VMEA: Studies on Replacing Strategies and Diversity in Dynamic Environments

Anabela Simões[1,2]
[2]Department of Informatics and Systems Engineering
ISEC - Coimbra Polytechnic
+351 239 790350
abs@isec.pt

Ernesto Costa[1]
[1]CISUC, Dep. of Informatics Engineering
University of Coimbra
+351 239 790000
ernesto@dei.uc.pt

ABSTRACT
We investigate some improvements to a memory-based evolutionary algorithm already studied with success in dynamic optimization problems. Two new replacing strategies to incorporate in the algorithm are proposed and a comparative study with previous approaches is made. The results show that the studied mechanisms powerfully improve the efficiency and the adaptability of the evolutionary algorithm.

Categories and Subject Descriptors
I.2.8 [**Problem Solving, Control Methods, and Search**]: *Heuristic methods*.

General Terms
Algorithms, Performance.

Keywords
Dynamic Environments, Memory, Diversity, Replacing Strategies.

1. INTRODUCTION
We study proficient ways of using memory when dealing with dynamic environments. We propose two different and efficient schemes of storing individuals into the memory (replacing strategies) and test them in an EA with an evolving population and a memory of variable sizes previously proposed and studied in [1]. Also, we will use a biologically inspired genetic operator called conjugation to control the population's diversity.

2. VMEA
Simões and Costa [1] proposed an EA called VMEA – Variable-size Memory Evolutionary Algorithm, to deal with dynamic environments. This algorithm uses a memory population, responsible for storing the best individuals of the evolving population. The two populations - search and memory – have variable sizes that can change between two boundaries and cannot go beyond a certain limit. The algorithm was tested and compared with other algorithms, obtaining better results. Details can be found in [1].

3. REPLACING STRATEGIES
When memory needs to be updated and there is no room for more individuals a replacing method must be chosen. We propose two different replacing strategies to use in VMEA. The first, called by *age2*, is also based on the age of memory individuals while the second, denominated by ***generational***, selects the worst individual present in the memory **since the last change**.

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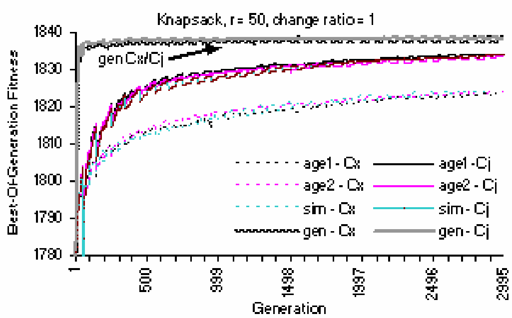
4. BACTERIAL CONJUGATION
In this work, computational conjugation replaces the crossover as the main genetic operator. Conjugation is applied after selecting the individuals to the mating pool dividing it into two groups: the **n**/2 best individuals become the 'donor', the remaining become the 'recipient' Then, the i^{th} donor transfers part of its genetic material to the i^{th} recipient (i=1, …***n***/2). This injection is controlled by two points randomly chosen. The donor remains unchanged. Following that all offspring created by this process are joined with the donor individuals and they become the next population of size ***n***.

5. RESULTS
The results obtained with the ***generational*** replacing strategy combined with the conjugation operator were excellent. After a change in the environment, individuals from the memory are introduced in the population and the algorithm can continue evolving without significant decrease on its performance. All the details and results about this work can be found in [2].



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