EMD and Gradient Boosting Regression for NILM (Energy Disaggregation)

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Abstract

In this study a novel appliance load estimation in a non-intrusive way is presented. The proposed algorithm includes signal processing techniques such as filtering and Empirical Mode Decomposition (EMD) which is used to decompose random noise from the power consumption data collected from the smart meter. Lag features that capture the variance of the data across time are utilized. Experimental results which showcase the effectiveness of the suggested method are also presented.

System architecture

- Supervised approach, based on an ensemble of decision tree regression models - gradient boosting regression
- Temporal change of current, active/reactive/apparent power for feature extraction
- Median filtering
- Signals decomposition with EMD
- Models re-training

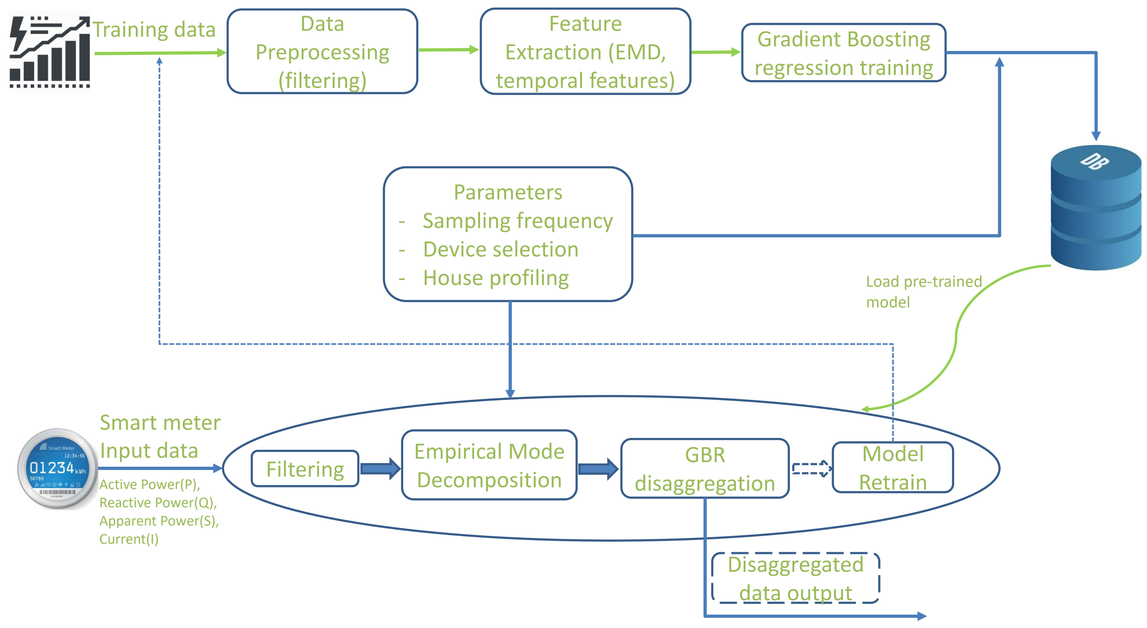

Figure 1. Disaggregation algorithm architecture.

Results

Datasets:

- AMPds dataset [1] (electric measurements of a residential user with a sampling rate of 1 min)
- CERTH/ITI's smart home [2] (sampling rate of 1 min)

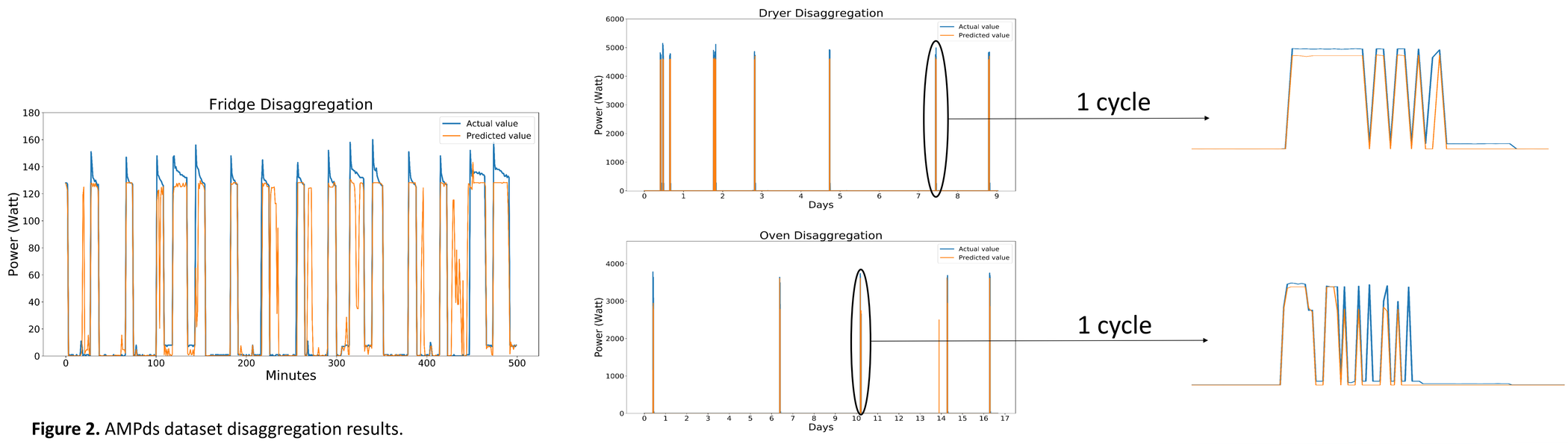

Figure 2. AMPds dataset disaggregation results.

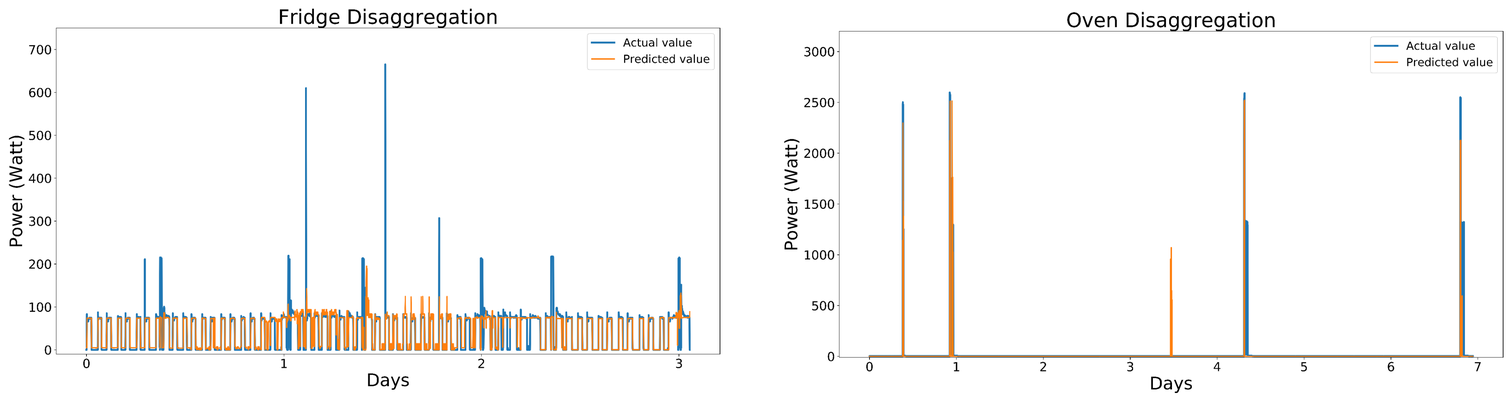

Figure 3. CERTH smart home disaggregation results.

Table 1. Evaluation metrics.

	AMPds dataset			CERTH Smart Home	
	Fridge	Oven	Dryer	Fridge	Oven
RMSE	74.1	84.1	67.8	30.9	135.9
MAE	31.4	3.78	4.2	15.1	15.6

Conclusions

- High accuracy at the prediction of the devices' on/off states
- High accuracy (RMSE and MAE evaluation metrics) of the disaggregated power values
- Incorporation by appliance manufacturers as a service

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