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COS301: Request for Project Proposal
Swarm Visualizer

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1 Introduction

In the field of computational intelligence there is a constant stream of optimization algorithms being proposed. Given this high rate of advancement and the stochastic nature of many of these algorithms, trying to develop an intuition of there behavior is increasingly difficult.

The focus of the project will be the visualization of particle movement, and communication. The project must be implement in either DirectX 11 or OpenGl 4.5 using C++.

2 Problem Statement

While swarm based techniques are often used to solve a variety of problems, the focus will be on the visualization of optimization problems of the form $f : \mathbb{R}^n \rightarrow \mathbb{R}$, where $n = 1$ or 2, often refereed to as the objective function. To make this more concrete a problem of the form $f : \mathbb{R}^2 \rightarrow \mathbb{R}$ should be visualized as a 3D terrain with the height determined at each (x_1, x_2) coordinate as $f(x_1, x_2)$.

While visualization of algorithm behavior in such low dimensions will probably not provide a complete picture of particle behavior, it should serve as an effective means of providing insight into particle behavior.

The visualization should also be aesthetically pleasing with particles movements represented as smooth transition, with some form of accompanied animation (e.g a ball rolling during the transition)

3 Requirements

The Particle Visualizer has the following requirements.

- Particles initial locations can be user selected via click placement.

- Extra initial properties can be user selected.
- Particles initial properties can be selected from a predefined set.
- The objective function can be selected from a predefined set.
- The optimization algorithm can be selected from a predefined set.
- The ability to control the speed of the particle movements during the run.
- It must be possible to have from 1 to 4 instances of the same objective function, being optimization by different optimization algorithms. This must be achieved in the same manner as multi player video games use a split screen.

- The paths traveled by particles must be made visible. This feature should be possible to able or disable during a run.
- The communication between particles where relevant must be visualized.his feature should be possible to able or disable during a run.
- There should be a movable first person view of the landscape.
- At least 10 objective functions must be implemented (I will provide them).
- The following optimization algorithms must be implemented
  - Random search
  - Hill Climbing
  - Conical Particle Swarm optimization (CPSO)
  - Guaranteed Convergence PSO (GCPSO)
  - Fully Informed PSO.(FIPS)
- The visualizer should allow different resolutions (800x600, 1024x789, 1920x1080)
- The system should run at least 60 frames per second at the resolution $1920x1080$ on a GTX540 or better.
- The system should have not be tightly coupled between the optimization algorithms or objective functions and the visualization front end. It should be easy to add new algorithms or objective functions.

4 Skills requirements

Proficiency with C++. To be registered for either COS314 or COS344 (both would be a plus).