

Matheuristics Integration

Hybrid Optimization Frameworks and Stefan Voß RTS Compliance Modeling

Giorgio Saibene

Level: PhD Seminar / Advanced Research Track

Course Overview

This advanced doctoral seminar examines the systemic coupling of exact mathematical programming with metaheuristic search spaces. The curriculum focuses on designing hybrid algorithmic architectures, deploying adaptive metaheuristics (Tabu Search, Genetic Algorithms), and evaluating Stefan Voß RTS compliance modeling to resolve large-scale, highly constrained combinatorial problems.

Core Methodological Modules

1. Hybrid Algorithmic Taxonomy

Classification of collaborative and integrative matheuristic frameworks. Structural mechanics of embedding mathematical programming inside adaptive metaheuristics—specifically Tabu Search memory matrices and Genetic Algorithms crossover operators—versus metaheuristic-guided mathematical decomposition.

2. Exact Decomposition & Search Space Reduction

Mathematical integration of Benders Decomposition, Lagrangian Relaxation, and Column Generation within heuristic frameworks. Leveraging exact lower bounds to prune heuristic neighborhood search spaces and accelerate convergence.

3. Mathematical Programming-Based Local Search

Design and execution of Large Neighborhood Search (LNS) driven by Mixed-Integer Linear Programming (MILP) solvers. Systematic fixing of decision variables via MIP-heuristics, including Local Branching and Relax-and-Fix paradigms.

4. Industrial Applied Logistics & Transport Modeling

Deployment of hybrid optimization frameworks to resolve large-scale operational challenges. Focused case studies in post-M&A freight logistics, port container terminal operations, warehouse layout/inventory strategies, public transit network design, and multi-modal urban mobility systems.

5. Stefan Voß RTS Compliance Modeling

Algorithmic integration of Rich Turn-Based Software (RTS) constraints into hybrid optimization flows. Structural modeling of real-time scheduling dependencies, memory state transitions, and compliance metrics inside complex facility location-routing frameworks.

6. Advanced HPC Deployment & Solver Interface

Implementation parameters on High-Performance Computing (HPC) nodes using Gurobi Optimizer 11.0.2 via native C++ APIs. Advanced memory management, parallel execution tracking, and benchmarking of non-linear cascade heuristics.