

**TCM® & PYTHIA™**  
A SYMBIOSIS FOR VIBRATION DIAGNOSTICS

Supported by

**SIEMENS Gamesa**  
RENEWABLE ENERGY

# PYTHIA™ – AN EXAMPLE ON WHAT YOU CAN INTERFACE TO TCM®

## TURNING BIG DATA INTO VALUABLE KNOWLEDGE

Vibration signals from the drive train (Main bearing, gearbox, and generator) are picked up by the TCM® M-System in the nacelle of the wind turbine and processed to extract features i.e. condition indicators (CI's), per component in the drivetrain.

These CI's, together with selected measurements are transferred to the TCM® Enterprise server in Brande where the Pythia™ platform integrates and extracts those from the TCM® Enterprise using its RESTfull interface. A REST interface is a secure and very flexible data model exposing an API (Application Programming Interface) which other platforms, as Pythia™, can interface to.



*The following case story is an actual example demonstrating TCM® & Pythia™, a symbiosis using feature extraction and artificial intelligence for pattern recognition to detect impending failures on wind turbine drive train components.*

Based on data from the TCM® (Turbine Condition Monitoring) system, Siemens Gamesa has developed a system that can simulate the damage development in each WTG component.

The collected condition features based on the processed data from the TCM® system is analysed in different types of machine learning models within the framework of "Pythia™". Pythia™ uses artificial intelligence, and machine learning data and condition features from the TCM® system to create digital simulation models.

## TCM® & PYTHIA A SYMBIOSIS FOR VIBRATION DIAGNOSTICS

In Brande Denmark, a fully automated system based on the TCM® setup and Pythia™ framework, keep watch over more than 11,000 Siemens Gamesa wind turbines worldwide, analysing the steady flow of data to detect minute irregularities that might indicate impending failures. The remote monitoring and diagnostics of wind turbines is part of the Siemens Digital Services. Approximately 2.300 parameters on each turbine are monitored around the clock.

Pythia™ is named after the Oracle of Delphi, as the purpose of Pythia™ is to look into the future, through advanced vibration analysis. Pythia™ is a framework that has been operational since the fall of 2014. Based on the TCM® system it enables advanced algorithms to look for changes in the vibrational behavior, according to certain overall patterns defined by machine learning algorithms.

The models are centered on generic mathematical algorithms containing a vast amount of comparable and reliable condition indicators (CI) extracted and processed by the TCM® system.

Pythia™ performs millions of extractions every day enabling the human experts in Brande to dig even deeper into the CI's detected by the TCM® system.

## PYTHIA™ LOOKING INTO THE FUTURE

The output from Pythia™ is the condition classification for the components in the drive train. These are used to detect impending failures and classify their severity.

Big data analysis of large historical data sets, can be done using the TCM® Ocular data analytics tool, to find the root cause and classify vibrational patterns, thereby enabling Siemens Gamesa to predict potential damage up to five years in advance.

For potential damages, a notification is created in the case handling system "MORS", which is sent to the service technician and the customer immediately. 24 hours later the information will be in the Vibration Diagnostic Health Trend reports on the customer portal "Wind Dialogue". This information is used by the service technician for maintenance of the wind turbine.

“Big data analysis of our large historical data pool from the TCM® system results in the intelligent algorithms that power our diagnostic models running in Pythia™, an agile platform allowing us to continuously improve our diagnostics.”

Bo Roemer-Odgaard, Head of Vibration Diagnostics, Remote Diagnostic Center, Siemens Gamesa Renewable Energy, Denmark

