Adopting Dynamic Operators in a Genetic Algorithm

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ABSTRACT
Genetic Algorithms have been used to solve difficult optimization problems in a number of fields. However, in order to solve a problem with GA, the user has to specify a number of parameters. This parameter tuning is a difficult task as different genetic operators are suitable in different application areas. This paper proposes a scheme for genetic algorithms where the genetic operators are changed randomly. The information of gender and age is also incorporated in this approach to maintain population diversity. The experimental result of the proposed algorithm based on a mechanical design problem shows promising result.

Categories and Subject Descriptors
1.2.8 [**Artificial Intelligence**]: Problem Solving, Control Methods and Search

General Terms
Algorithms, Design, Experimentation, Performance.

Keywords
Genetic Algorithm, Gendered Reproduction, Continuous Age Structure, Dynamic change of Genetic operators, Adopted Child.

1. INTRODUCTION
The choice of GA parameters and genetic operators are often very time-consuming and it becomes a complex permutation problem. Setting the GA parameters in advance entails the following problems: (1) normally the optimal values for the GA parameters depend on the particular problem; and (2) the optimal genetic operators and parameter settings are likely to be different for each problem or even for each individual. There has been much research on adaptive GAs that allows dynamic adjustment during execution [1, 3]. In this context, a self adaptive GA, in which the genetic operators and GA parameters settings are varied during GA execution, has been proposed in this paper.

2. PROPOSED GA
The goal of this novel algorithm is to ease the parameter tuning. This approach also maintains diversity in the population and thus prevents GA to converge prematurely to local minima. The proposed algorithm is based upon the following fundamental factors:

- The reproduction is only permitted to opposite gender and this produces one child or two children depending on the fertility rate of the parents. The fertility rate is calculated based on its age function.

- The gender of the child is determined based on gender density of the population.

- When the crossover is not carried out, the parents may adopt children.

- Mutation rates for male and female are different and they are used to determine the overall mutation rate of the population.

- A random integer is generated to decide the time (i.e. generation) to change the environment. The genetic operators (e.g. selection type, crossover type, crossover rate and mutation rates) are changed randomly to represent the dynamic environment. Thus, the algorithm utilizes strengths of a group of genetic operators instead of using fixed types of operators throughout its execution.

3. MECHANICAL DESIGN PROBLEM
The mechanical design of a pressure vessel is taken from [2] which aim to minimize cost. For comparison purpose, the results of four variants of Genetic Algorithm are presented in Table 1. The performance measures used are solution quality, online and offline measure.

Table 1: Results of GA variants

GA Variants	Best Solution	Worst Solution	Offline Measure	Online Measure
Standard GA	7267.85	20549.430	12618.050	14006.970
Gendered GA	6461.68	11379.810	11608.260	11209.830
Aged GA	6966.49	14908.500	12326.120	14360.030
Proposed GA	6442.66	15097.433	10517.863	13353.564

4. CONCLUSION
The proposed algorithm is being applied on function optimisation problems. Instead of random assignment, future research could implement strategies to guide the parameters and the genetic operators.

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