A Bio-Inspired Approach to Solve the Problem of Regular Carpooling

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INTRODUCTION

The idea of carpooling is to share a car with several people making the same trip. Unlike hitchhiking, transportation costs are shared by everyone in the vehicle (Teal, 1987). It can be casual (travel, music festivals, etc.), or regular, such as carpooling with colleagues. Due to its economic and ecological benefits, carpooling is becoming more and more popular (Vanoutrive et al, 2012).

In most cases, carpooling reduces the cost of car trips. In fact, all the passengers of the vehicle share the expenses related to the displacement, such as the fuel cost and toll fees. The cost of this solution is significantly lower than that of taking public transportation or traveling alone by car.

Keeping in mind the time constraints of the operation, this work aims to minimize the number of vehicles used and the total distance travelled by all users.

Carpooling can be seen as a combination of a clustering and routing problem.

Using the Firefly algorithm, this work seeks to solve the problem of regular large carpools and extensions in a more effective way.

Numerous government agencies and employers have used carpooling as an effective strategy to address a wide range of climate, environmental, and congestion mitigation goals, while simultaneously increasing roadway and parking capacity for decades. (Shaheen et al, 2018).

The authors of this study are interested in regular carpooling. Finding the best groups under different constraints is the challenge.

The main objective of this study is to provide companies with efficient use of transport increase their returns. As a result, several questions are required:

- How the best group be properly determined?
- How the distances be minimized?
- How should we proceed to reduce transport costs?

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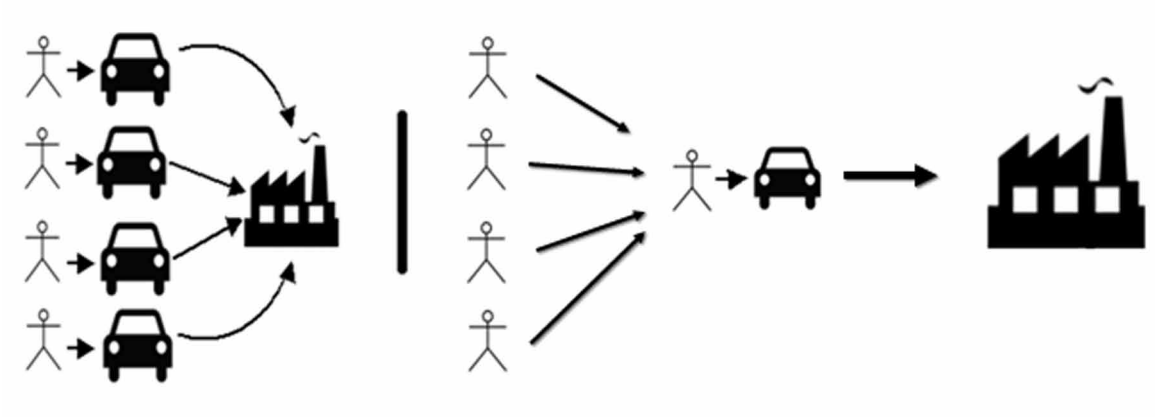
The rest of the chapters are organized as follows: section 2 provides an overview of the subject area. Sections 3, 4, and 5 describe the method used to develop the contribution. In section 6, the authors present the results obtained using the proposed approach. These results are discussed in section 7. The authors finish with a conclusion, including future possibilities.

Figure 1. Regular carpooling



BACKGROUND

This section presents an overview of the methods used to solve carpooling problems.

In 2021, Kaleche (Kaleche et al, 2021) presented An Improved Biogeography Based Optimization for the Long Term Carpooling Problem.

Unlike the popularity of its related problems, little literature exists on carpooling. In the literature, different approaches have been proposed to solve the problem of regular carpooling, including an algorithm based on recording functions (Ferrari, 2003), The ANTS algorithm (Akka, 2018), a simulation-based approach (Viegas, 2010), a multi-matching system (Yan, 2011), and the Bird swarm algorithm for solving the long-term carpooling problem (Bendaoud, 2018). In this section, the authors classify resolution methods into two main categories: heuristics and metaheuristics.

Saving Functions Based Algorithm (SFBA)

In the SFBA Algorithm, a heuristic information processing routine is used to support efficient matching in carpool systems.

In addition, they are based on saving functions and belong to two distinct classes of algorithms to provide two deferential models of this problem. The focus is primarily on modeling the problem, rather than resolving it.

By associating different users to the support of the body model, resolution methods are relatively simple. In real-world applications, the approach has shown to be able to reduce travel distance by a significant amount.

Despite this, the approach relies heavily on the distribution of users; only benchmarks with clustered distributed users have achieved satisfactory results (Ferrari, 2003).