

SIMULATION AND OPTIMIZATION OF AN ON-DEMAND RAIL-ROAD TRANSPORTATION SYSTEM IN SPARSELY POPULATED AREAS

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Mobility in sparsely populated areas

- Sparsely populated areas with a **lack of mobility solutions and public transport**
- **Inadequate** public transport offer with low frequency
- **First and last miles problem** almost impossible to solve
- Personal car quasi-mandatory to move

Flexy vehicle



Flexy Vehicle

- **Rail-Road** vehicle that can switch mode without stopping
- 6/9 seats for customers
- **Lighter** and **cheaper** than heavy regional trains
- **Reduced maintenance costs** for vehicle and infrastructure

On-demand Transportation

- Facilitate the travel of inhabitants with **door-to-door** transportation
- New transport offer designed for sparsely populated areas
- Revive small and **unused train lines** (~ 9000 km in France)
- **Boost railway** transportation

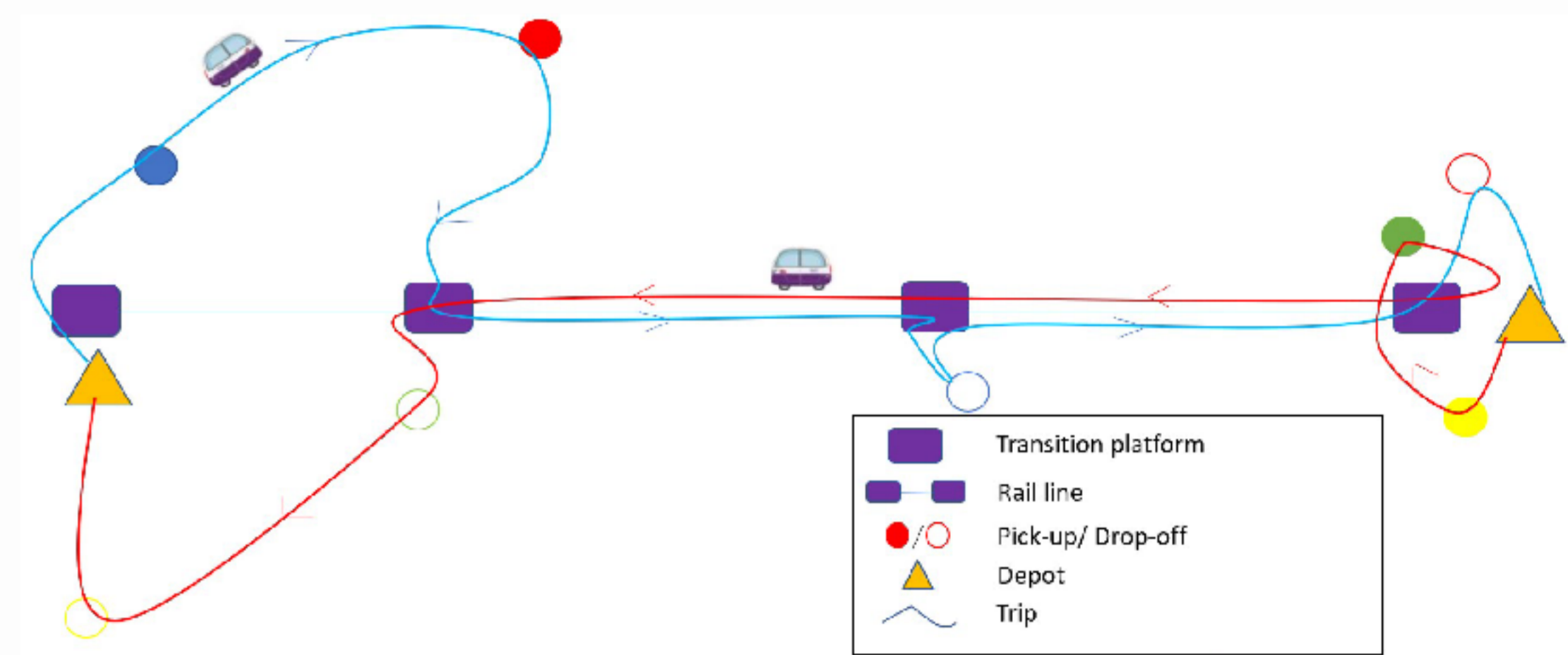


Unused rail and Flexy on rail

Original problem

Hybridisation between the Dial A Ride problem and the single track railway scheduling problem:

- Maximize the **number of clients serviced**
- Respect the coupling constraints specific to railtrack utilization



Route example with 2 vehicles

Results and perspectives

- Model as a Dial A Ride problem with railway constraints [1]
- Generation of *realistic instances* based on a small line candidate for the FLEXY
- Generic algorithm** adapted to the solution of any vehicle routing problems with resource synchronisation [2, 3]
- Study the impact of the vehicle's **rail and road speed** on the number of clients serviced
- Evaluate the impact of the new on-demand transport with a **multi-agent simulator**: MATSim
- Dynamic case**: Accept new clients while vehicles are in service
- 3-step system:
 - Acceptance of new clients through a **booking** phase
 - **Optimization** with confirmed requests for the service
 - Deal with **new clients** while the system is running

References

- [1] J. Jodeau, N. Absi, R. Chevrier, D. Feillet, Optimization of a Dial-A-Ride service with rail-road vehicles, Verolog 2022
- [2] T. Gschwind, M. Drexler, Adaptive large neighborhood search with a constant-time feasibility test for the dial-a-ride problem, Transportation Science 53 (2) (2019) 480–491
- [3] P. Grangier, M. Gendreau, F. Léhuédé, L.-M. Rousseau, The vehicle routing problem with cross-docking and resource constraints, Journal of Heuristics 27 (1) (2021) 31–61