**Introduction**

Protecting environment, reducing the pollution and improving transport infrastructures are some of the main topics of our modern society. Several researches are done to solve these problems. The implementation of I.C.T. infrastructure through the electric network and the development of electric vehicles lead us to a new era of technology.

However, some limits still exist, they are caused by the level of technology, as a result, the range of the electric vehicle is relatively low, and the charging time of the battery is also a problem.

Therefore, we have studied the thesis “ An efficient Itinerary Management Scheme for Electric Vehicles using ACO “ written by Deepika Hooda and Neeraj Kumar from Thapar university, India, who tried to find out the most efficient itinerary management which is influenced by three arguments: the distance, the cost and finally the time. The algorithm which they have chosen is ACO (Ant Colony Optimization).

We will summarize their approach, and finally try to figure out their advantages and drawbacks of this thesis.

**Hypothesis and Limits**

Hypothesis:

- Only one type of electric vehicle (no differences between electric vehicles)

- The nodes of the itinerary are the charging points

- There are less than 100 charging stations between the source and the destination

Limits

- The number of charging stations between the source and the destination

- The type of the road (free road or toll road)

- The traveling time between two stations

- The cost of charging at a station

- The type of the battery used in the electric vehicle

**Used approach**

This study uses the ACO algorithm (Ant Colony Optimization). The ants always use the most optimized path to go looking for resources. Ants make several round trips between the anthill and the resources location and leave a trail of pheromones on their path. This algorithm considers the most used path as the shortest and the one containing the higher quantity of pheromones. The longer paths will have the lowest pheromones quantities and be less used by the ant colony. The authors of the article have made a mathematic formula out of the ants behavior. Then, they modified this formula to use it with electric vehicles by replacing the quantity of pheromones, data impacting the path choice for the ants, with the cost of the travel (road toll + charging cost).

**Results**

Thanks to the ACO method, the researchers have created an algorithm that takes several arguments such as, the number of charging stations, the road type (toll road or free road), the toll prices, the travel time for each road, the charging cost at each station and finally the battery type used in the vehicle. This algorithm allows to compute for each station of the circuit the probability of going from one to another. The station with the highest probability is chosen and step by step the route is built.

**Advantages, disadvantages and errors**

Advantages:

* Developer-friendly, easy to understand:

The algorithm used in the article does not require a complex implementation. It just requires applying the probability formula deduced from the method.

* Inspired by existing algorithm:

The method used is strongly inspired by the ACO, which facilitates the understanding and the verification of the results obtained.

disadvantages :

- non dynamic itinerary :

The method proposed in the article is optimal only if the input values of arguments are fixed. In fact, all the probabilities are calculated before the departure and the path is unchangeable. As a result, not a single update will be made during the journey.

- Non efficient itinerary :

ACO is a long process which requires a lot of time to find the most efficient path. In order to limit the processing time, the authors modified the algorithm. They finally decided to determine the most efficient way by looking for the optimal path from each node to next node rather than from the beginning to the destination. As a result, the path obtained is not guaranteed to be optimal.

* Structure of the algorithm unsuitable for dealing with large quantities of data:

The final algorithm consists of 2 loops (one nested in the other one) each browsing N values ​​(N represents the number of charging stations). If N is very high (for example N> 1000), the execution time of this algorithm will be relatively long because the program will run a number of N² calculations.

In this thesis, some errors can cause problems:

- In the equation [3] and [5], they didn’t explain the difference between the variables and , which can lead to comprehension problems.

- The equation [4] is not correct, after our research, we find out that is the right one. (The equation in Wikipedia page ACO)

- Some typos in the text complicate the understanding of the results

- The example of the pathway is an idealization, who doesn’t work in all actual circumstances.

**Conclusion**

The algorithm of ACO is one of the methods which can solve the problem of itinerary management optimization. By using the ACO, the users will have the competence to find the most efficient path between two stations. Developer-friendlyness and simplicity of implementation are advantages of this method which we can’t neglect. Nonetheless, some important disadvantages still exist, like the lack of dynamism, the limited amount of calculations and the non-time efficiency, which make this solution become unusable for our project.