SenSIP Algorithms and Devices REU

Anomaly Detection for Energy Load Analysis

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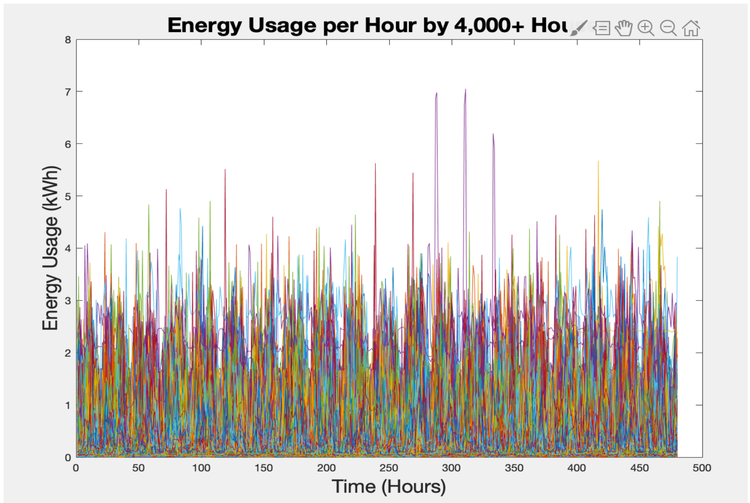
ABSTRACT

- The goal of times series analysis is to find patterns in large amounts of data that is collected over large periods of time.
- K-means clustering is used to find reoccurring patterns in energy usage.
- Anomaly detection is used to find abnormal patterns in the data.

MOTIVATION



- Identify anomalies using segmented data and forecasted data [1].

PROBLEM STATEMENT

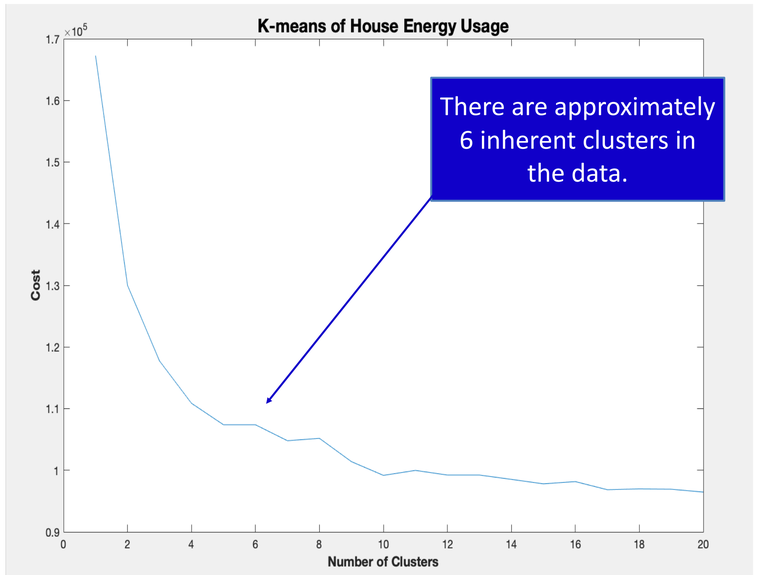
- Create an anomaly detection algorithm to identify anomalous energy usage.

EXPERIMENTAL METHODS: SENSORS

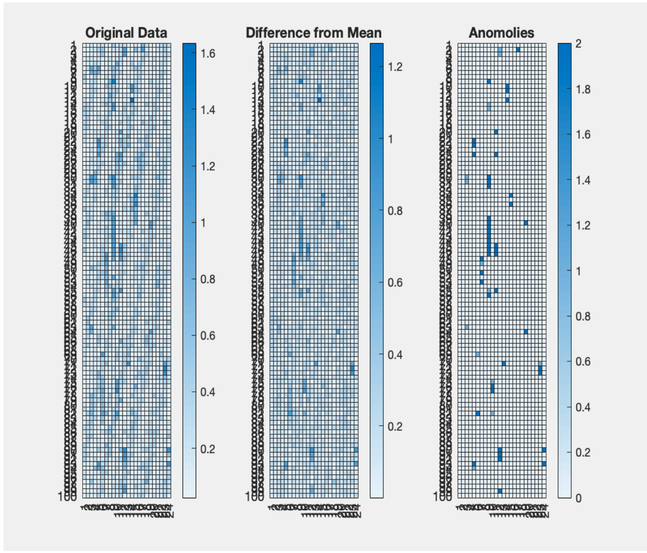
- Cleaning Data, removing houses that did not participate in the study
- K-means to find the number of clusters needed
- Anomaly detection algorithms to find patterns that are not normal [2].
- Use Gaussian Distribution density model to identify anomalies in data set

Given an $n \times d$ dataset of n d-dimensional objects $\boldsymbol{X} = \{\boldsymbol{x}_1, \boldsymbol{x}_2, \ldots, \boldsymbol{x}_n\}$, k-means determines the optimal cluster assignment $\mathcal{C}^o$ that minimizes each cluster's sum of squares (or variance).

$$\mathcal{C}^o = \arg\min_{\mathcal{C}} \sum_{c=1}^{k} \sum_{i \in c} \|\boldsymbol{x}_i - \boldsymbol{\mu}_c\|^2$$



PRELIMINARY RESULTS



CONCLUSION

- Multivariate Gaussian Models is a machine learning algorithm that is useful to detect anomalies.
- Heat maps can display anomalies to make them easier to visualize

REFERENCES

[1] J. R. Schofield, S. Tindemans, R. Carmichael, M. Woolf, M. Bilton, and G. Strbac, "Low Carbon London project: Data from the dynamic time-of-use electricity pricing trial, 2013," *UK Power Networks and EDF Energy*, Nov. 2015.

{2} D. Smith, "Machine Learning for Customer Energy Segmentation and Forecasting," *RES ASU* .

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