

Project EV4EU Clustering Applications in Electric Mobility

Power and Energy Systems

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Introduction

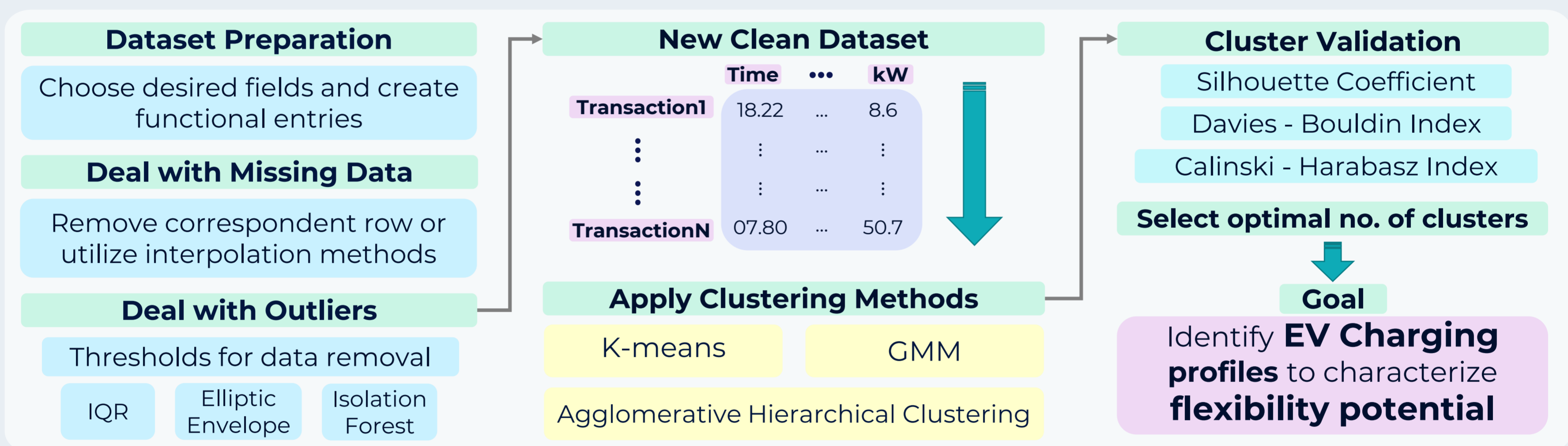
The continuous growth of electric vehicles (EVs) poses new challenges to power systems, and clustering has emerged as a powerful tool to help better understand the uncertain behavior of users and the electric vehicle supply equipment (EVSE) needs.

In this work, different **clustering** techniques were tested to identify the **usage profiles** of EVSEs (**EV Charging profiles**) and mainly the **usage flexibility**.

A use case considering both open and private EV charging data (from Caltech University, **ACN-Data**, and the publicly operated EVSEs in Greece, **GR-Data**, respectively) has been utilized to test the proposed methodology. This information is particularly important to planning problems, enabling distribution system operators and charge point operators to successfully integrate EVs into the energy system.

Methodology

The defined methodology is presented in the following schematic:



Results

- **ACN-Data** features mostly morning to afternoon long-term sessions with high flexibility potential (Fig. 3). **K-means** produced the best results (Fig. 1);
- **GR-Data** includes quick-stay sessions, mostly with low energy delivered and low flexibility potential (Fig. 4). **K-means** yielded the best results (Fig. 2).

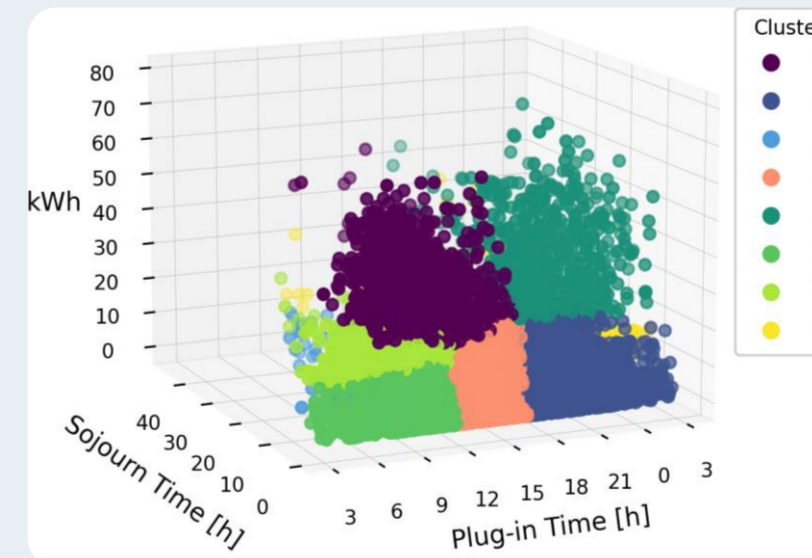


Figure 1 – ACN-Data Clusters.

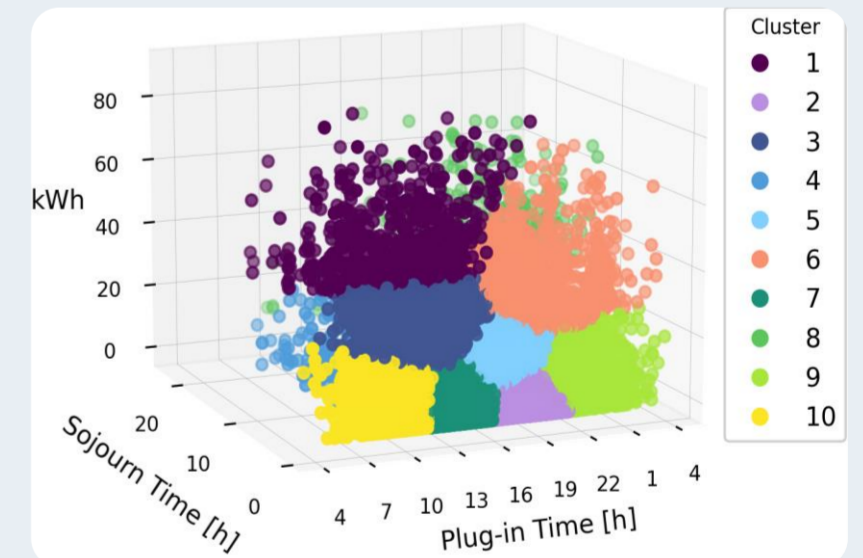


Figure 2 – GR-Data Clusters.

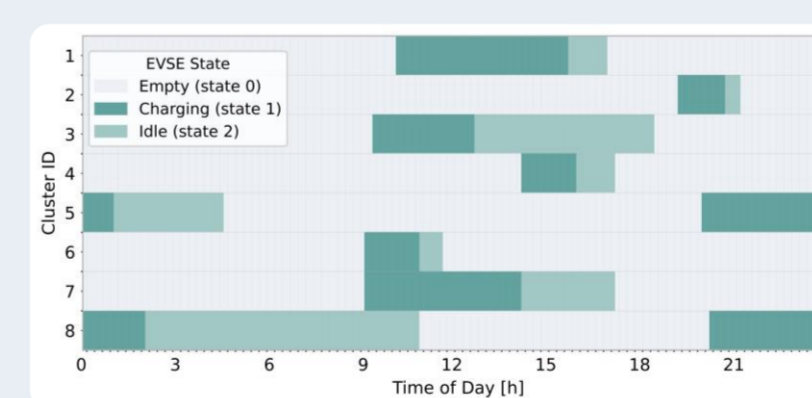


Figure 3 – ACN-Data flexibility.

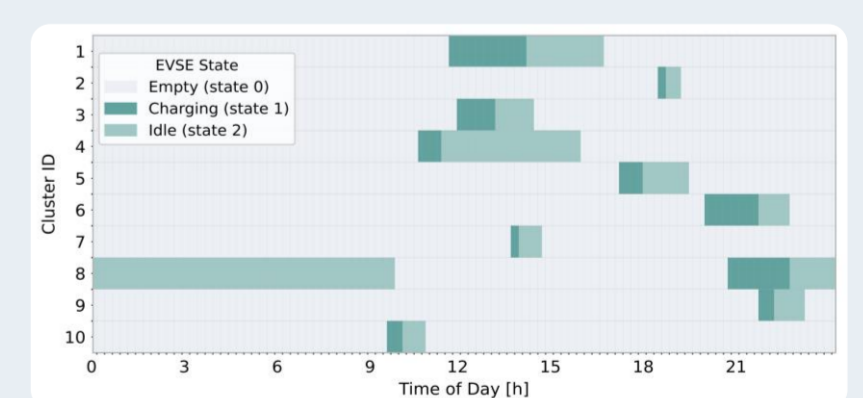


Figure 4 – GR-Data flexibility.

Scientific Outputs

This work was carried out as part of Marcelo Forte's master's thesis. It resulted in the following outputs:

- **EV4EU project deliverables;**
- **Two articles**, submitted to *Electric Power Systems Research*, Special Issue 23rd Power Systems Computation Conference, and to *Renewable and Sustainable Energy Reviews*.

Acknowledgments



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