

Abstract

Methodologies and tools that can support the task of **finding out the possible causes of a fault manifested by a specific alarm or a set of alarms** can benefit wind farm owners to increase availability and production and reduce costs. On the other hand, data availability from **SCADA of the wind park has a great potential of information that can support this specific task**, more when it is already available and using this data for fault diagnosis does not require any type of extra implementation or hardware installation in the wind turbine. However, due to the high number of available variables and data, analyzing them can be a high time consuming task and when just well-known related variables are analyzed hidden causes or not common causes cannot be or are hard to be found. For all these reasons, in this work, we present a **methodology and tool, part of Smartive platform**, that been fed by all available SCADA data and other source of information, **can support fault forensic analysis in order to find the main causes of faults.**

Objectives

Improve efficiency of O&M tasks by mean of **“forensic” analysis** of SCADA data and alarm records in order to find the main **“culprits”** of failures and therefore:

- Reduce WTG down-time.
- Detect more critic faults in earlier stages.

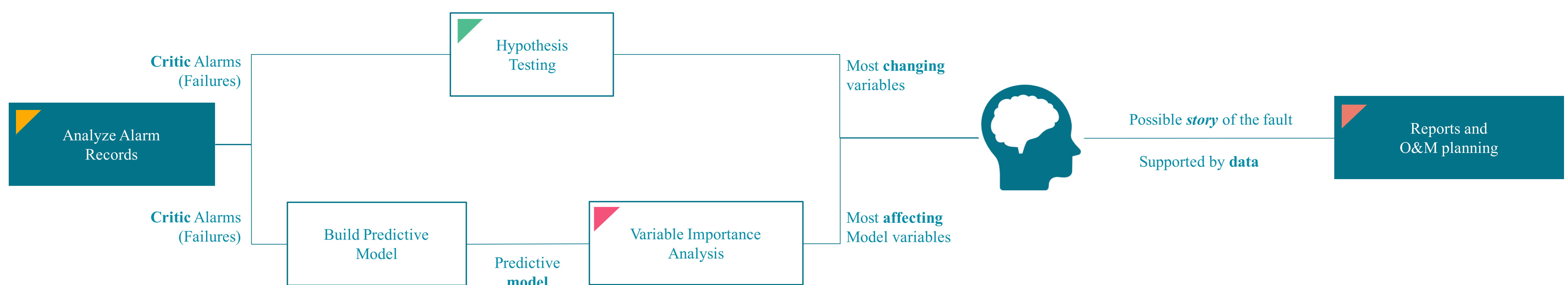
For that we need:

- Find the **main related variable** with the fault in the current day of the failure and in previous days before failure.
- Build a **visual analysis** of the found relationships and depict the appropriated **“history”** that can explain the observations.
- Based on these results **plan the O&M tasks**

Methods & Results

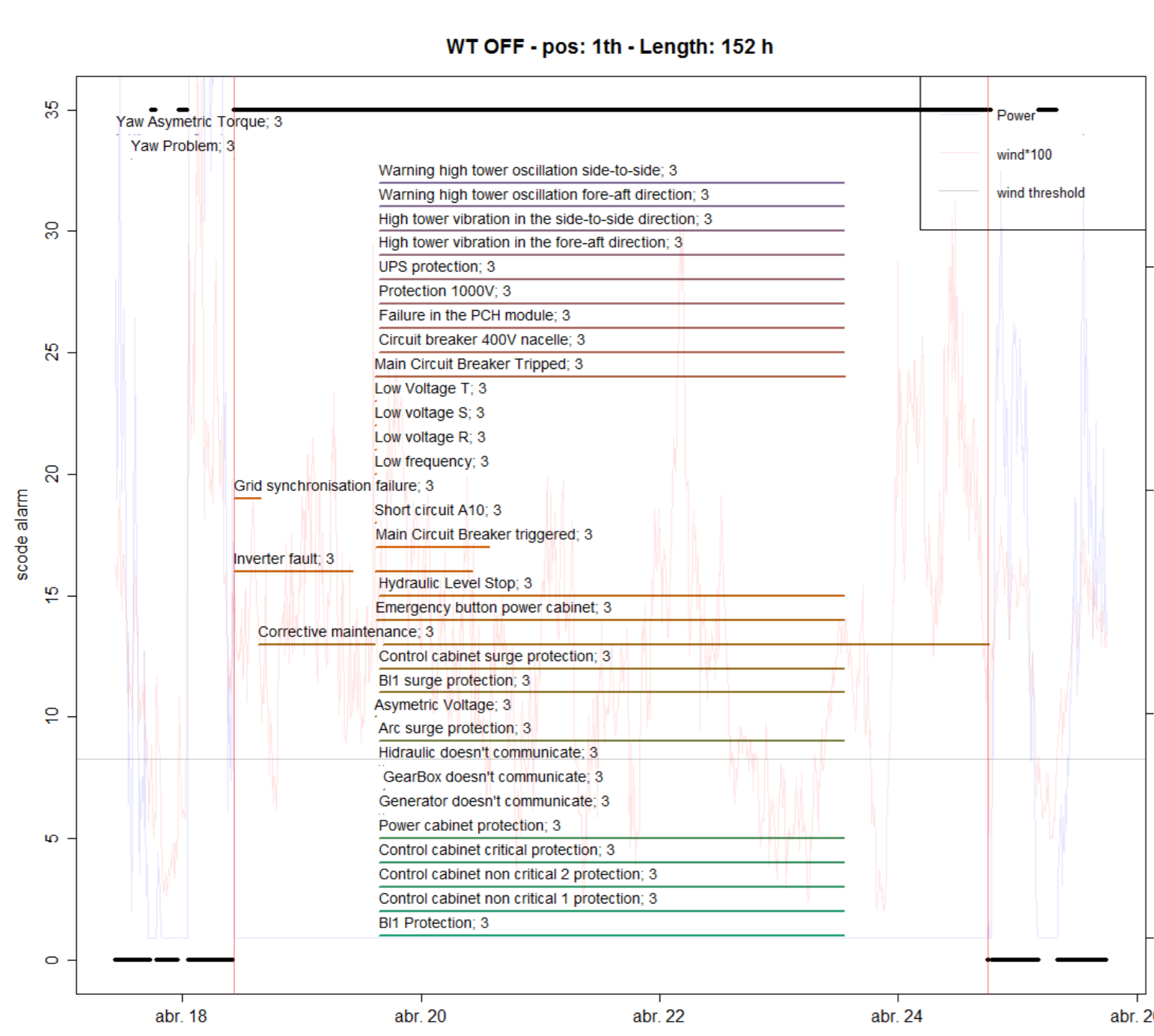
The proposed methodology is based on statistical and machine learning techniques in order to find out the most related variables with the fault under analysis.

Methods

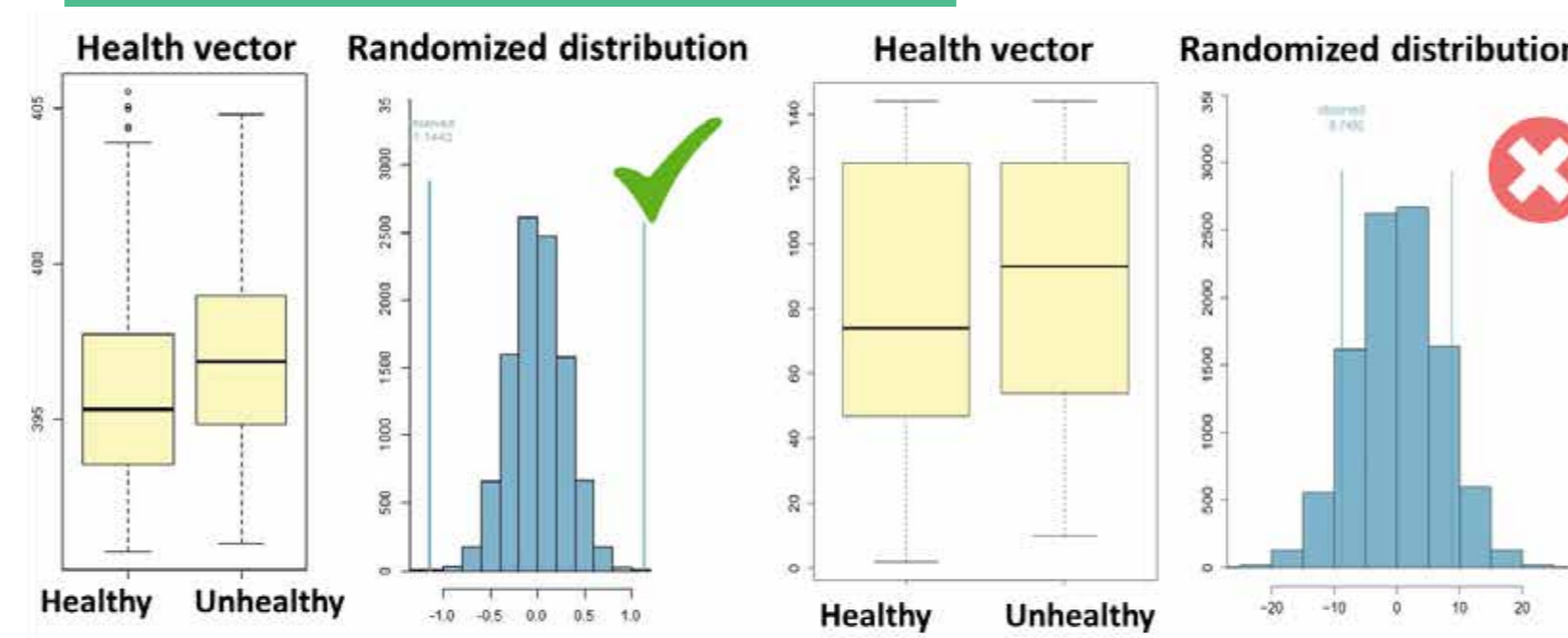


Results

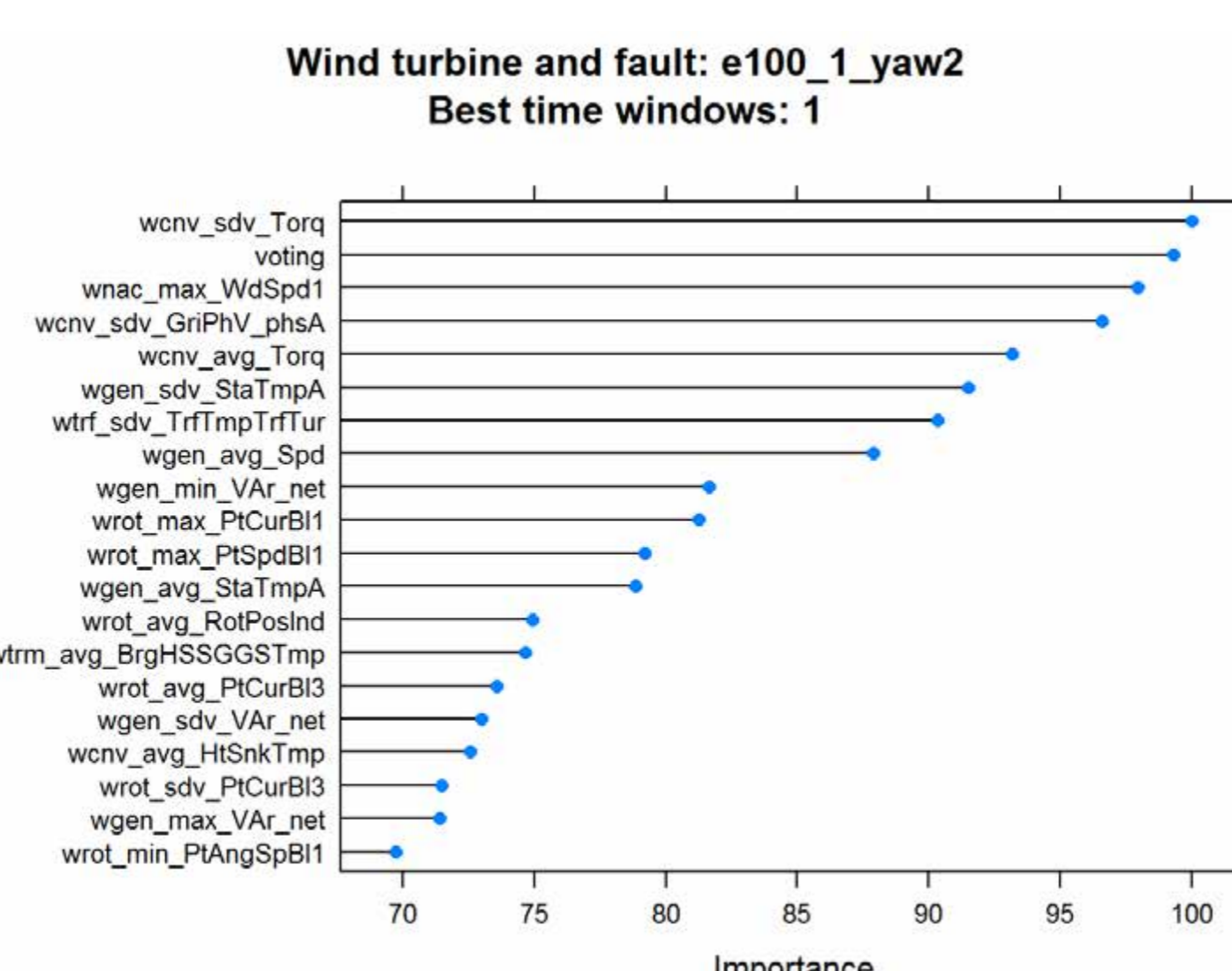
Analyze Alarm Records



Hypothesis testing

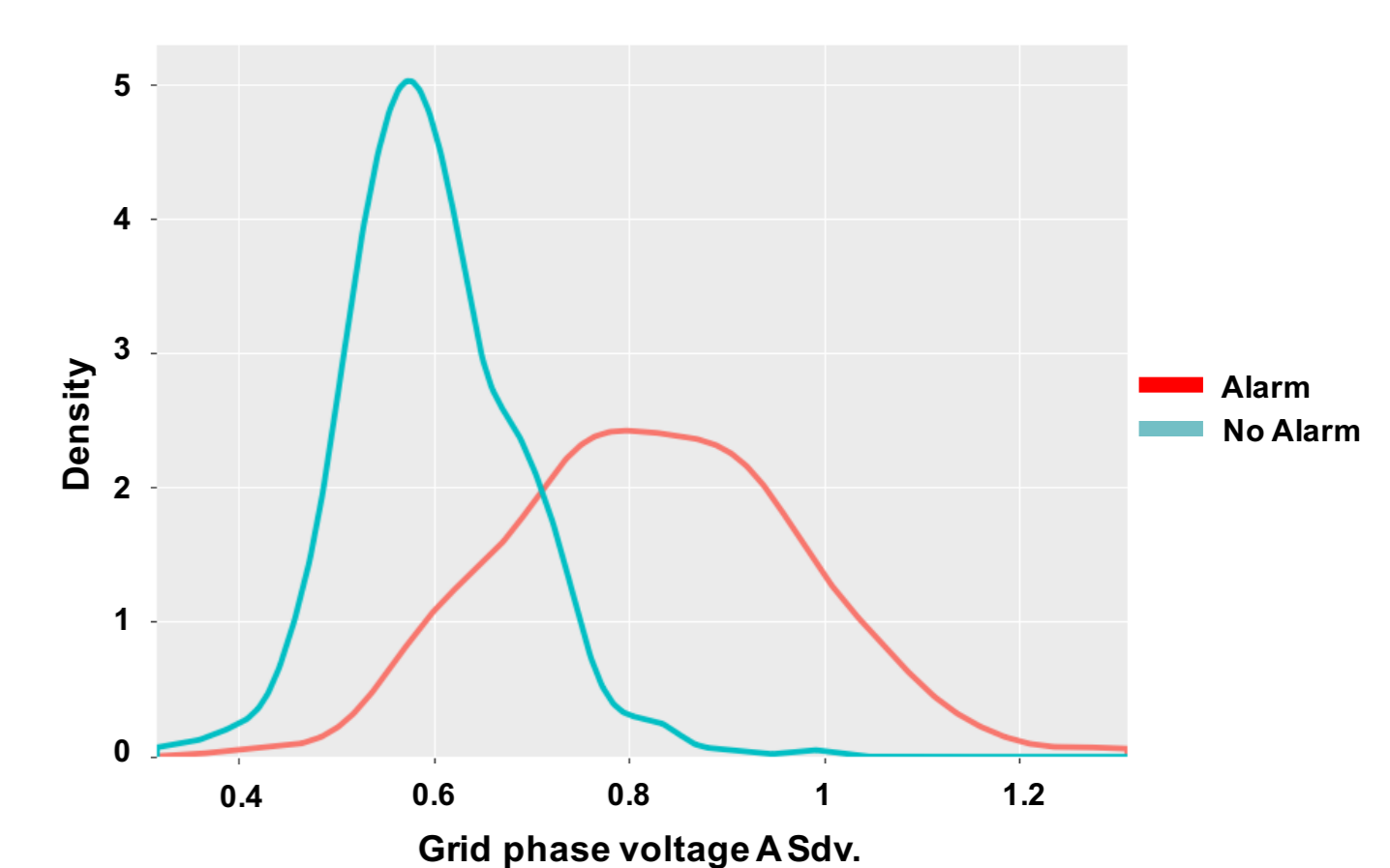
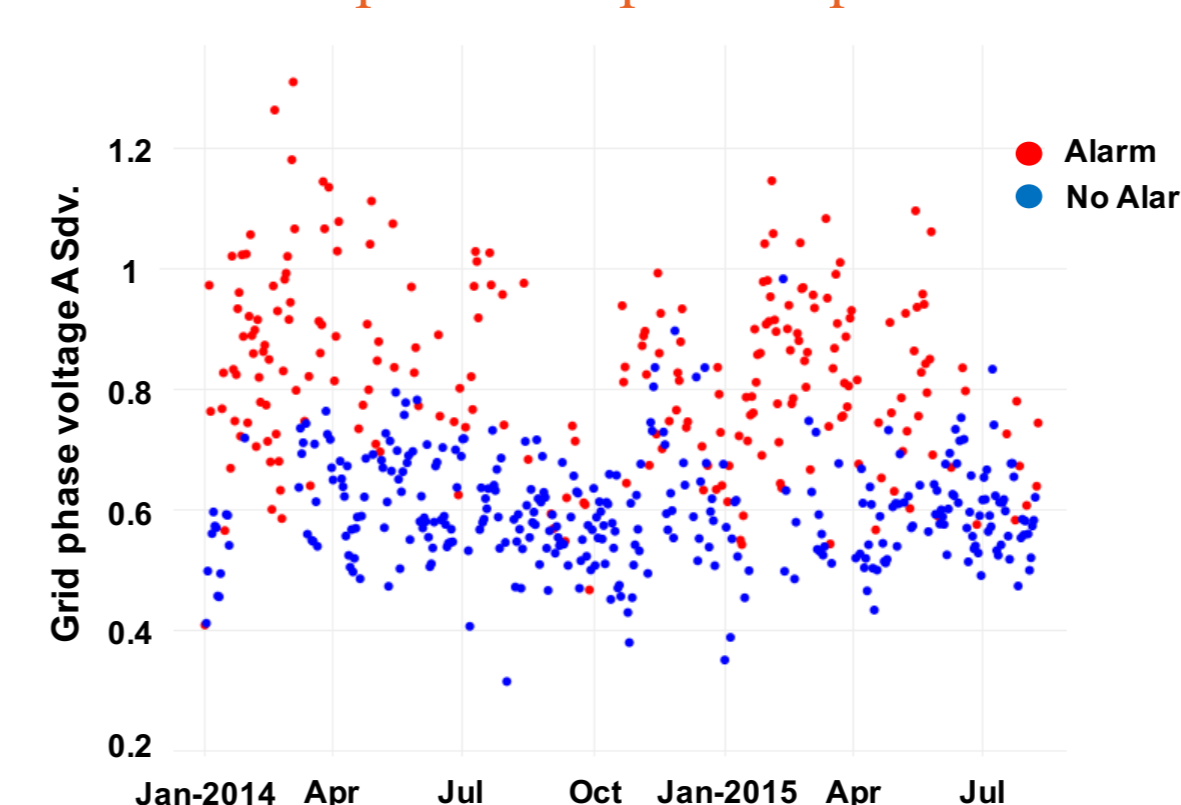


Variable Importance Analysis



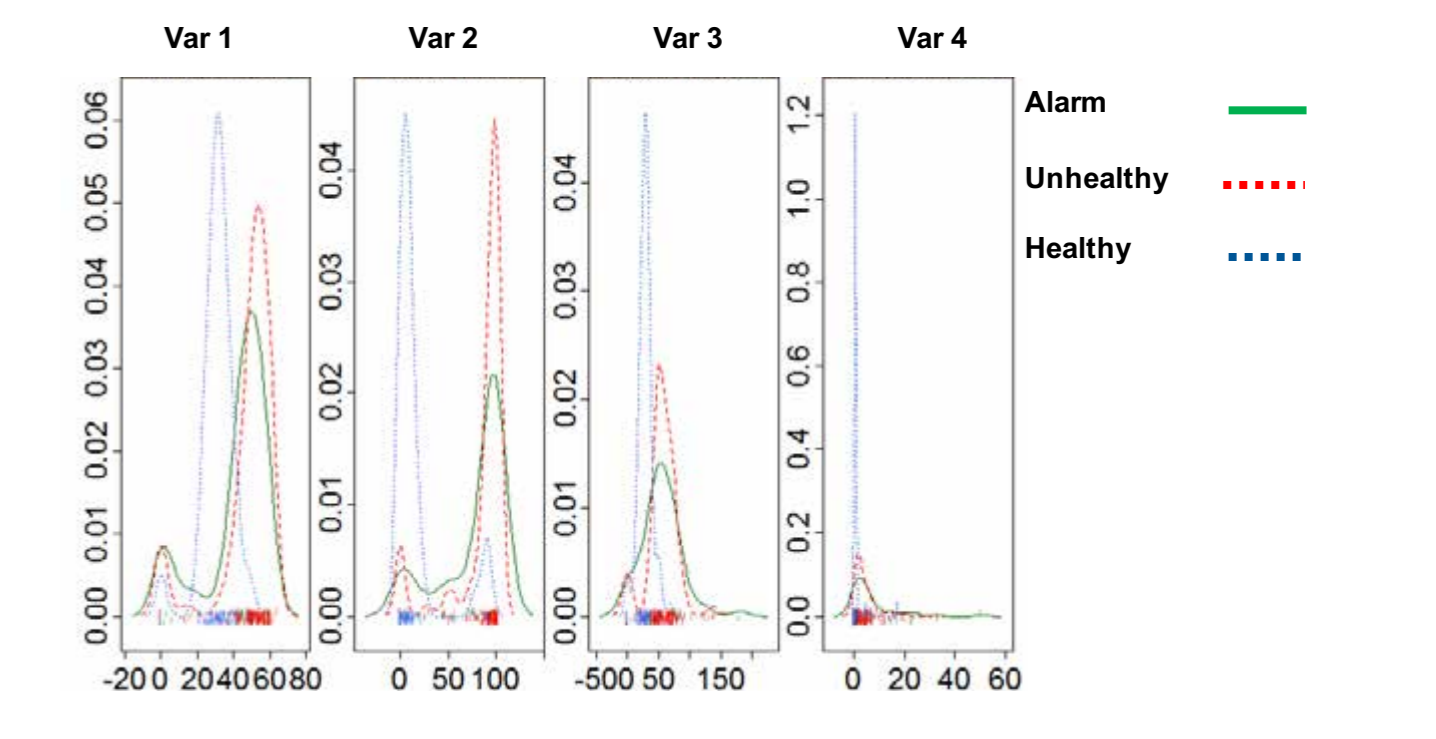
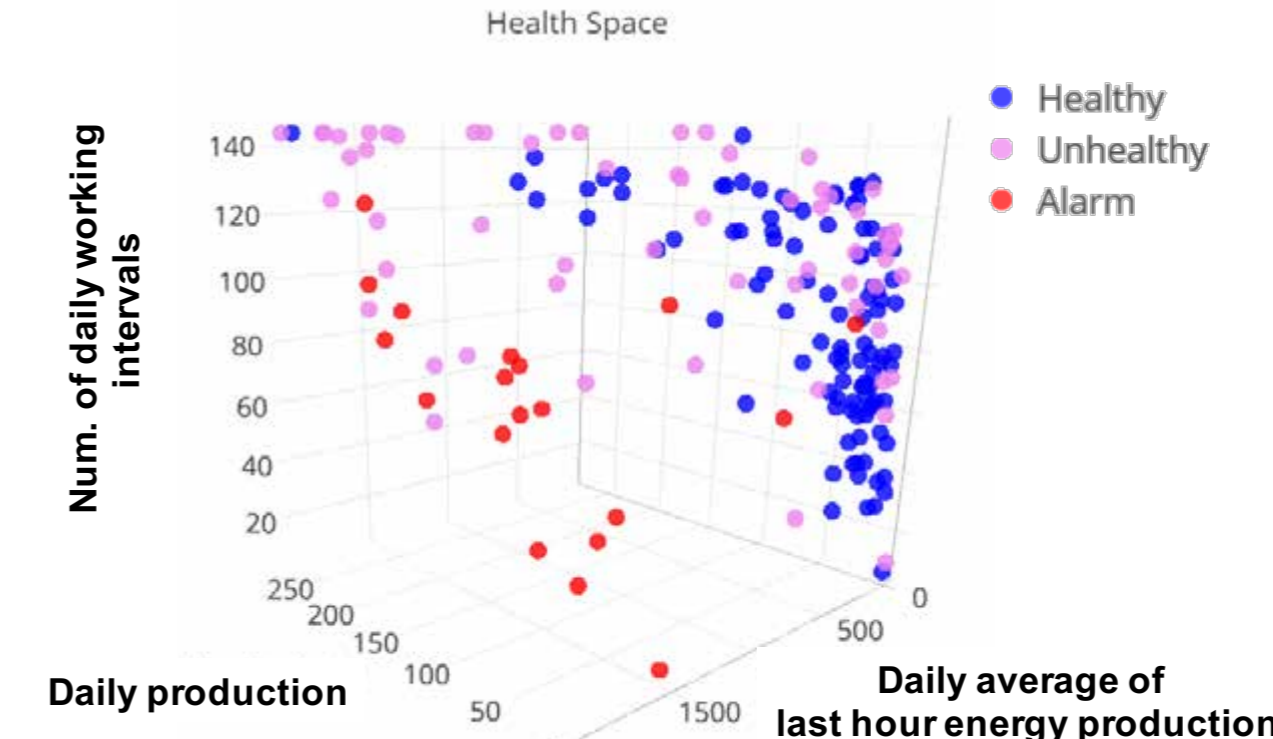
Reports and O&M planning

Unexpected culprit: torque unbalance in yaw motors due to grid instability



Reports and O&M planning

Confirmation of possible culprit in Gear Box fault: possible cause – mechanical stress of the Wind Turbine for high intensity production



Conclusions

In this work, it has been presented a technique and tool, available in Smartive platform, that can exploit SCADA data in order to carry out a **forensic analysis** of faults, and so find out the main causes of a fault. This is helpful to improve O&M process by reducing times of **fault diagnosis** and detecting critic faults in earlier stages.

This technique is a **derived use of predictive models** that are mainly used for failure prediction and wind turbine's health estimation in Smartive platform.

Valuable information has been obtained from this technique in different wind farms around Spain.

References

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2. Coronado, Diego and Fisher, Katharina, "Condition Monitoring of Wind Turbines: State of the Art, User Experience and Recommendations" Fraunhofer Institute for Wind Energy and Energy System Technology IWES, Project Report, January 2015.
3. Tchakoua, Pierre et al. 2014. "Wind Turbine Condition Monitoring: State-of-the-Art Review, New Trends, and Future Challenges." Energies 7(4): 2595–2630. <http://www.mdpi.com/1996-1073/7/4/2595/htm>.
4. Schlechtingen, Meik, and I Santos. 2011. "Condition Monitoring with Ordinary Wind Turbine SCADA data—A Neuro-Fuzzy Approach." Proceedings of the European Wind Energy Association (EWEA) Offshore.
5. Smartive Platform: <http://smartive.eu/>

