Project Proposal

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Title: Tracking Objects in Visual Images Using Population-Based Adaptive Algorithms

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Background

Optimization problems are defined as computational problems whereby the objective is in finding the best solution for a problem. These problems usually have a set of known input (real-valued) parameters and an output value, which forms an Objective Function. The Fitness Function, which is a particular type of an object function, quantifies the optimality of the solution [1]. So in a more general sense, optimization problems are concerned with finding an optimal value, either a global minimum or a global maximum in an fitness function [2].

In some problems however, finding the optimal value is not easy because the relationship between the input parameter values and the output value change over time, i.e. the fitness function changes over time. There are a number of different reasons why a system could change over time. Some of these are [3]:-

- The location of the optimum value in the fitness function changes.
- The location of the optimum value remains constant, but the optimum value varies.
- Both the location and value of the optimum could vary.
- In a multidimensional system, the above three variations could occur on one or more dimensions, either independently or simultaneously.

The problem of finding and tracking the optimum in such cases as those above is known as Dynamic Optimization.
In recent years, a number of new dynamic real-valued optimization techniques have been developed to cater for problems with a dynamic nature. These techniques have been aimed at detecting and tracking global minimum/maximum values in the problem domain without the need to restart optimizing the problem domain whenever the problem being observed changes.

Some of these new techniques include:

1. Particle Swarm Optimization [3]
2. Evolutionary Algorithms [4,5]

Some new research has been focused to putting population-based adaptive methods, such as those mentioned above, to the use of tracking visual objects in an environment being observed [7].

This could be particularly useful for things such as camera surveillances, tracking missiles, tracking a football, etc, because problems such as the effect of noise on the environment being observed, a deformation of the shape of the object of interest or its occlusion have been found not to drastically affect these new population-based adaptive methods.

**Aim**

The aim of my research project is to compare different population-based adaptive methods and see how well the most promising approach performs in the problem of detecting and tracking the movement of an object in an image. Choice of the most promising algorithm will depend on factors such as the effect of noise on the algorithm and how well the algorithm performs with any sort of occlusion or deformation of the object being observed.

To reach my aim, I will review different dynamic optimization techniques and compare the ability of each algorithm to track down moving optima in an n-dimensional landscape based on the previous experimental work done on this field of study. The claimed best approach will be selected and applied to the problem of tracking moving optima. Obstacles such as the noise effect on the algorithm and the deformation of the fitness function due to occlusion of the optima will be taken into consideration when choosing the most promising approach.

I would then extend the idea of tracking moving optima in an n-dimensional
landscape to tracking a moving object in an environment by determining a minimization function that represents the object in the environment and tracking the optimum in it. A simple proposed method to track the moving object is to use a series of frames from a video of the moving target object and seeing how well each algorithm would track the object.

The above aim is hoped to be extended to demonstrate the ability for an AIBO robot or similar to track an object using it’s eyes in a real time environment. This aim is however not a prime aim and will only be considered if time constraints allow for its development.

**Method**


2. Select the best approach for optimizing real-valued systems based on previous experimental work.

3. Implement the algorithm.

4. Determine minimization function from visual images.

5. Apply the best approach to the problem of tracking a moving object.

6. Implement a real-life demonstration using an AIBO robot or similar to track an object using it’s eyes.

7. Write dissertation.

**Bibliography**


