Practical Methods of Defective Input Feature Correction to Enable Machine Learning in Power Systems

CURENT

Jingzi Liu[1], Fangxing Fran Li[1], Francisco Zelaya-Arrazabal[1], Hector Pulgar-Painemal[1], and Hongyu Li[1]
[1] The University of Tennessee, Knoxville

BACKGROUND

A well-trained machine learning (ML) tool may become less accurate in its performance with defective input features, even if only one input feature is defective. Also, measured input data for ML may be defective due to risks of measurement issues.

- It is worth exploring how to enable a well-trained ML tool to function reliably even with defective input features.
- The most direct and effective solution is to correct defective input features.

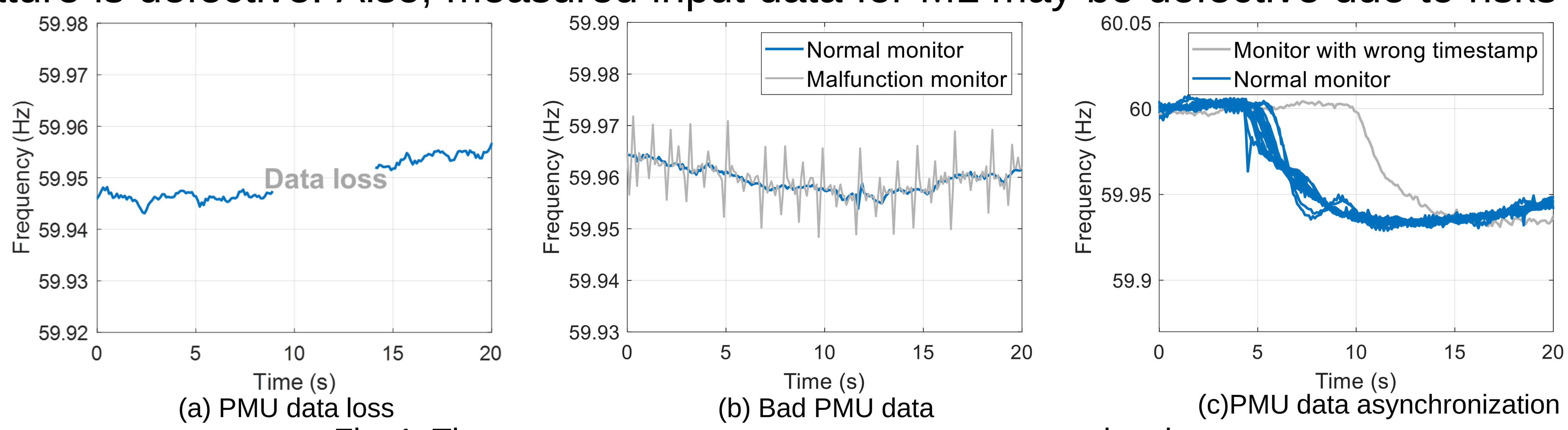

Fig. 1. Three common power systems measurement data issues.

METHODOLOGY

- A module is built to correct defective input features before the trained ML tool online application.
- Three methods are proposed for the correction module.

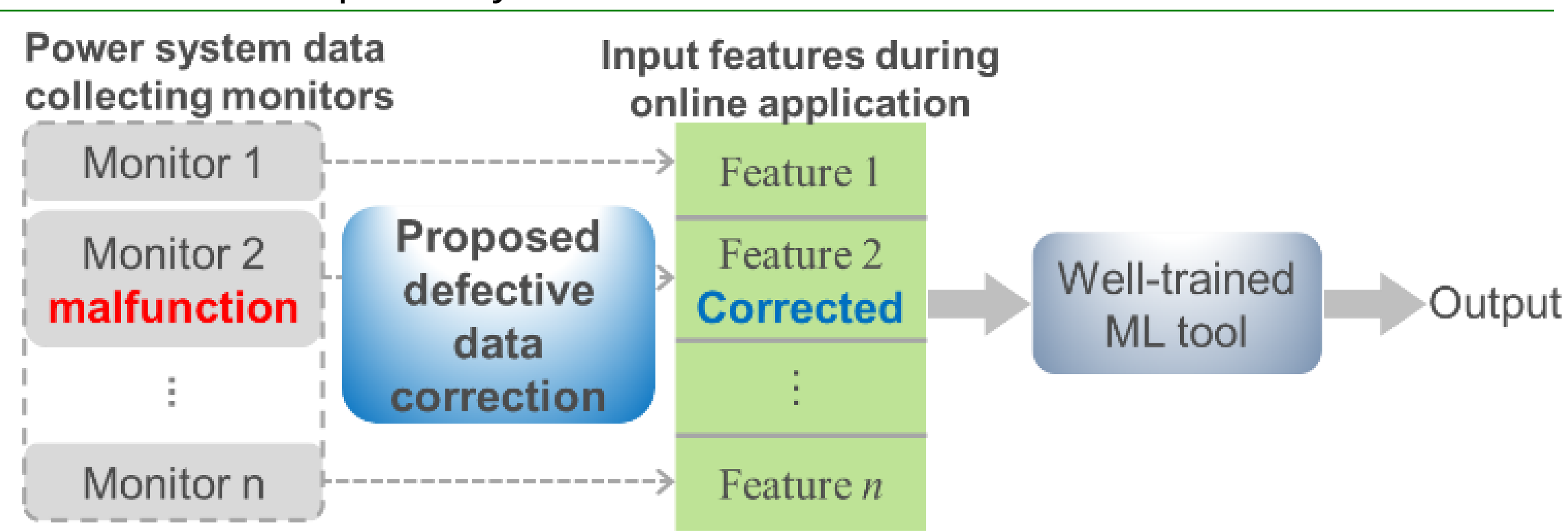

Fig. 2. The idea of defective input feature correction.

METHOD 1: STATISTICAL-VALUE-BASED METHOD

- The statistical value of the same type (i.e., the same location) input feature in the historical training set is used to complement defects.

METHOD 2: MINIMAL-ERROR-BASED METHOD

- An initial assessment is provided by the well-trained ML tool to yield the value with minimal prediction error to correct defects.

METHOD 3: DNN-BASED ADAPTIVE METHOD

- Deep neural network (DNN) models are trained to capture features in historical input data, which are invoked to yield the value for corresponding defect correction.

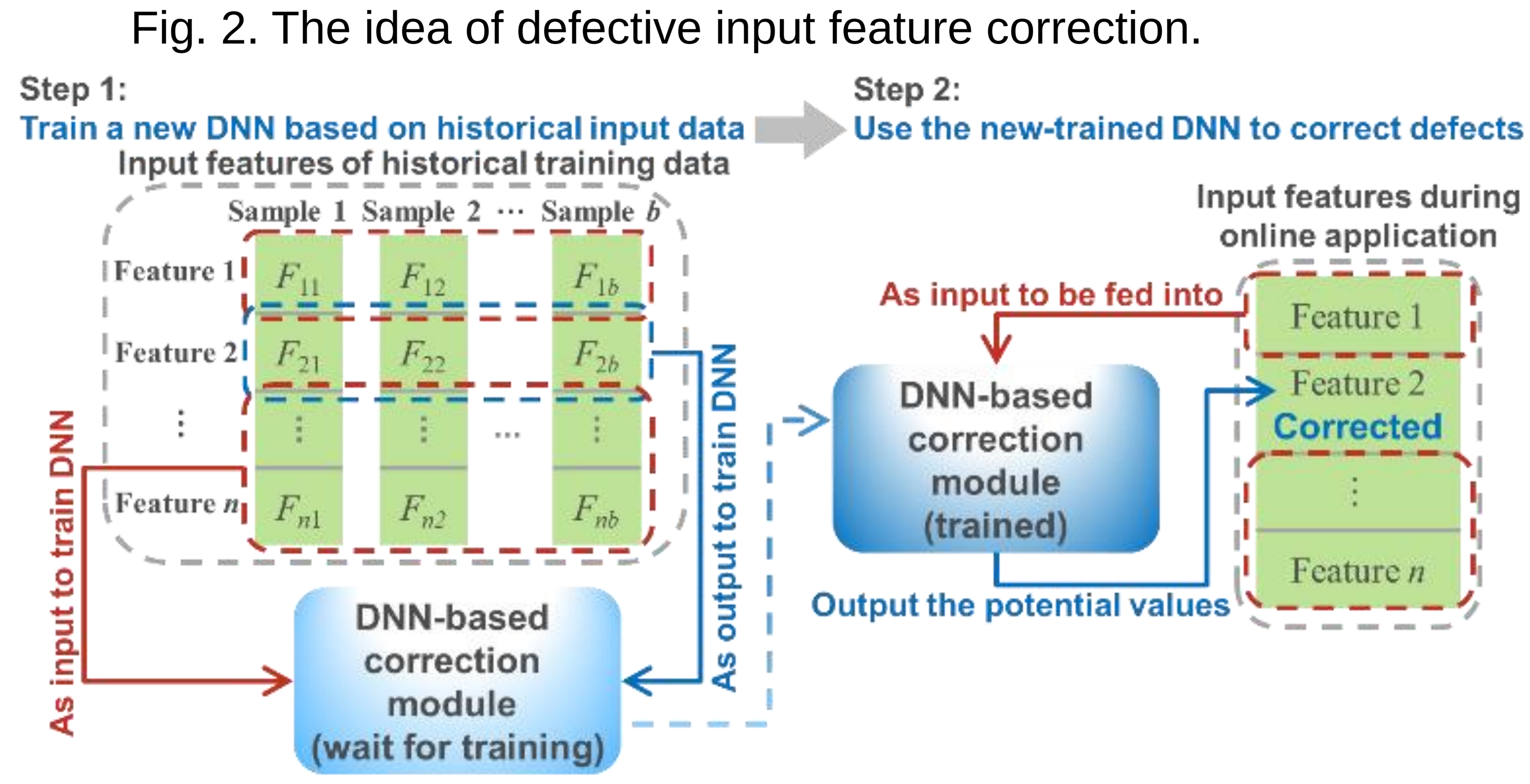

Fig. 3. The process of DNN-based adaptive method.

PERFORMANCE

Table. 1. Performance of each method.

Method	Mean error	Total time/s
Statistical-value-based method	6.07%	0.0078
Minimal-error-based method	5.70%	444
DNN-based adaptive method	1.97%	11

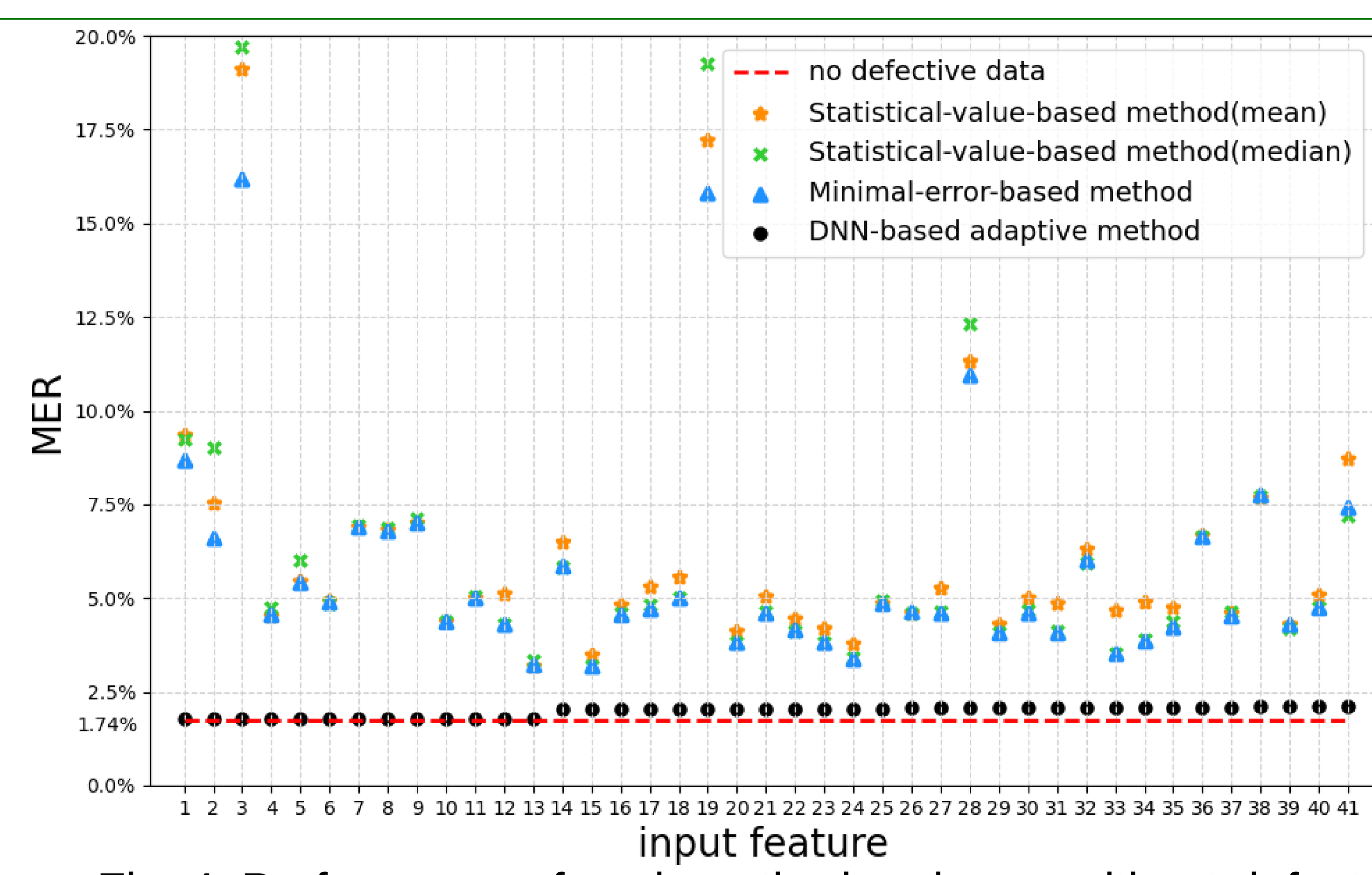

Fig. 4. Performance of each method and case without defects.

CONCLUDING REMARKS

- Three easy-to-implement, effective, and practical data-driven methods are proposed to correct defective input features for enabling ML tool smooth applications in power systems.
- Each method achieves a desirable performance for defective data correction, especially the adaptive method enables the well-trained ML tool to attain nearly the same accuracy level as the case of no defective data.

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