Using genetic Algorithms in Time Cost Trade off Optimization Project Networks

A Thesis
Submitted to the Faculty of Engineering
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Of the Requirements of the Degree of Master of Science in civil Engineering

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STATEMENT

This dissertation is submitted to Ain Shams University, faculty of engineering for the degree of M.Sc. in civil Engineering.

The work included in this thesis was carried out by the author in the department of Structure Engineering, Faculty of Engineering, Ain Shams University, from November 2013 to May 2017.

NO Part of the thesis has been submitted for a degree or qualification at any other university or institution.

The candidate confirms that the work submitted is his own and that appropriate credit has been given where reference has been made to the work of other.

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ABSTRACT

In this thesis, an optimal balance of time and total project cost is achieved. a new simple, robust methodology and computer program were developed. the program deals with all the construction project data (huge number of activities, construction methods or modes (genes) and relationships) to solve time–cost trade-off (TCT) problem this leads to huge amount of permutation solutions, through there permutation produce infinite series of individuals have been produced, which have different costs and times.

The genetic algorithm technique is employed to produce the optimum solution to this problem. This is achieved through initialization of parent generation using matrices obtained from VBA Program. the data is suitable for the Genetic Julia algorithm performance and are considered to be the initial population for the evaluation process. new developed Julia script is used to determine the fitness of each solution. Selection, crossover, mutation, replacement is applied to get a new offspring generation. Finally, a special elitism technique is used for multi objective to get time-cost trade off curve and the choices of strategies, which give the ideal Balance of time and cost.

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Chapter 1

Introduction

1.1 Research Significant:

This research introduces a new, simple, robust methodology and computer program, which deals with all the construction project data (huge number of activities, construction methods or modes (genes) and relationships) to answer time-cost trade-off (TCT) problem. This leads to great amount of permutation solutions, and through there permutation produce infinite series of individuals that have different costs and different times (initial solutions). The algorithm of genetic is utilized to achieve the optimal solution.

Visual Basic program (VBA), is used to produce the basic matrices required:(duration matrix, cost matrix, global relation matrix, and greater number of options vector). Data entry in this step is split into two functional areas: (1) costs of the resources (labor, material, equipment) that the company can provide for the current project and their productivity. (2) this precedence relationship of the network. Once the user inserts the band for every activity the (VBA) program gets the genes automatically. So, it would be simple to create basic matrices which is the fundamental data exported to **the Julia program**.
Using Julia program and the imported data from the (VBA), the program calculates values of every objective for each individual (cost and time), convert the decision space to objective space and produce infinite number of solutions which serve as the foundation for genetic algorithm performance. Through this large amount of solutions, the vacuum sample are reduced vacuum sample using the genetic technique (initial population, fitness, selection, and crossover, mutation) to get the best individuals that achieve the optimal pareto solutions (time-cost trade off curve) then use the indirect cost to get the optimal solution.

The technique developed identifies the best selections of crew size or equipment (genes) that achieve the optimal balance of two conflict objectives (time-cost) and produce the optimal string (schedule or chromosome) which has minimum possible cost and time to fulfill the project and respect the contractual time limit. This serves contractors to receive early completion bones and avoid the liquidated damage. It serves owners to obtain their desires to fulfill the project. It also serves the engineer to be sufficient aware of rates of performance required for every activity making better his controls the site. The study introduces complicated ideas in a simplified shape that should be

beneficial to both the interested people and researchers included in solving optimization problems.