A New Solution for Maxterm Problem in Trigonometric Functions by Simulated Annealing Algorithm

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ABSTRACT

The present paper is an attempt to get total minimum of trigonometric Functions by Simulated Annealing. To do so the researchers ran Simulated Annealing. Sample trigonometric functions and showed the results through Matlab software. According the Simulated Annealing Solves the problem of getting stuck in a local Maxterm and one can always get the best result through the Algorithm.

Keywords: Algorithms, Matlab Software, Maxterm Problems, Simulated Annealing, Total Minimum, Trigonometric Functions

1. INTRODUCTION

Mathematics has always been in search for improvement which captures a large area in computer science, Economics, management and so on. Trigonometric functions are among mathematic functions which apply for a large area in improving and to find Maxterm in these functions has always been important because of their wavy state. And there are different methods as how to get their improving status. Since former methods like Hill-climbing and gradient ascent methods suffer from local optimization the present paper applies simulated annealing to remove the problem. The algorithm avoids being stuck in local minimum through an Error probability coefficient and moves towards an optimal answer. Simulated Annealing is used to get the most optimal condition

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of building a structure while keeping expenses low on strength high in which the results are more optimal than former methods.

The paper is organized as follows. The researcher review optimization methods like hill climbing and Gradient Ascent in section 2. In section 3, simulated Annealing will be explained and in section 4 the recommended method will be explained and finally in section 5 the paper will be concluded by presenting the results of the paper.

2. OPTIMIZATION METHODS

2.1. Hill Climbing

Hill climbing is a method through which one can get the best answer to a problem by finding an answer which is optimal enough.

The method is used to find several equivalent answers and select the best answer (Vaughan, 2000). In this method the following hypotheses are required.

- **Finite Sum of Values**: Finite sum of values is a set which describes several values to be used in the function which are used to find target function values.

- **Target Function**: It is a function which allocates a clear value to every value in the s. the purpose is to find the best answer provided through the function. In this method, first one of the members of s set is selected randomly and calculates the function value based on the selected members then other members from among the set members are selected for later steps which are adjacent to former member. In other words Function values possess more optimal answer compared to former member.

The optimal answer can be used to find minimum or maximum value of the function. Depending on the optimization condition and whether maximum or minimum is required (Vaughan, 2000; Russell & Norvig, 1995). The Algorithm semi-code is as following (Vaughan, 2000) in Box 1.

The shortcoming of the method is that if the function has a large local minimum and maximum it will get stuck in a local Maxterm and will not be able to get out of it therefore the method cannot always provide the best answer because of a fore mentioned problem [1, 3].

2.2. Gradient Ascent

This is much like the hill-climbing method which is run in a sample contiguous space. Changes will take place like Formula (1) (Russell & Norvig, 1995; Dabney & Barto, 2003):

$$\omega \leftarrow \omega^* + \alpha \frac{\partial}{\partial \omega} f(\omega)\bigg|_\omega$$  \hspace{1cm} (1)

Figure 1 illustrates a sample change trough the aforementioned method.

Figure 2 shows some steps of the mentioned method.

This method also like hill-climbing has the probability of getting stuck in a local Maxterm and is probable to get stuck in a local maximum or minimum besides this methods has shortcom-

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**Box 1.**

Generate a solution (s')

Best = S'

Loop

S = Best

S' = Neighbors (S)

Best = SelectBest (S')

IF there is no changes in Best solution THEN

Jump to new state in state space

Until stop criterion satisfied

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