CSE 848 Project Proposal

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1 Title

Modification of Groundwater Flow Algorithm using Algorithmic Equivalence with an Evolutionary Algorithm Framework for Unimodal Functions

2 Introduction and Motivation

Groundwater Flow Algorithm (GWFA) [1] is a new addition to the list of meta-heuristic algorithms which are currently being used for numerical optimization. It uses the natural inspiration from the movement of groundwater from one place to another and Darcy's quantified representation for that flow to develop a mathematical model which can be used for optimization. Although there are many different meta-heuristics applied in the field of numerical optimization, researchers often argue that most of these algorithms are similar at the core. So, it is really interesting to experiment whether we can find some kind of equivalence among different sets of algorithms. This will hugely improve the applicability of different algorithms over a large set of problems. For example, if we can find a version of algorithm A which is equivalent to algorithm B, we can extend A's applicability to the problems already explored by B. This also helps us learn which operations in A are not suitable for immigration to the problem domain of B. That is why Algorithmic Equivalence [2] has gained importance over the past years.

3 Project Goal

As a part of this project, I want to explore the algorithmic equivalence of GWFA with an existing Evolutionary Algorithm framework. The goal of the study is to check how we can modify or improve GWFA to make it applicable to the problem domain of the EA framework. By problem domain, I mean the problems where EAs have been successfully applied in the past. In order to conduct the algorithmic equivalence study, I wish to introduce different evolutionary operators like: mutation, selection, crossover, steady-state-update [3] etc. and check the effect of these modifications via its applicability over three popular unimodal functions namely, Ellipsoidal, Schwefel's and Rosenbrock's functions. The ultimate objective is to find an evolutionary version of GWFA which is applicable over these three unimodal functions. In the process, I want to understand which operators embedded in GWFA are not applicable for this set of problems and how they should be changed to bring the notion of evolution in GWFA. Unimodal problems test the exploitation abilities of a particular algorithm. So, these three problems are excellent in testing how GWFA should be modified to improve its exploitation.

4 Preliminary Sketch

Motivated by the goal of this project, I did some initial research and I was able to represent the standard GWFA as an equivalent Evolutionary Algorithm. The algorithmic equivalence sketch of GWFA is provided in Figure 1.

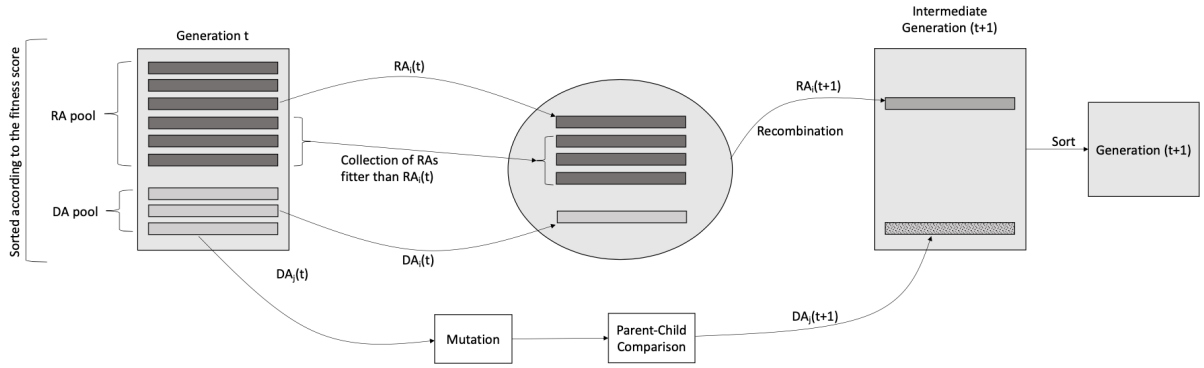

Figure 1: Caption

Please note that this sktech is not finalized. It is a preliminzary sketch of GWFA based on my observations and understandings of evolutionary approaches. It may change over the course of this study.

References

[1] Ritam Guha, Soulib Ghosh, Kushal Kanti Ghosh, and Ram Sarkar. Groundwater flow algorithm: A novel hydro-geology based optimization algorithm. 2020.

[2] Kalyanmoy Deb and Nikhil Padhye. Improving a particle swarm optimization algorithm using an evolutionary algorithm framework. *KanGAL report*, 2010:003, 2010.

[3] Kalyanmoy Deb, Dhiraj Joshi, and Ashish Anand. Real-coded evolutionary algorithms with parent-centric recombination. In *Proceedings of the 2002 Congress on Evolutionary Computation. CEC'02 (Cat. No. 02TH8600)*, volume 1, pages 61–66. IEEE, 2002.