A Study of Genetic Algorithms for Searching and Maintaining Building Blocks Based on Symbiotic Evolution Between Individuals and Viruses

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In this paper, we propose a symbiotic evolutionary genetic algorithm (SEGA). SEGA aims to enhance search efficiency of GA by searching and maintaining building blocks based on symbiotic evolution between individuals and viruses. Various works related to genetic algorithms (GA) have been studied as one of the stochastic search techniques since GA was proposed. We need to prepare some individuals which are represented as candidate solutions when we use GA. GA searches solutions by Selection, Crossover, and Mutation for the prepared individuals. Recently, many researchers have studied works which aim to enhance the search efficiency by controlling destructions of building blocks in individuals and identifying building blocks in individuals. Our work is classified into these works. Various methods have been proposed from these works. SEGA is classified into coevolutionary methods of these methods.

This paper has six chapters. Chapter 1 describes backgrounds and purposes of our works and Chapter 6 describes conclusions of our works. Chapter 2 describes a procedure, the search mechanisms of GA, and definition of a deception problem that GA has a difficulty in searching. We also talk about the reason why GA has a difficulty in searching it in Chapter 2. Chapter 3 describes SEGA and related works of SEGA. We should deal cautiously with the virus selection and virus evaluation of SEGA. Therefore, Chapter 4 describes two kinds of selections and two kinds of evaluations techniques of viruses. We compare them each other and discuss about behaviors of SEGAs using them through the function optimization experiments . We also show that the most efficient virus selection and evaluation technique in SEGA are the sigmoid selection and the independent evaluation. Finally, we apply SEGA using the sigmoid selection and the independent evaluation to the minimum search problem using some test functions which have distinguishing shape in Chapter 5. We also discuss about the minimum search behaviors, the minimum search efficiency, and building blocks search and maintenance by viruses through comparison SEGA with simple GA and coevolutionary GA, which is a related method of SEGA.