Newton Competitive Genetic Algorithm Method for Optimization the Production of Biochemical Systems

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In this work, the optimization of biochemical systems production is performed by using a hybrid method of Newton competitive genetic algorithm is presented. The proposed method works by representing the biochemical systems as a generalized mass action model, where it leads to the process of solving a complex non-linear equations system. The optimization process becomes hard and difficult when it involves multi-objective problem. This is where two objectives, namely the maximize the biochemical systems production and minimize the total amount of chemical concentrations involves. To deal with the problem, this work proposed a hybrid method of the Newton method, genetic algorithm, and competitive co-evolutionary algorithm. The proposed method was experimentally applied on the benchmark biochemical systems and the experimental results showed that the proposed method achieved better results compared to the existing works.

Keywords: Biochemical systems, Newton method, Genetic algorithm, Competitive co-evolutionary algorithm, Computational Intelligence.

1. INTRODUCTION

To overcome the problem in limited fossil resources and environmental pollution, renewable biofuel is a good choice¹. Lately, many research has focus on biofuel source because the amount of energy produced by biofuel. Biofuels can be extracted from plants such as sugar cane and corn. Nowadays, the demand for renewable biofuel has increased which results in the competition of limited plant and land issues²-⁴. To overcome this situation, many researchers focus on the microbial production rather than increasing the plant and land. Most of researchers manipulate the microorganisms’ activities to increase biofuel production. This can be obtained by integrating the microbial genomes knowledge and biotechnology process

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to improve the production of biofuel. This is because the integration of knowledge and biotechnology processes can make microorganisms’ activities to be viewed as a system known as biochemical systems. A way to improve biofuel production is by adjusting the value of variable in the biochemical systems. This process can be considered as an optimization process, where it intends to improve the biochemical systems production by fine-tuning the value of variable in the biochemical systems⁵-⁶.

There are many studies in the optimization of biochemical systems production have been performed⁷-¹².