

Borg-RiverWare

2025 RiverWare User Group Meeting Presenter: Edie Zagona, Patrick Lynn

Multi-Objective Simulation-Based Optimization

Overview

Multi-objective simulation-based optimization



Example: find the "best" reservoir guide curve

Problem: Find the best set of values of these 5 variables for these Conflicting objectives:

Minimize risk of flooding downstream

Minimize risk of water supply shortage

How to solve: 1. run many simulations, e.g. POR, with combinations of values of the variables.

2. Compute the values of the objectives for each.



- 2. Identify non-dominated solutions to consider for the policy
- 3. Decision-making: what tradeoff to accept between the objectives?

Automate by using MOEA Multi-objective evolutionary algorithm

A search algorithm that generates many sets of variables and identifies the Pareto optimal solutions

Borg-RiverWare Wrapper

Software that exchanges information between simulator RiverWare and the MOEA Borg to find a non-dominated (pareto optimal) set of solutions

Borg is an MOEA developed by David Hadka and Patrick Reed at the Pennsylvania State University and licensed by The Pennsylvania State University. See borgmoea.org



Tradeoffs among multiple objectives can be visualized using parallel coordinates plots; each axis is an objective. Each line is an approximate Pareto optimal solution. (Alexander, MS Thesis 2018)



Borg-RiverWare

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Demo and Future Development

Configuring & Executing a Search

• Problem formulation: decision variables + objectives

• **RiverWare**:

- Identify decision variable slots, create objective slots
- Create DMIs to exchange data with Borg-RiverWare
- Configure search (needs environment variable)

Borg-RiverWare

- Execute Search
- Analyze results

Modeling Decision Variables

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Configuring the Search

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Configuring the Search

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Configuring the Search

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Execute the Search

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Execute the Search



Future of Borg-RiverWare

- Goal: easy and effective for any RiverWare user
- Initial public release
 - Licensing
 - Documentation and examples
 - Installation