IFORS2023

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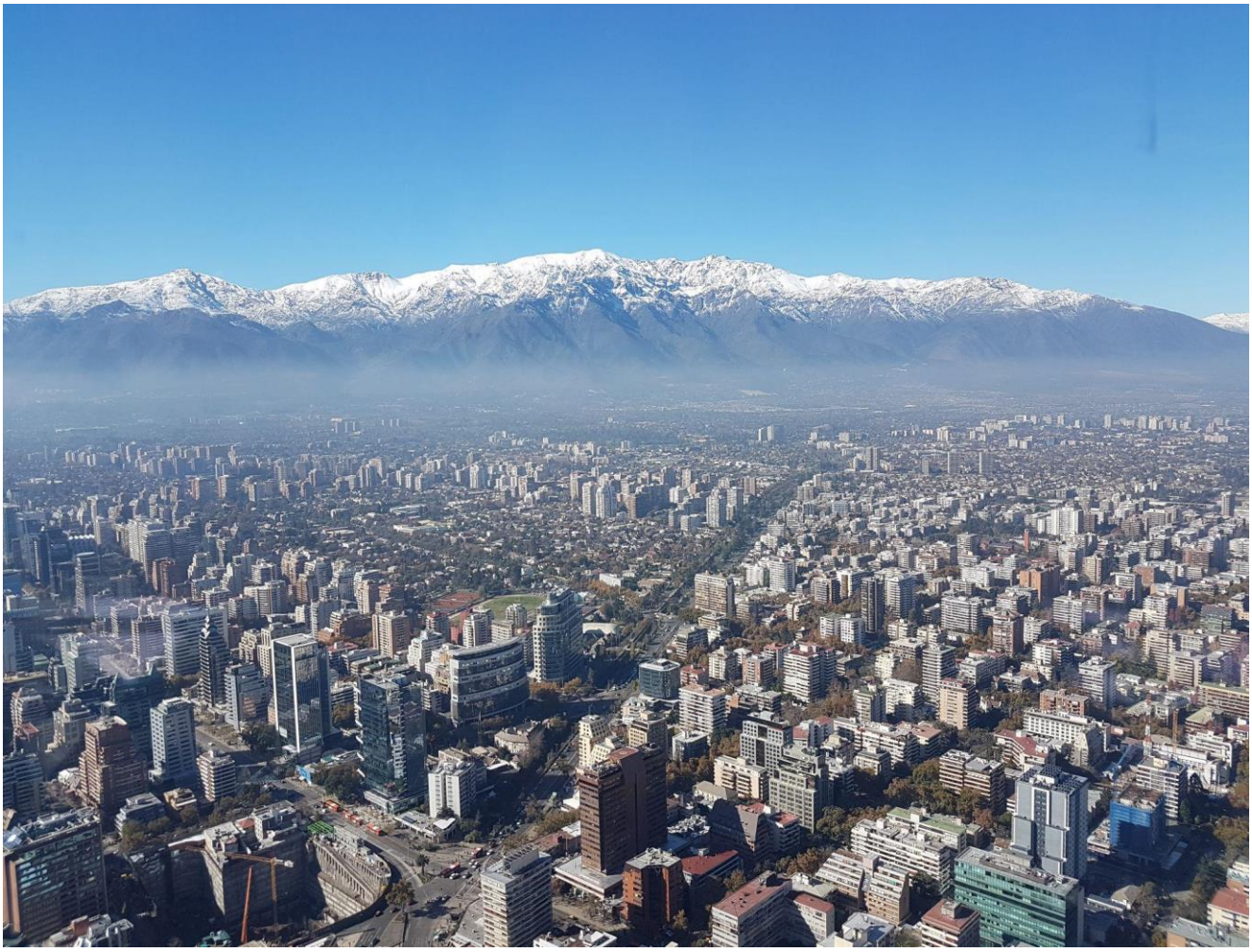

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Proceedings of the 23rd International Conference of the International Federation of Operational Research Societies

Alice E. Smith, Jorge R. Vera, and Bernard Fortz (editors)

achieves improvements from around 0.4% to 6.36%, compared to previous results from a similar genetic algorithm. These findings demonstrate the effectiveness of our approach in addressing the Home Health Care Routing and Scheduling Problem.

4 - Optimizing the door-to-door transport of people with reduced mobility in the city of Barcelona
Helena Ramalhinho Lourenco, *Laura Portell*

Dial-a-ride problems (DARP) involve designing routes for transporting people from a specific origin to a specific destination. In particular, we introduce the rich heterogeneous DARP (rHDARP), inspired by the daily door-to-door transport of people with reduced mobility in the city of Barcelona. The rHDARP considers multiple constraints, such as heterogeneous users and vehicles, time windows, maximum ride and waiting times, and the possibility of an accompanying staff member when required. We apply our metaheuristic based solution to a real-world case study of the Transport Service for People with Reduced Mobility in Barcelona and demonstrate the efficiency and cost-effectiveness of our method compared to the current routes being used. Our results show a significant improvement in the quality of service for users and highlight the potential of our approach for solving real-world transportation problems.

Recent Applications of Metaheuristics and Matheuristics in Industrial Engineering Problems

Cluster: Metaheuristics
Invited session
Chair: *Debora Ronconi*

1 - On the advances of metaheuristics for parallel machines scheduling: Computational evaluation and guidelines for efficiency.
Gustavo Alencar Rolim, *Marcelo Nagano*

Metaheuristics are vastly adopted solution techniques in discrete optimization, and they have attracted a special attention from both scientific and industrial communities. In the past few years, the number of these approaches has been continuously growing with the emergence of new algorithms inspired by various phenomena. Since the unrelated parallel machines scheduling problem with sequence-dependent setups has many practical applications, it has generated a great impact in the field, resulting in the publication of numerous metaheuristics over the last 20 years. Although this research leads to new insights, it unavoidably induces certain problems. First, most of the methods proposed for makespan minimization do not provide a proper consolidation of the existing knowledge, so it is impossible to determine the ones most efficient in terms of the solution quality and the computational effort required. Second, the proposed methods become also increasingly complex, making them more difficult to understand and apply. Third, the state-of-the-art remains unclear due to the absence of rigor and adequate formalism, as well as the lack of a homogeneous framework to conduct a fair comparison between methods. To avoid or at least alleviate these issues, we interpret and implement several metaheuristics not previously compared and conduct computational experiments in a standardized set of conditions. We comment on their performance and classify solution encoding schemes, neighborhood exploration structures, and acceleration procedures to determine key aspects for the design of efficient algorithms.

2 - The Capacitated Family Traveling Salesperson Problem
Saúl Domínguez-Casasola, *Jose Luis Gonzalez-Velarde*, *Yasmin Rios-solis*

Retail companies have increased their desire to fulfill their consumers' orders rapidly. The picker's itinerary problem in massive warehouses motivates the Capacitated Family Traveling Salesperson Problem (CFTSP), a Family Traveling Salesperson Problem variant. In the CFTSP, we consider a graph where the nodes are partitioned into disjoint families; the problem consists of selecting a given quantity of nodes per family and deciding the sequence the nodes will be visited by a set of capacitated agents to minimize the total distance traveled by the pickers. We propose an integer linear programming formulation for this problem. We develop five specific sub-tour inequalities sets, then experimentally tested with linear solvers and compared with the classical approaches. We also propose an alternative for large instances: a Biased Random-Key Genetic Algorithm with four decoder algorithms finding high-quality solutions in short computational times.

3 - An adaptive multi-objective Biased Random-Key Genetic Algorithm to schedule technicians and tasks
Debora Ronconi, *Ricardo Damm*, *Antonio Chaves*, *José Angel Riveaux*

This work addresses an enhanced Biased Random-Key Genetic Algorithm to solve a multi-objective version of the Service Technician Routing and Scheduling Problem, involving daily planning of technicians' tasks (such as installing a device or providing equipment maintenance to businesses). Each task has a priority level representing the importance of the customer. In addition, the time windows of each task are associated with customers' availability, technicians having the skills allowing them to perform each task, and technicians' working hours and lunch breaks must be respected.

Two goals are sought simultaneously in line with the demands and expectations of large cities' customers. On the one hand, we aim to maximize the sum of priority values associated with the tasks performed. On the other hand, we aim to serve priority customers, as soon as possible. For this problem, a bi-objective mixed integer programming model is proposed. Furthermore, a multi-objective version of the Biased Random-Key Genetic Algorithm (multiBRKGA) is also developed to explore the problem's characteristics and search space properly. BRKGA works with a population of solutions, making it a natural candidate to be applied to multi-objective problems. Besides, the practical application of BRKGA in several combinatorial optimization problems motivates this study. Moreover, we use the Q-Learning method to control the parameters of the multiBRKGA during the evolutionary process.

Extensive numerical experiments are presented, and a comparative study was conducted with Non-dominated Sorting Genetic Algorithm II and the Strength Pareto Evolutionary Algorithm 2 - widely used methods and particularly well-suited for many combinatorial problems. Both algorithms were adapted to use random keys for the solution representation and the same decoders proposed for the multiBRKGA-QL. While the considered methods have a similar performance in small-sized instances, the proposed multiBRKGA-QL outperforms the other approaches in large-sized instances with up to 200 tasks and 30 technicians, the size of the instances appearing in practice. In a comparison made with the optimal Pareto set for small problems, on average, the BRKGA found 96% of the Pareto-optimal solutions, achieving 99.8% of the optimal Hypervolume and 0.999 of the Epsilon Multiplicative Indicator.

Metaheuristics Applied to Problems in Natural, Industrial and Health Crises

Cluster: Metaheuristics
Invited session
Chair: *Andréa Cynthia Santos*

1 - A fix-and-optimize matheuristic to solve the location-allocation of vaccination facilities: the case of Jalisco, Mexico.
Marisol Sarai Romero Mancilla, *Jaime Mora Vargas*, *Angel Ruiz*