# Fuzzy Goal Programmýng Modellýng of Intellýgent Character Recognýtýon (ICR) System

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## 1. Introduction

In statistical studies actuality of data as important as quality of data for result of studies. Development in Information Technologies (IT) becomes the base of easiness in all areas for researchers and gets minimized errors in system arised by human day by day. Reflections of IT in data entry system is Intelligent Character Recognition (ICR) System. Main idea of ICR is recognition of handwriting. Both system and decision maker's demands include constraints and uncertainty. Therefore, this situation caused to use Fuzzy Goal Programming (FGP) technique.

This paper presents a Fuzzy Goal Programming modelling for Intelligent Character Recognition system.

## 2. Fuzzy Goal Programming

Most cases in real world like decision makers' goals and aims are uncertain in their nature. FGP is different from classical Goal Programming (GP) because of uncertainty of goals. Also FGP is flexible to make decisions in intervals with meaningful deviations. It is possible to make decisions by FGP in most non-feasible cases by GP. [1, 5, 6]

Matrix structure of a FGP model shows in (2.1) and deviation shows in (2.2). Linguistic terms like 'most about', 'about' and 'least about' are denoted by $\underset{\sim}{<}, \underset{\sim}{\sim}, \underset{\sim}{>}$ in FGP model with similar expression due to known mathematical operators. Model is become a Linear Programming (LP) problem by using of membership functions. Therefore, solution of model is obtained by usual LP solving methods. [1, 3, 4, 5]

$$(Ax)_i \underset{\sim}{\sim} B_i \qquad (2.1)$$

$$D_i = B_i - B_{iL} = D_i = B_{iG} - B_i \qquad (2.2)$$

## 3. Modelling Of Icr System In Fuzzy Goal Programming Structure

### 3.1 Intelligent character recognition system

General ICR procedure shows below in order to flow.

**Batch Preparing:** Filled questionnaire forms are grouped by constraints of ICR system and called batch. **Scanning:** Batch's images are obtained by scanners. **Processing:** Images of alphabetical and numerical handwriting characters convert to optical characters. **Correction:** Non-recognized or mis-recognized characters, mark-ups are corrected by computer operators. **Exception:** Indecision cases are corrected by expert computer operators. **Archive:** Data belongs to corrected questionnaires store in database. [2]

### 3.2 Modelling of ICR System with Fuzzy Goal Programming

All processes have constraints due to the system. However, goals of decision makers have constraints too. Existence of constraints for goals caused to use GP for model. Nevertheless GP is not sufficient to analysis whole system and linguistic terms of decision makers' demands. It is possible to satisfy decision makers' demands and system constraints simultaneously by FGP with

consideration of meaningful deviation.

Goals in the model; 1) Maximization of total number of questionnaire forms are showed with (3.1); 2) Maximization of scanning questionnaire forms with each scanner are showed with (3.2); 3) Minimization of questionnaire forms in exception are showed with (3.3); 4) Maximization of stored data in archive is showed with (3.4).

FGP model for ICR System is

$$\sum x_i \gtrsim N \quad (3.1)$$

$$x_i \gtrsim n_i \quad (3.2)$$

$$(1-R)e \sum x_i \lesssim Q \quad (3.3)$$

$$\sum x_i - (1-R)e \sum x_i \gtrsim A \quad (3.4)$$

$$a_i Y_i \lesssim n_i \quad (3.5)$$

$$a_L \le a_i \le a_U \quad (3.6)$$

$$a_i = \sum b_{ij} d_j \quad (3.7)$$

$$t\ t_i \gtrsim n_i \quad (3.8)$$

$$t_{iL} \le t_i \le t_{iU} \quad (3.9)$$

$$0 \le e \le k \quad (3.10)$$

$$x_i, Y_i, b_{ij}, t \ge 0 \ .$$

$x_i$ is total number of forms which are scanned with scanner i; $N$ is goal value of total number of forms; $n_i$ is goal value of total number of forms which are scanned with scanner i; $t_i$ is total number of forms which are processed with processors belong to scanner i; $Q$ is goal value for total number of forms which are processed in exception; $A$ is goal value for total number of forms which are stored in archive; $a_i$ is number of forms in batch i; $Y_i$ is number of batchs; $e$ is exception ratio; $b_{ij}$ is number of form groups which are obtained by j forms in batch i; $d_j$ is number of forms in form group j; $t$ is number of processors; $t_{iL}, t_{iU}$ are lower and upper bounds for number of processed forms with each processor of scanner i; $a_L, a_U$ are lower and upper bounds for number of forms in batch ; $k$ is upper bound of exception ratio.

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**RESUME**


Dans ce travaille, on a fait la modélisation de technique de ea programme de but pour le systéme de reconnaissance de charactére raisonable.