additional logic and increased processing requirements, and in most cases the overall system process-

ing speed is reduced.

In a real-time application (e.g. in many industrial or commercial environments), the processing speed of a system can be a factor as important as the attainable recognition performance. In most cases involving multiple expert decision combination strategies, the design emphasis has concentrated on achieving the highest recognition performance, and the implications concerning execution speed (in terms of system throughput, for example) have often been ignored, making commercial exploitation of these schemes difficult. In this paper, the performance of various established multiple expert recognition strategies has been investigated in relation to the implications of processing speed and implementability in this type of environment.

## 2 Selected Multiple Expert Decision Combination Methods

A range of multiple expert decision combination methods have been selected in order to investigate processing speed and implementability issues in the context of multiple expert decision combination strategies as applied to the character recognition task, by way of a specific example. These methods include the following:

- The Aggregation Method (Ho *et al.*[5], Hull *et al.*[7]),
- The Ranking Method (Mazurov *et al.*[8] and Ho *et al.*[5]),
- The Behaviour Knowledge Space Method (Huang and Suen[9]),
- The Majority Voting Scheme (Kittler and Hatel[10]).

