Black Box Modeling of the Electrical Output of a CEC

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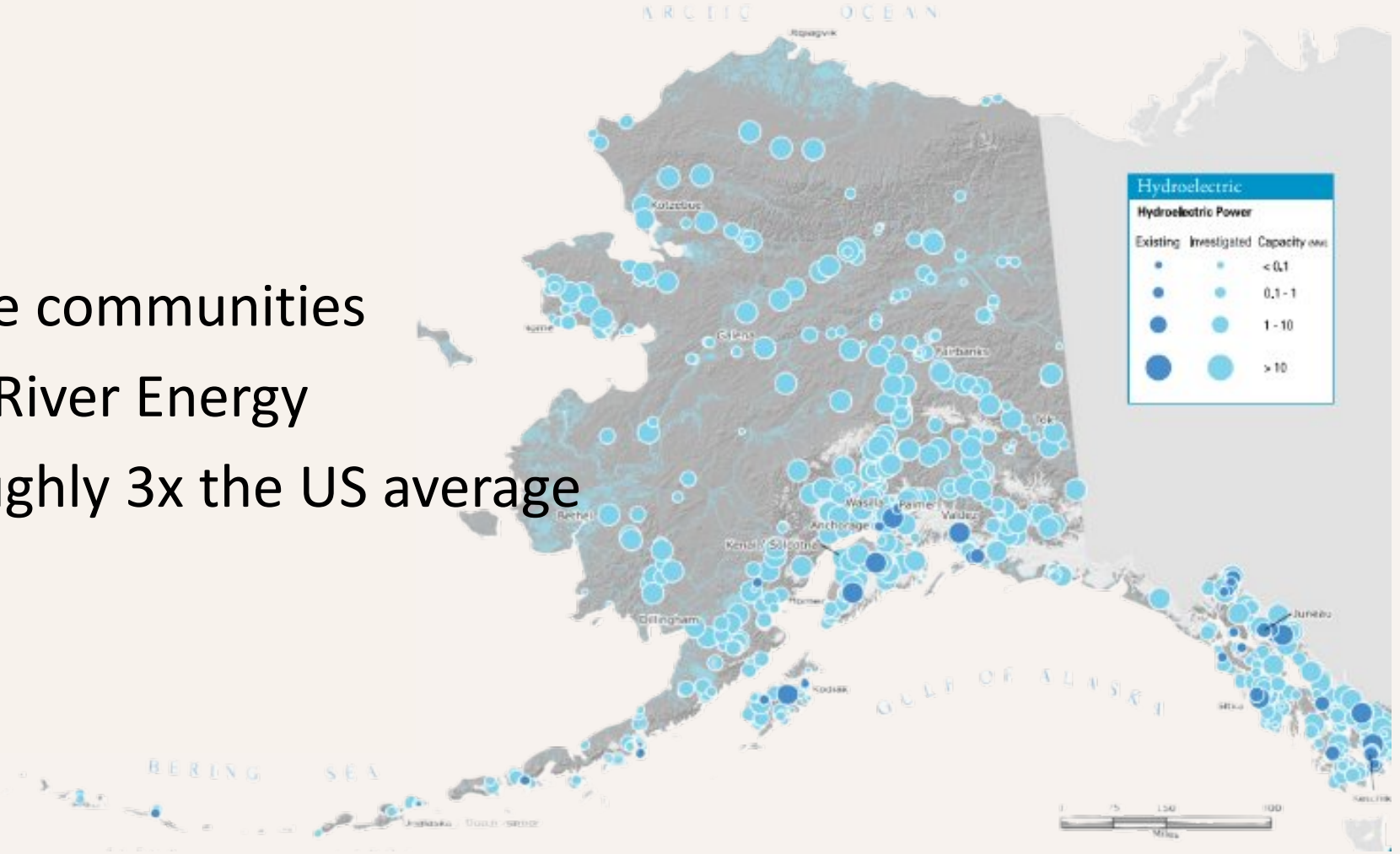
Motivation

- Over 240 remote communities
- 40% of the U.S. River Energy
- Energy costs roughly 3x the US average



(Authority, Alaska Energy, 2019)

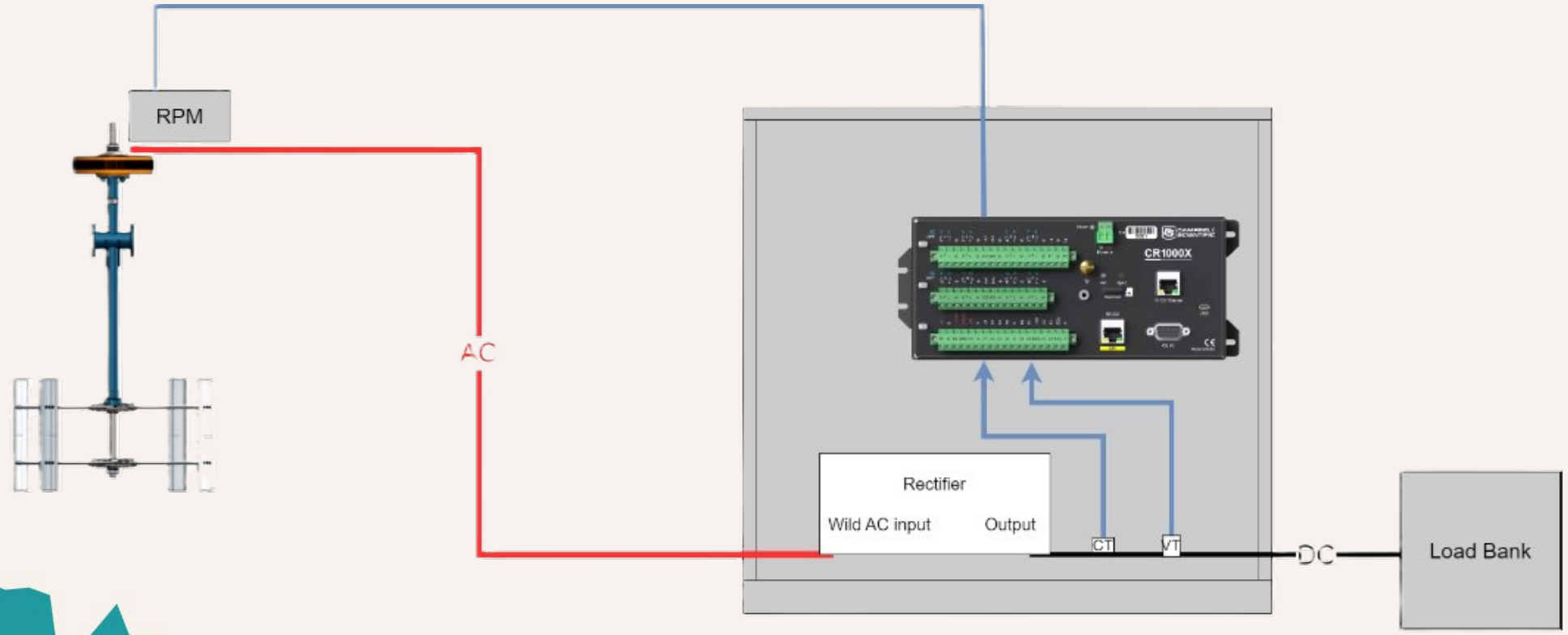
Tanana River Test Sight (TRTS) Challenges

Sediment

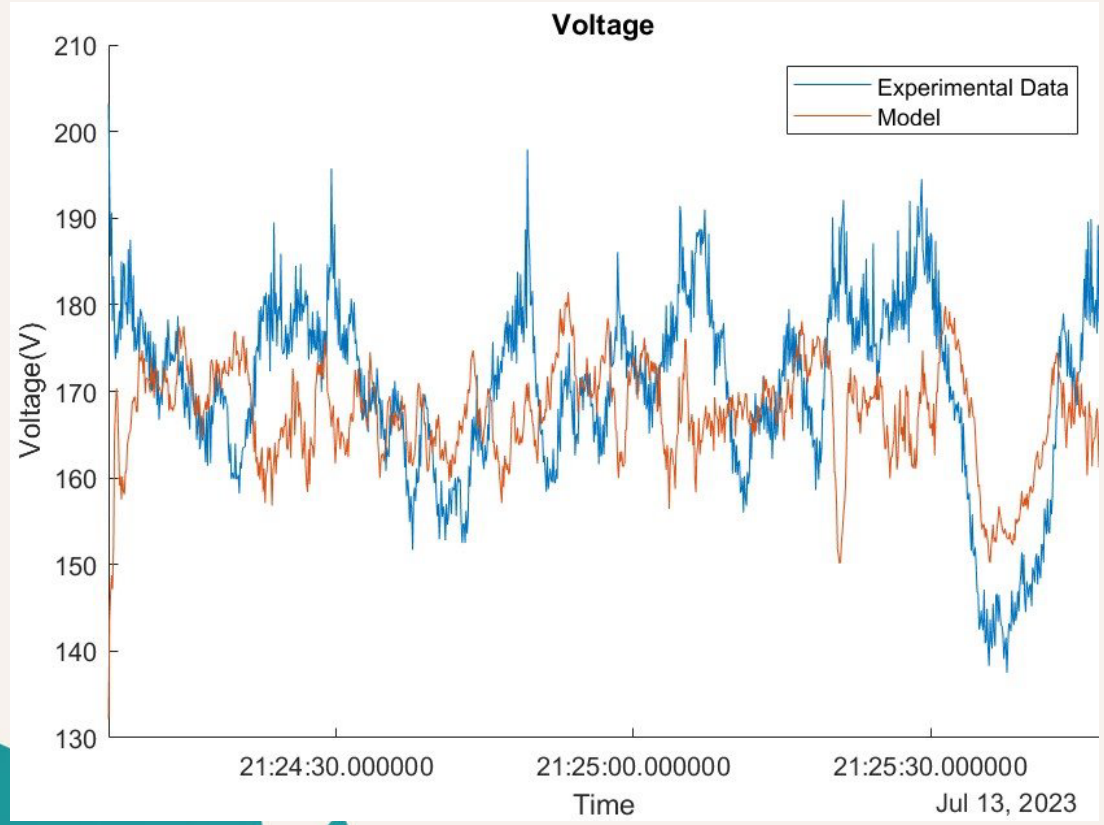
Average particle size in micrometers

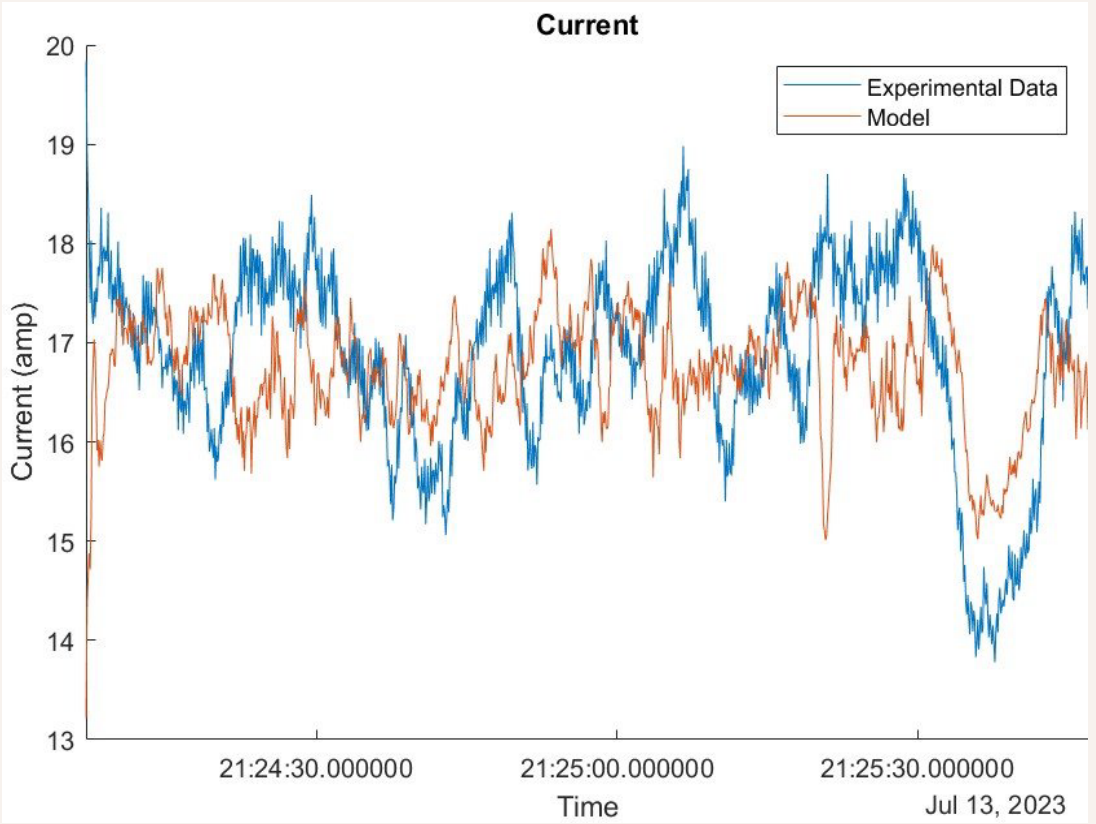
Debris

TRTS New Energy Vertical Turbine Electrical Set-up



Previous Simulink Model

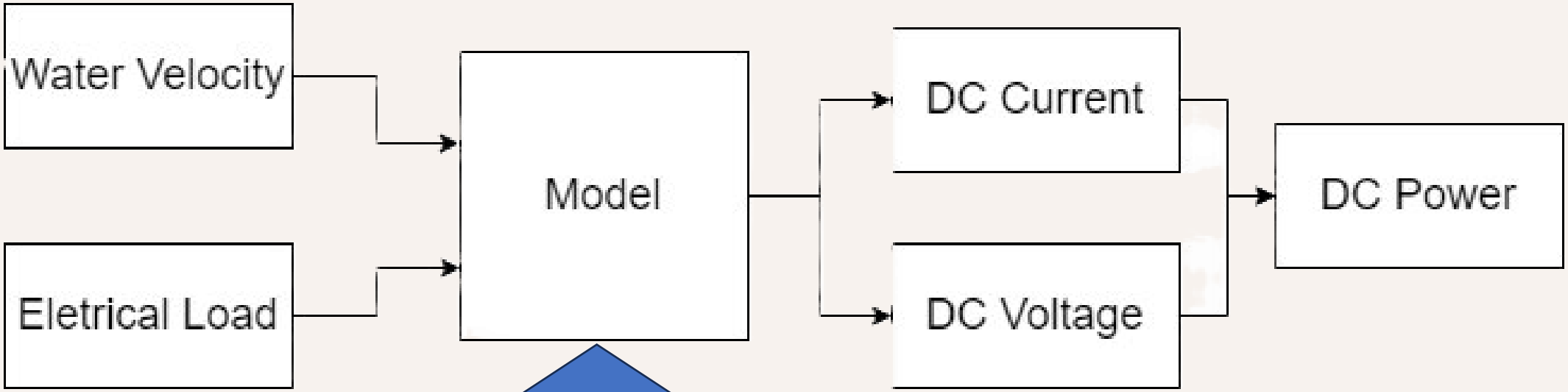




5.179% Average Error

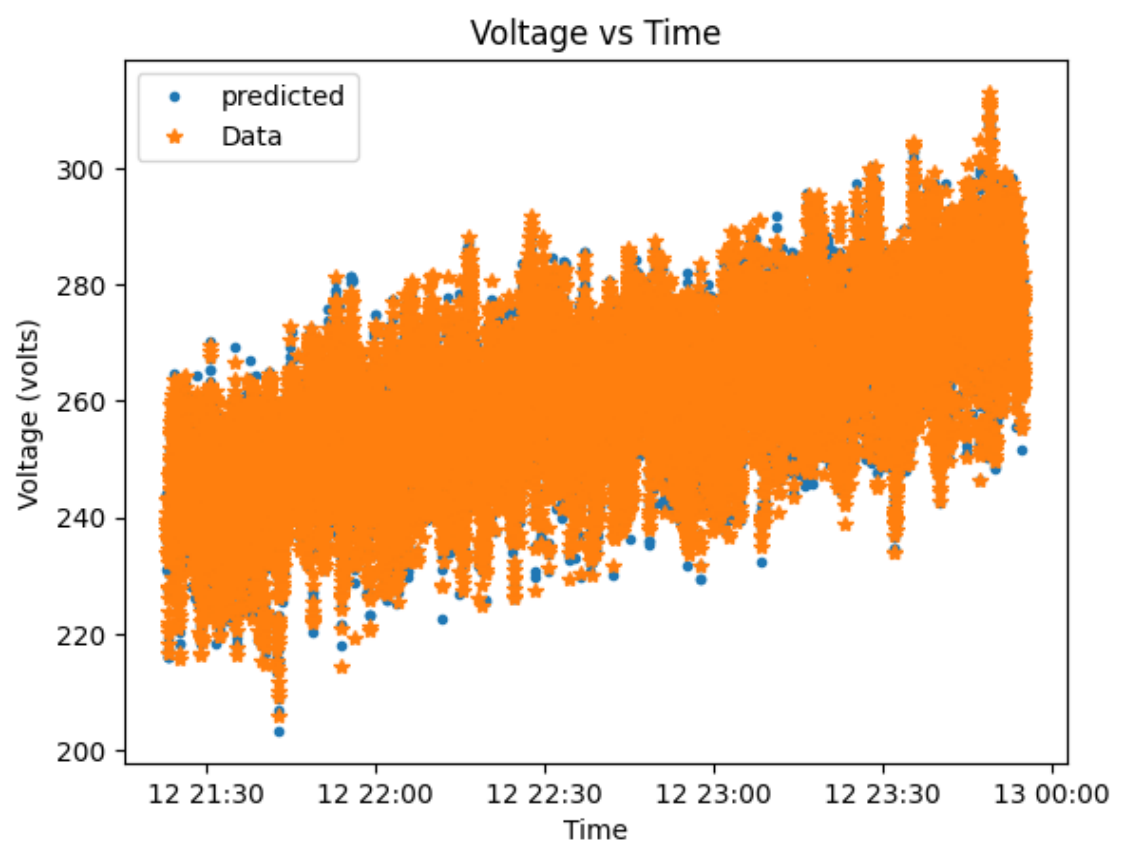
5.397% Average error

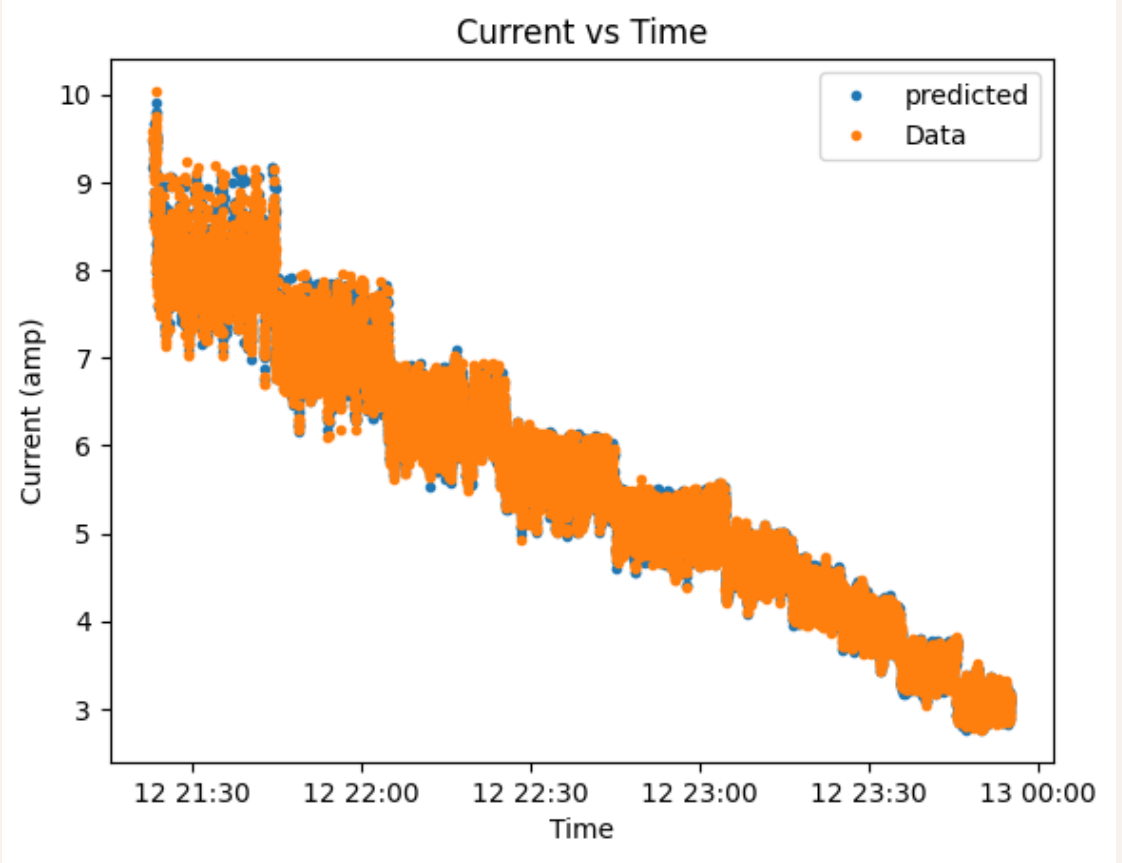
Machine Learning Model



Scikit learn
Decision Tree
Regressor model
in python

Data Comparison





Volt R squared: 0.9368489290678386

Volt MSE: 13.807773780153429

Current R squared: 0.9854717411916606

Current MSE: 0.03374016205797655

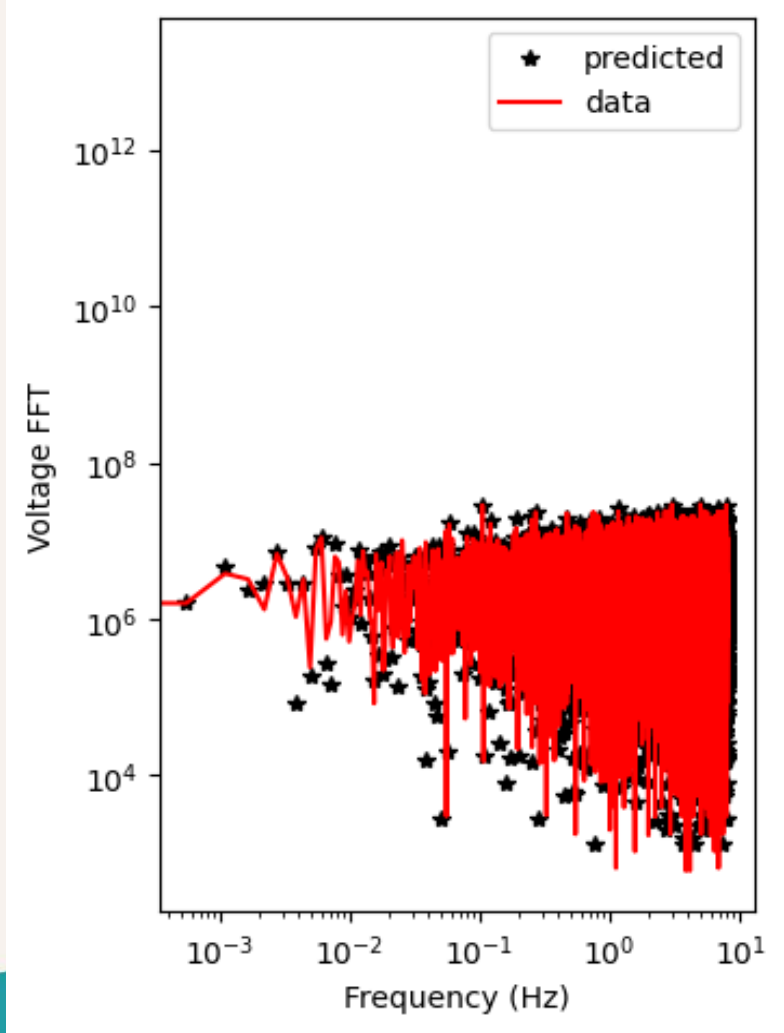
Spectrum Comparison

Voltage Spectra

P-value=0.999

Degrees of

Freedom =29182.0

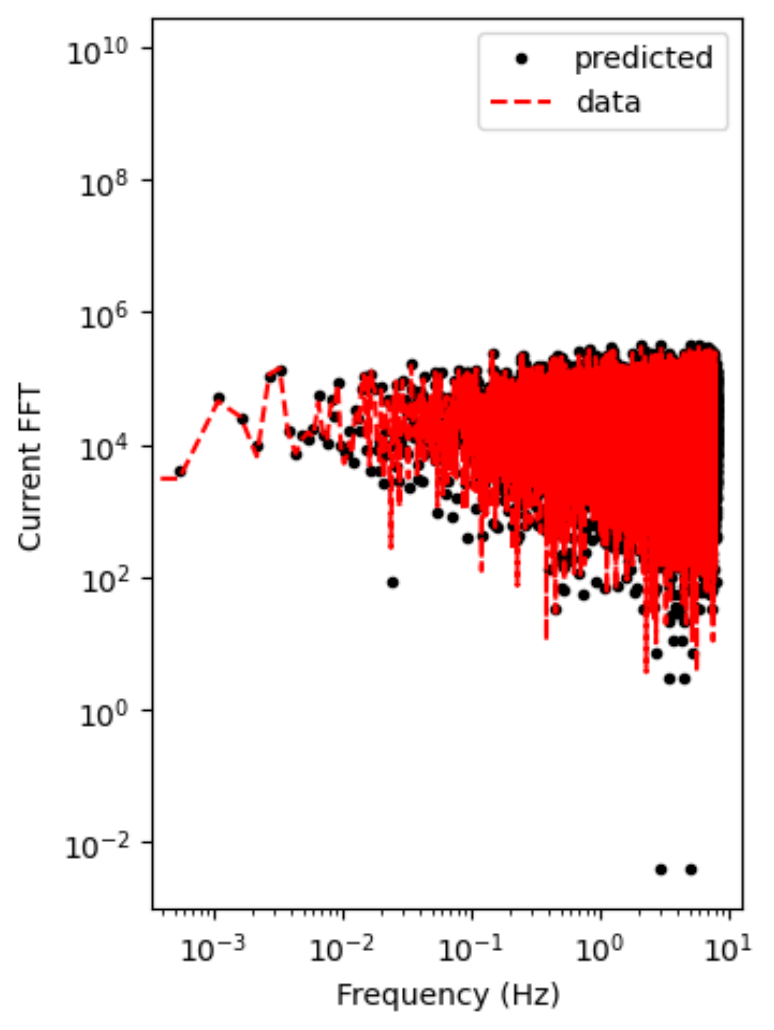


Current Spectra

P-value=0.999

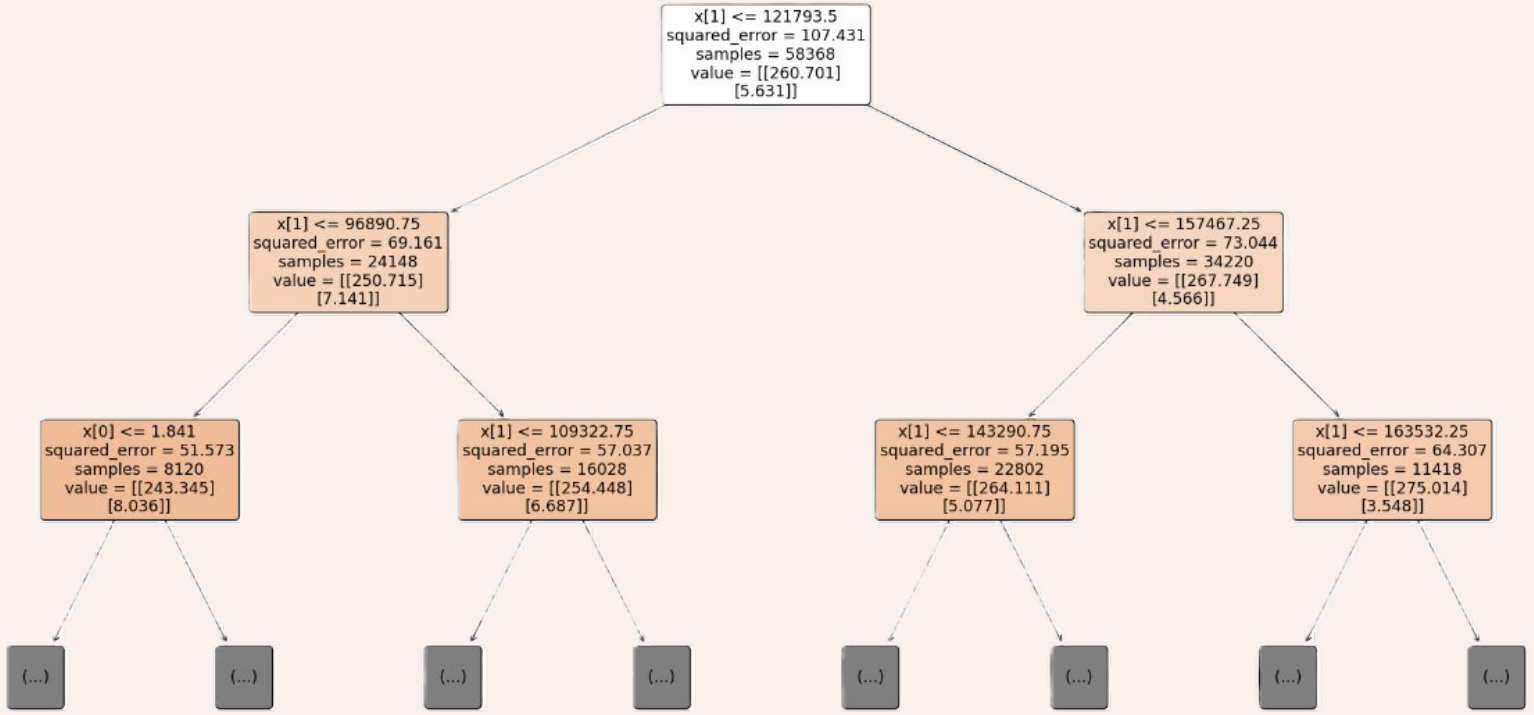
Degrees of

Freedom =29182.0



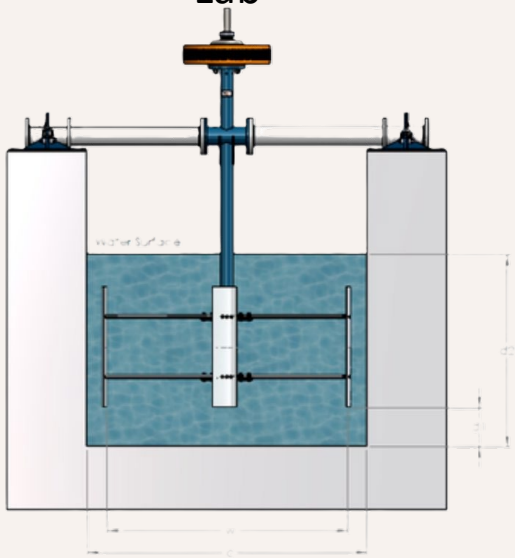
Decision Tree Model Infromation

- Max depth: 75
- Number of leaves: 58244
- Voltage: Importance: 0.508
- Current: Importance: 0.492



Applications

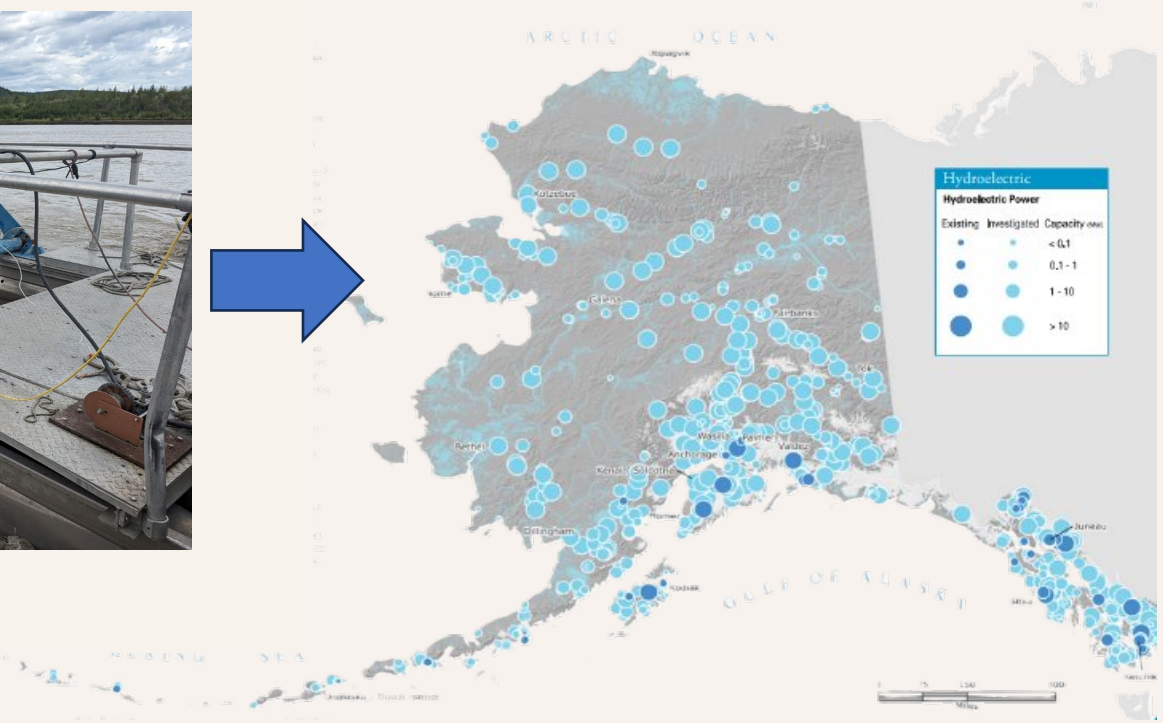
Lab



(EVG-005, New Energy, 2023)

Field

Deployment



(Authority, Alaska Energy, 2019)

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Decision Tree Model Infromation Extended

- Max depth: 75
- Min samples split: 2
- Min samples leaf: 1
- Max features:None
- Criterion: squared_error
- Number of leaves: 58244
- Parameters: {'ccp_alpha': 0.0, 'criterion': 'squared_error', 'max_depth': None, 'max_features': None, 'max_leaf_nodes': None, 'min_impurity_decrease': 0.0, 'min_samples_leaf': 1, 'min_samples_split': 2, 'min_weight_fraction_leaf': 0.0, 'random_state': None, 'splitter': 'best'}
- Voltage: Importance: 0.5079466386801587
- Current: Importance: 0.4920533613198414