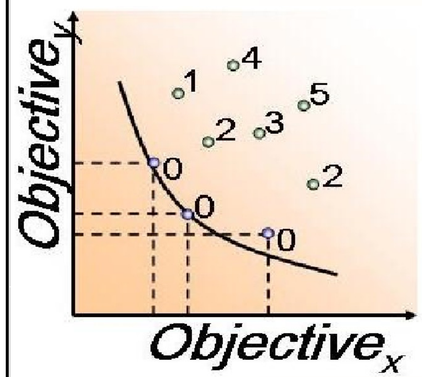
MULTI-OBJECTIVE OPTIMIZATION AND BBO

UMBC
AN HONORS UNIVERSITY IN MARYLAND

Yasir M Rafi
yasir2@umbc.edu

Introduction: Multi-objective Programming



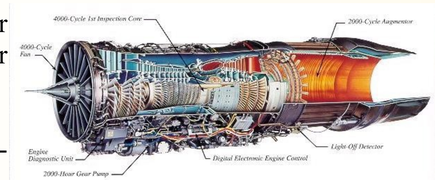
. - For a real world problem, a single objective with several constraints may not adequately represent the problem being faced.

.-The multiple objectives representing the problem are often conflicting but all the objectives need to be optimized.

. -If there is a vector of such objectives, there has to be a tradeoff between the objectives in the solution in some way. An ideal solution has all the objectives fully optimized, but is almost impossible.

.-Example– Aircraft Engine Sensor selection –optimize cost and sensor selection.

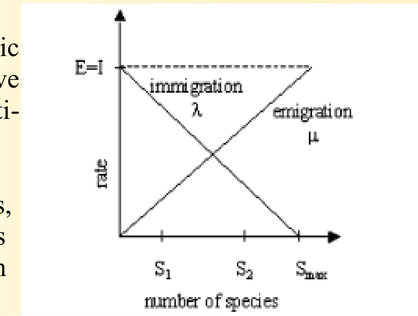
Portfolio investment–maximize revenue, minimize risks.



Biogeography-based Optimization

-Similar modern techniques such as Genetic algorithm, evolutionary algorithms have proven to be more effective for multi-objective problems.

-Problem solutions are represented as islands, and the sharing of features between solutions is represented as immigration and emigration between the islands.



Initialize a set of solutions to a problem

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Compute "fitness" (HSI) for each solution.

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Compute S, λ, and μ for each solution

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Modify habitats (migration) based on λ, μ.

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Mutation based on probability.

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Implementation of elitism.

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Go to step 2 for the next iteration if needed.

Current focus

-Work on the school redistricting problem with BBO. Comparison with Hill climbing and other methods used in the current work.

. Since there is no perfect solution, present the trade-offs between objectives for different solutions to decision makers, where there is unequal importance for the objectives.

-Work on the Sierra Nevada reserve site selection system and comparison of solution using BBO with that for simulated annealing.

- Survey for 'Integration and optimization of alternative sources of energy'.

Future work

-Based on the framework of the solutions developed for optimal integration and optimization of sources of energy, the next task would be to model "situation awareness" with regards to future sources of energy.

Conventional methods to solve Multi-objective problems

-Stochastic - Random walk, simulated annealing, Monte Carlo)

-Linear Programming - fast, but restricted to linearized situations only

-Gradient Based/Hill Climbing - nonlinear, applicable to smooth (differentiable) functions

--Sequential Optimization - ranks objectives by preference and optimizes them in order (lexicographic)

-Weighting Objectives - creating a single scalar vector function to optimize.

-Constraint - optimizes preferred objective with others treated as constraints

Relevant work

-Comparison with other optimization methods like Genetic algorithm, evolutionary Strategy, Ant colony optimization etc. for performance on specific problems.
-Discrete optimization of a gear train.
-Power flow problem.

- Economic load dispatch problems.

-Fuzzy Rule Base Generation from Numerical Data.

- Relevant Problem - integration and optimization of alternative sources of energy for a specific region.

Acknowledgements and References:

. - Dr. Stuart Schwartz, Senior Research Scientist, CUERE, UMBC

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