SaDI: A Self-adaptive Decomposed Interpretable Framework for Electricity Load Forecasting under Extreme Events

Anonymous submission

Supplementary material Introduction

The appendices are all in "supplementary_materials" folder. In "Code" Folder, "SaDI_demo.ipynb"(red in Figure 1) is the main entrance function of SaDI framework. sub-folder "ETL.py" (green in Figure 1) gives the definition referred at section "External-variable Triggered Loss" in main paper. "GAM.ipynb" (orange in Figure 1) in "GAM" folder provides source code to generate visible explainable figures. In "Technical" Folder, this "Technical_appendix.pdf" describes appendix materials and illustrates the "Experiments" procedure in the main paper.

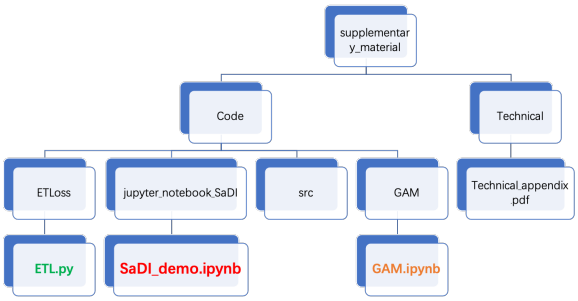

Figure 1: material introduction

Data Confidential Statements

On-line raw load data produced by Central-China and South-east China 's grid company is confidential constraint by agreements. Regretly, we could not provided related data in public. However, the Experiments procedure will illustrate here in details to help reader to understand our works.

Experiments Statements

As Experiments mentioned in main paper, Hubei,Hunan,Henan,Jiangxi,these Central-China provinces' system load cover 269 million population. Nearly recent 30 months data is provided by the grid company in Central-China. 70% sample data is used for training, 10% for tuning hyper-parameters, 20% for testing the model/ Ningbo citizen system load over 9.5 million in the South-east China. Similar rate for training, validation, and test.

Algorithm 1: Framework Experiments Procedure

DateTimeFeaturizer: Constructing temporal features
DifferenceFeaturizer: Loading difference weather features
RollingStatsFeaturizer: Rolling history load data with different windows
FeatureEnsembler: Ensembling temporal, weather and load features tog
Pred_one_component: Predicting long-term trend, short-term trend,peri

`/* Performing decomposition */`
$y_t^{LT} \leftarrow$ moving average of y_t
$y_t^{ST} \leftarrow$ moving average of $y_t - y_t^{LT}$
$y_t^{S} \leftarrow y_t - y_t^{LT} - y_t^{ST}$
`/* Modeling` y_t^{LT} `linear model */`
$\boldsymbol{w}^* \leftarrow \arg\min \sum_{t=0}^{N} (y_t^{LT} - \boldsymbol{w}^T \boldsymbol{x}_t)^2$
`/* Learn` y_t^{ST} `with GAM */`
Model1 $\leftarrow$ GAM(training set = $\{\boldsymbol{x}_t, y_t^{ST}\}$, loss=ETL)
`/* Modeling` y_t^{S} `with lightGBM */`
Model2 $\leftarrow$ lightgbm(training set = $\{\boldsymbol{x}_t, y_t^{S}\}$, loss=RMSE)
`/* Predict using learnt models */`
$\hat{y}_t^{LT} \leftarrow (\boldsymbol{w}^*)^T \boldsymbol{x}_t \quad \forall t = N \dots N+m-1$
$\hat{y}_t^{ST} \leftarrow \text{Model1}(\boldsymbol{x}_t) \quad \forall t = N \dots N+m-1$
$\hat{y}_t^{S} \leftarrow \text{Model2}(\boldsymbol{x}_t) \quad \forall t = N \dots N+m-1$
$y_t \leftarrow \hat{y}_t^{LT} + \hat{y}_t^{ST} + \hat{y}_t^{S} \quad \forall t = N \dots N+m-1$
Return $\{y_t\}_{t=N}^{N+m-1}$

Feature Engineering

Three catagraies in Table 1

Performance under extreme events

In Figure 2 we show the supplemental results to address the question in RQ2 (How does SaDI perform under extreme events). We show here the cases in Jiangxi and Henan.

Ablation Study

ETL vs MSE

Table 1: Three types of features after feature engineering

Features	Temporal features	Difference features	Rolling features
	year	**2_metre_temperature**	**load_win_7_offset_192_median**
	month	**Surface_pressure**	**load_win_7_offset_192_mean**
	day	**Total_cloud_cover**	**load_win_7_offset_192_min**
	is_workday	**Total_precipitation**	**load_win_7_offset_192_max**
	is_holiday	**Skin_temperature**	**load_win_7_offset_192_std**
	is_weekend	**...**	**load_win_7_offset_192_skew**
	day_of_month_sin	**2_metre_temperature_diff_offset_192**	**load_win_7_offset_192_q025**
	...	**...**	**...**

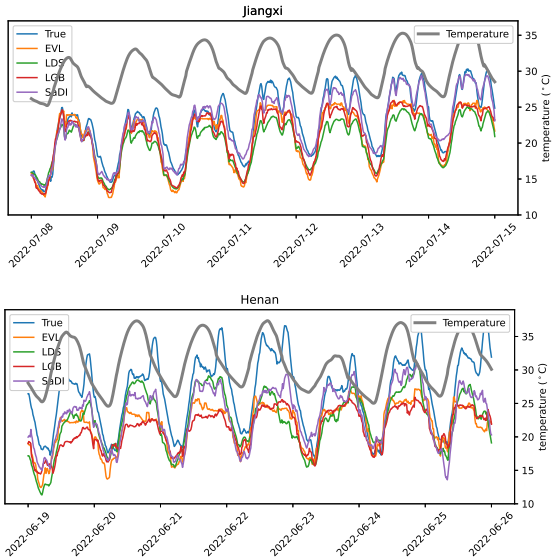

Figure 2: Performance comparison of SaDI with canonical LightGBM model and two baselines (EVT and LDS) designed for dealing with extreme events. We select two 7-day extreme events on the datasets of Jiangxi (up) and Henan (down). The Y axis is masked for confidentiality purposes.

Interoperability

6 more figures

References