

## FERGUS CURRIE PROPOSAL FOR RESEARCH ON MULTIOBJECTIVE GENETIC ALGORITHMS

Why :

The problem:

The New Zealand company Plant and Food are involved in a range of agricultural pursuits. One is breeding fish. More specifically Chinook; a species of Pacific salmon. The main goal of farming is profit, as such biologists at Plant and Food want to breed the Chinook so that advantageous traits like taste are increased. Fish with more profitable genetics will create greater revenue. A difficulty is that if breeding is too selective genetic diversity of the Chinook population becomes too small. I do not have much genetic knowledge but I have been informed that small genetic diversity is bad and therefore effects profit.

The breeding program now has two objectives; increase profitable traits and keep genetic diversity large.

Why it's interesting:

The conflicting nature of the two objectives means that traditional optimisation techniques will struggle in finding a solution that works well for both objectives.

Multiobjective optimisation algorithms are effective at solving these types of problems. I'll use a MOA to find an optimal balance between the two objectives.

This is an interesting area because it has so much application to industry. Most applications I can think of for optimisation would have conflicting objectives that would ideally be optimised too. For example an investment portfolio could be optimised for both profit and risk management.

-Brief summary of other research related:

A Fast and Elitist Multiobjective Genetic Algorithm: NSGA-2

This paper covers an algorithm for MO which solved three main issues in the field at the time: (1) inefficiency ( $ON^3$ ), (2) lack of elitism and (3) specification of sharing parameter. NSGA-2 outperformed the techniques it was compared to in almost all instances.

A Comprehensive Survey of Evolutionary-Based Multiobjective Optimisation Techniques

This paper reviews the most important evolutionary-based techniques for MO, I'll note that the algorithms are summarised and their original paper referenced. Also this paper is written in 1998 and so does not include many advancements such as NSGA-2.

Multiobjective evolutionary algorithms: A survey of the state of art

This paper surveys advancements in MOEA and MOEA for complicated problems. It focus around develops in the field over the last eight years. Considering it is published in 2011 it is the most recent of these sources.

What:

Aim : The aim of this project is to develop novel multi-criteria decision making algorithms/ systems for informing breeding programme designs and to obtain a set of models of breeding programs with trade-offs between various potentially conflicting objectives, such as short-term and long-term gains.

Goals to achieve aim:

1. Decide on metrics, constraints, parameters and decision variables
  - 1.1. This will require talking with Plant and Food as they have more of the biological understanding
2. Read relevant literature related to MO
  - 2.1. A Fast and Elitist Multiobjective Genetic Algorithm: NSGA-2
  - 2.2. A Comprehensive Survey of Evolutionary-Based Multiobjective Optimisation Techniques
  - 2.3. Multiobjective evolutionary algorithms: A survey of the state of art
3. Collect data
4. Learn how to use relevant tools
  - 4.1. Matlab
  - 4.2. SLiM

How:

Key Milestones:

- November 2020 Research begins
  - Jan 2021 student to finish literature review and problem modelling
  - Feb 2021 student to finish data collection, analyses and report... end of summer project.
- These are from Linley.

These are my own based off that but need revision:

WEEK	MILESTONE
9/11/2020	Finish Proposal
16/11/2020	Finish Data Collection
23/11/2020	
30/11/2020	
7/12/2020	
14/12/2020	Literature Review and Problem modelling finished. Code and results.
<b>BREAK</b>	
11/1/2021	
18/1/2021	
25/1/2021	
1/2/2021	Report finished and published.

Resources :

SLiM  
Matlab  
Internet  
Papers/Readings  
Victoria Computing, Printing and Work station