OPTIMIZATION OF HMM BY A GENETIC ALGORITHM

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ABSTRACT

Hidden Markov Model (HMM) is a natural and highly robust statistical methodology for automatic speech recognition. It is also being tested and proved considerably in a wide range of applications. The model parameters of the HMM are essence in describing the behavior of the utterance of the speech segments. Many successful heuristic algorithms are developed to optimize the model parameters in order to best describe the trained observation sequences. However, all these methodologies are exploring for only one local maxima in practice. No one methodology can recovering from the local maxima to obtain the global maxima or other more optimized local maxima. In this paper, a stochastic search method called Genetic Algorithm (GA) is presented for HMM training. GA mimics natural evolution and perform global searching within the defined searching space. Experimental results showed that using GA for HMM training (GA-HMM training) has a better performance than using other heuristic algorithms.

1. INTRODUCTION

The Hidden Markov Model (HMM) [1,2] model parameters are the most important data in a HMM based speech recognizer because the speech segment can be characterized and represented by the HMM model parameters, thus, it directly affects the system recognition accuracy. For artificial speech, the model parameters of the HMM are known in advance and can be used for recognition, however, in the case of natural human speech, these parameters can only be estimated. Many successful heuristic algorithms such as the forward-backward method [3] and the gradient method [4] are developed to optimize the model parameters to best describe the training observation sequences. However, all these methodologies are starting from an initial guess and iteratively converge to a local maxima. A stochastic search method called Genetic Algorithm (GA) can be used for HMM training. Unlike the hillclimbing method used by many heuristic algorithms, GA mimics natural evolution and performs global searching within the defined searching space. Figure 1 describes the structure of Genetic Algorithm. As shown in the figure, GA is manipulated on a population of individuals or genetic representation of solutions. An encoding mechanism is then e