Contribution ID: **41** Type: **Apresentação regular**

One Model, Many Constraints: Multi-task learning for Multi-depot Vehicle Routing Problems

The Vehicle Routing Problem (VRP) is a fundamental combinatorial optimization challenge with wide-ranging applications in logistics and transportation. While machine learning has recently gained traction as a scalable alternative to traditional solvers, most existing methods are designed for a single specific VRP variant, limiting their generalizability to solve a diverse range of VRP problems. To address this, Multi-task learning (MTL) —a learning paradigm in which a single model is trained to solve multiple related tasks —has emerged as a promising method, enabling shared learning across different VRP formulations. However, prior MTL efforts have focused mainly on single-depot VRPs, overlooking the more realistic and complex Multi-Depot VRP (MDVRP). In this work, we introduce a reinforcement learning-based MTL model capable of solving not only the classic MDVRP, but also other variants incorporating backhauls, open routes, route duration limits, time windows, and any combination of these constraints. In total, our unified model can solve 16 distinct MDVRP formulations without requiring architectural changes or retraining. Extensive experiments show that our approach achieves minimal solution gaps compared to state-of-the-art meta-heuristics, while operating at a fraction of their computational time.

Author: CORRÊA, Arthur (Departamento de Engenharia Mecânica, CEMMPRE, ARISE, Universidade de Coimbra, Coimbra, Portugal)

Co-authors: MONIZ, Samuel (Departamento de Engenharia Mecânica, CEMMPRE, ARISE, Universidade de Coimbra, Coimbra, Portugal); SILVA, Cristóvão (Departamento de Engenharia Mecânica, CEMMPRE, ARISE, Universidade de Coimbra, Coimbra, Portugal)

Presenter: CORRÊA, Arthur (Departamento de Engenharia Mecânica, CEMMPRE, ARISE, Universidade de Coimbra, Coimbra, Portugal)

Session Classification: Session 5.1 - Vehicle routing