Donato **Meoli**

Research Fellow · Dipartimento di Informatica, University of Pisa

(+39) 389 157 2680 | donato.meoli@outlook.com | dmeoli.github.io | dmeoli | dmeoli |
donato-meoli | ORCID 0009-0001-2500-2606

Summary

I came to optimization from symbolic AI, and I work between the two. What holds them together is a single idea: the difficulty of a problem lies in how it is written, so the useful move is to rewrite it, as a set of smaller problems or in a different formalism altogether. A planning problem stated as a constraint satisfaction problem and then as a propositional formula becomes the business of a CDCL solver; a monolithic program split along the structure it already has inherits duality, and with it methods that never look at the whole problem at once.

On the numerical side this means decomposition, Lagrangian and Benders, the bundle methods that solve the nondifferentiable duals they give rise to, the parallel solution of the independent subproblems, and exact combinatorial algorithms, dynamic programming above all, wherever a subproblem turns out to be a knapsack, a shortest path or a min-cost flow.

On the symbolic side, knowledge representation and reasoning: rule-based expert systems for domains whose knowledge is codified and whose reasoning has to stay inspectable, satisfiability, planning, and the translations between them. Where the two sides meet, heuristics learned from data placed exactly where an exact method makes a choice, so that the learned part chooses and the exact part still guarantees.

Publications

A. Frangioni, C. Gentile, **D. Meoli**. *Dynamic programming for the single-unit commitment problem with spinning reserves and reactive power*. Submitted, 2026.

Reserves and reactive power are absorbed into the polynomial dynamic programming algorithms for the single-unit commitment problem at essentially no algorithmic cost, by a per-period partial minimisation that folds them into an effective convex piecewise-quadratic production cost; the two resulting solvers outperform a state-of-the-art MILP solver, with optimal modelling choices, by roughly two orders of magnitude.

D. Fioriti, A. Pampado, C. Scarpelli, G. Pasini, G. Lutzemberger, S. Barsali, D. Poli, **D. Meoli**, L. Mencarelli, A. Frangioni. *Enhancing Energy System Modelling with advanced mathematical decomposition techniques: feasibility of coupling SMS++ and PyPSA*. Proceedings of the 2025 IEEE International Conference on Environment and Electrical Engineering and 2025 IEEE Industrial and Commercial Power Systems Europe, pages 1–6, 2025. doi:10.1109/EEEIC/ICPSEurope64998.2025.11169291

Research Software

SMS++ • main maintainer, with A. Frangioni, since 2021.

A framework for block-structured optimization, in which a model is a tree of *Block*s and an algorithm is a *Solver* that attaches to one, so that a single instance can be solved monolithically, dualized, or split by scenario without rewriting the model. Written end to end: *SVMBlock*, support vector machines as a Block in both formulations; *TwoStageStochasticBlock* and *MultiStageStochasticBlock*, here-and-now design over wait-and-see recourse, and scenario trees built out of it; *BendersDecompositionSolver*, generic Benders over any partition of a Block; *BranchAndXSolver*, relaxation-agnostic branch-and-X. Major contributions to *UCBlock*, including the two exact dynamic programming solvers for the single-unit commitment problem with reserves and reactive power, to *BundleSolver* and *MILPSolver*, and to the core: Block, Solver, Function, Configuration, serialization, and the template every new module is generated from.

aima-python • contributor since 2019.

Reference implementation of the algorithms in Russell & Norvig's *Artificial Intelligence: A Modern Approach*, of which I am the fourth-most-active contributor by commits. Contributed the conflict-driven clause learning solver and its branching heuristics, the AC3b, AC4 and GAC constraint propagation algorithms, the translators that recast a planning problem as search, as a constraint satisfaction problem and as satisfiability, support vector machines and the linear learners, and the algorithms missing from the fourth edition, among them game theory, expectation maximisation, Kalman filters, dynamic Bayesian and decision networks, and SARSA.

OptiML • author, since 2020.

Optimization algorithms, from line search and Newton-type methods to proximal bundle and interior point, together with the learning models trained by them, so that a method and the model it serves can be studied against each other.

Elsewhere. Bound-constraint support in *qpsolvers*; corrections in *SciPy*, *HiGHS*, *MCFClass* and *FastFlow*; the linkage of the COIN-OR distributions on Windows. Earlier work in symbolic reasoning and knowledge representation: *NeuroSAT*, neuro-symbolic branching heuristics for satisfiability; *PESAD*, an expert system on the DSM-5-TR criteria for anxiety, obsessive-compulsive and trauma-related disorders; *WS4J* and *WNAffect*, semantic relatedness and affect over WordNet.

Experience

University of Pisa — *Dipartimento di Informatica, DESTeC*

Research Fellow — *Dec. 2021 - Present*

- Decomposition methods and solvers for large-scale optimization, and core development of SMS++, within the AUTENS, RESILIENT and PowerMax research projects.
- Applied to planning and scheduling under uncertainty, where a general-purpose solver alone does not close the instance.

Exprivia S.p.A. — *Molfetta, Bari, Italy*

Data Scientist — *Sept. 2018 - Feb. 2019*

- Learning models for predictive maintenance on multivariate time series, for waste classification, and for real-time detection and counting, each taken from prototype to a service in production.

Reports

Support Vector Machines — *University of Pisa*

A comparative study of the formulations from an optimization point of view — *June 2021*

Education

University of Pisa — *Pisa, Italy*

MSc in Computer Science, Artificial Intelligence — *Jan. 2020 - Present*

University of Bari "Aldo Moro" — *Bari, Italy*

BSc in Computer Science — *Oct. 2014 - Apr. 2018*

Grade: 110/110 cum laude