



HAL
open science

A comparative performance evaluation framework for power based wind turbine fault detection methods

Usama Aziz, Sylvie Charbonnier, Christophe Bérenguer, Alexis Lebranchu, Frédéric Prevost

► **To cite this version:**

Usama Aziz, Sylvie Charbonnier, Christophe Bérenguer, Alexis Lebranchu, Frédéric Prevost. A comparative performance evaluation framework for power based wind turbine fault detection methods. WindEurope Offshore 2019, Nov 2019, Copenhagen, Denmark. hal-02391923

HAL Id: hal-02391923

<https://hal.science/hal-02391923>

Submitted on 3 Dec 2019

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

A comparative performance evaluation framework for power based wind turbine fault detection methods

PO.118



Usama Aziz, Sylvie Charbonnier, Christophe Bérenguer, Alexis Lebranchu, Frederic Prevost
Univ. Grenoble Alpes, CNRS, GIPSA-lab, Grenoble, France, Valemo S.A.S, Bègles, France



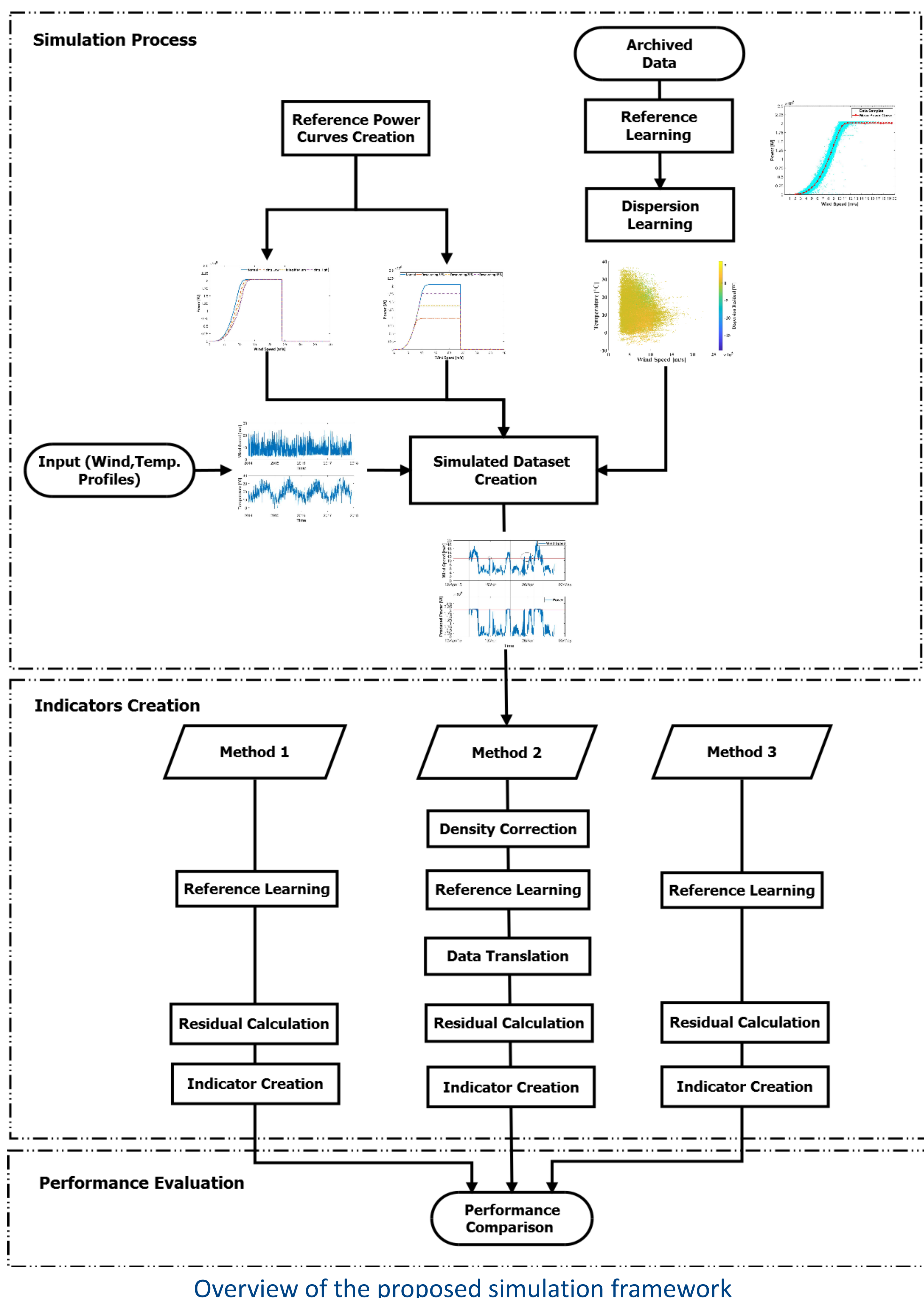
Abstract

Wind turbine (WT) operations and maintenance (O&M) teams need reliable, comprehensive and robust condition monitoring tools. Both the industry and research has seen increasing interest in the use of already installed Supervisory Control and Data Acquisition (SCADA) system data for the condition monitoring of WTs due to the availability, familiarity, cost effectiveness, relative ease of exploitation and interpretation. Maximizing power production whilst reducing downtime and maintenance costs is at the core of any condition monitoring strategy. The power based wind turbine condition monitoring systems using SCADA data as presented in the literature neither provide a comprehensive performance comparison, nor do they converge to a recommendation for best practice implementations through comparative benchmarking. This gap motivates a comprehensive performance evaluation analysis of existing solutions through an array of diverse scenarios. This rigorous analysis framework has the potential to aid with systematic transition towards generalizable condition monitoring solutions.

Objectives

- Development of a realistic simulation framework to enable rigorous analysis.
- Identification of key phenomena affecting fault detection performance.
- Comparative performance evaluation of existing fault detection methods.

Proposed Framework



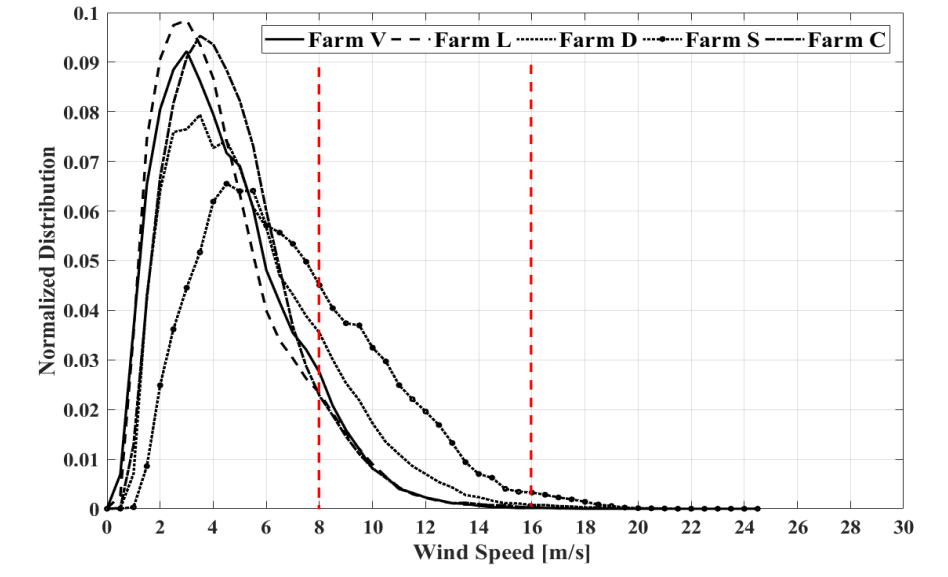
Overview of the proposed simulation framework

Implementation: Fault Detection Methods

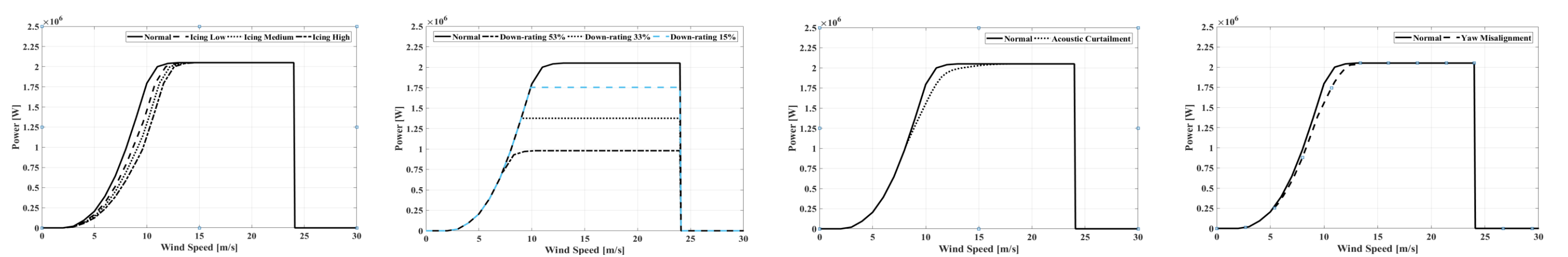
A wide ranging source of data from 5 wind farms is used for analysis.

Wind Farms	# of WTs	Location *	Year
Farm - V	6	Center-North	2014
Farm - L	3	Center-East	2014
Farm - D	6	Center-North	2010
Farm - S	5	South	2009
Farm - C	5	West	2010

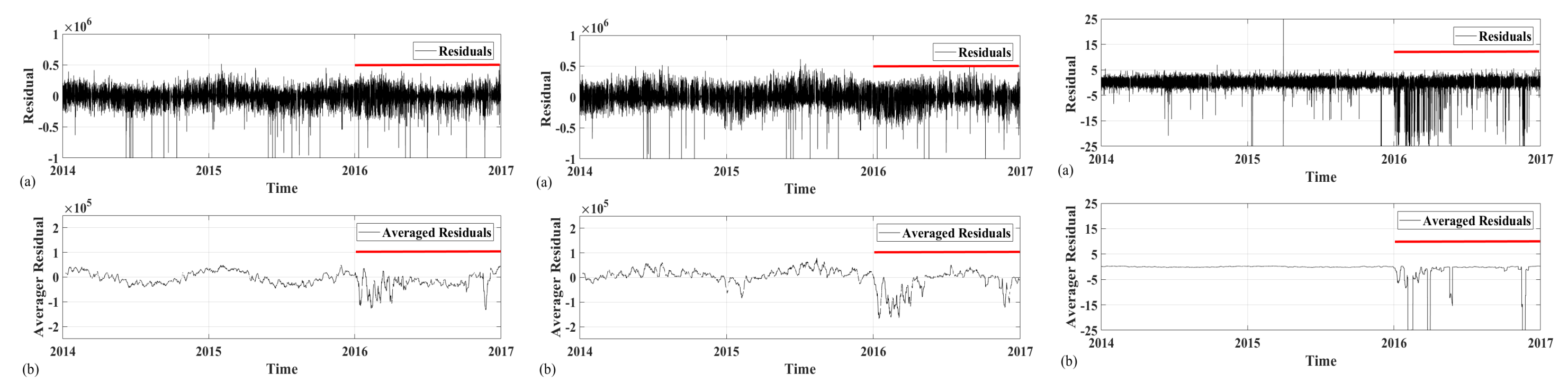
* within Mainland France



Fault scenarios evaluated are realistic and representative of real life scenarios.

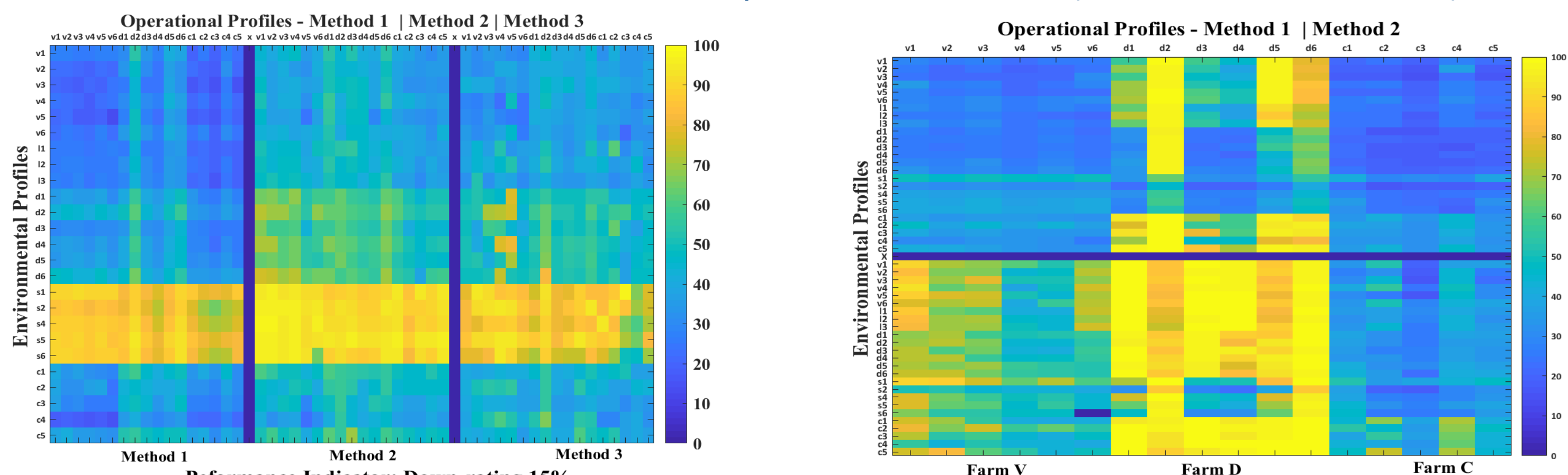


Three methods of fault detection from the literature are used to calculate residuals.



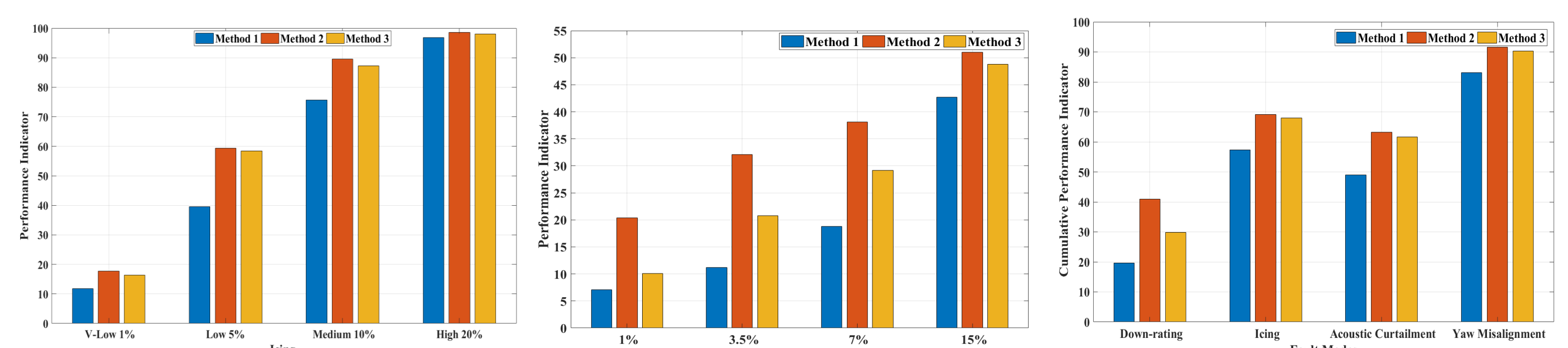
Results: Performance Evaluation

Performance Indicators calculated are presented below. (For details see ref. 4)



Environmental Profiles	Method 1	Method 2	Method 3
Farm V	26,61	40,99	36,24
Farm L	27,14	44,17	39,40
Farm D	37,86	58,40	52,45
Farm S	83,81	91,90	82,69
Farm C	35,16	46,83	43,13

	Farm V	Farm D	Farm C
Method 1	30,57	61,68	25,41
Method 2	50,31	88,78	37,38



Conclusions

The work presents a framework for performance analysis to enable a realistic, controlled and critical comparison of existing fault detection methods. This simulation framework and power based fault detection methods are used to identify and quantify the impact of environmental & operational variations on fault detection performance. A robust and comprehensive performance analysis, achieved using multiple power based fault scenarios of various intensities, geographically distant data sources and different condition monitoring solutions lay the foundation for transition towards an industrial fleet level implementation.

References

- IEC 61400-12-1. (2005). Power Performance Measurements of Electricity Producing Wind Turbines.
- Van Trees, H. L. (2001). Detection, estimation, and modulation theory. Part I, Part I. New York; Chichester: Wiley. Retrieved from <http://search.ebscohost.com/login.aspx?direct=true&scope=site&db=nlebk&db=nlabk&AN=98954>
- Cambron, P., Lepvrier, R., Masson, C., Tahan, A., & Pelletier, F. (2016). Power curve monitoring using weighted moving average control charts. *Renewable Energy*, 94, 126-135. <https://doi.org/10.1016/j.renene.2016.03.031>
- U. Aziz, S. Charbonnier, C. Bérenguer, A. Lebranchu, and F. Prevost. "Simulation of wind turbine faulty production profiles and performance assessment of fault monitoring methods," p. 8, 2018.

