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From a Matlab Based Wind Power Forecast to an Integrated EMS Solution

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Abstract

New policies are being introduced with the aim of **increasing** the use of **renewable energy**. From **12.9 GW** of wind power installations in 2000, the European Union reached **106 GW** of installed capacity in 2012. Due to this fast growth of volatile energy provision, uncertainties are emerging in the transmission network operation. The **Transmission System Operators** (TSOs), responsible for the overall power system stability, have to deal with the increase of this intermittent energy. Facing this problem, TSOs need a reliable tool to **monitor** and **forecast wind power generation** within their control zone.

The Short Term Wind Power Forecast

The forecast program integrates **SIPREOLICO, a Matlab based kernel from** Red Eléctrica de España. This short-term wind power prediction tool uses **statistical and combined forecasting methods to produce a forecast.** The forecasting horizon is between **one hour and 48 hours but it may be** extended up to the **longest horizon of the external forecasts.**

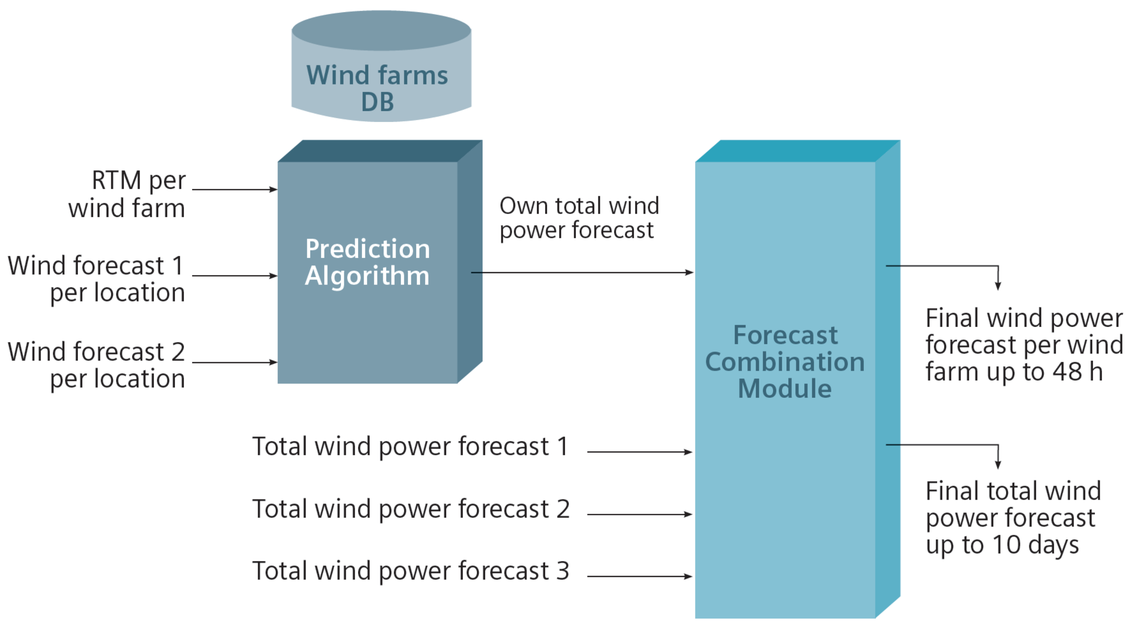

Fig. 1. Architecture of the wind power forecast kernel

Prediction Algorithm: calculates predictions up to 48 hours using real time measurements (RTM) and weather forecasts. It generates 8 different forecasts and combines them internally.

Forecast Combination Module: used to combine results of forecast with external total wind power forecasts. This module uses two combination methods: the "combination for adaptation" and the "combination for improvement".

Adaptation of the Solution

- ✓ Kernel modified to run with **configurable time grid**
- ✓ **Connection** to **meteorological institutes** and **external forecasts**
- ✓ **Connection** to other **EMS applications**
- ✓ After the Fact **Error Analysis**
- ✓ Oracle **Database**
- ✓ Java-based **UI** to visualize/modify both input and output data
- ✓ **Windows** & **Linux**

Graphical User Interface

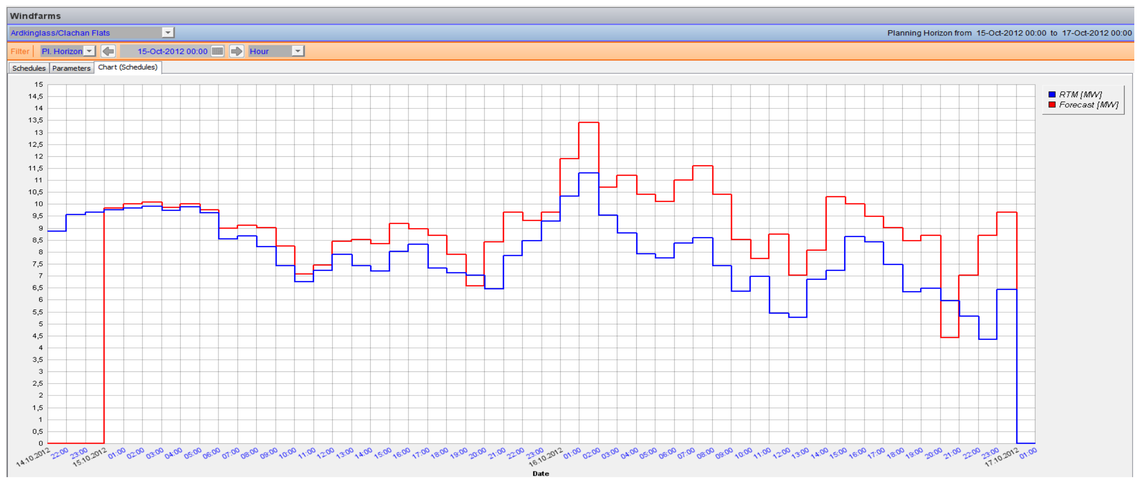

Fig. 2: Wind power forecast and real production of a wind farm

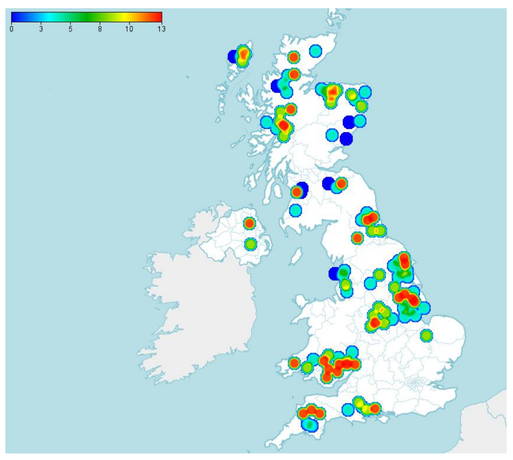

Fig. 3: Wind power plants forecasts per location

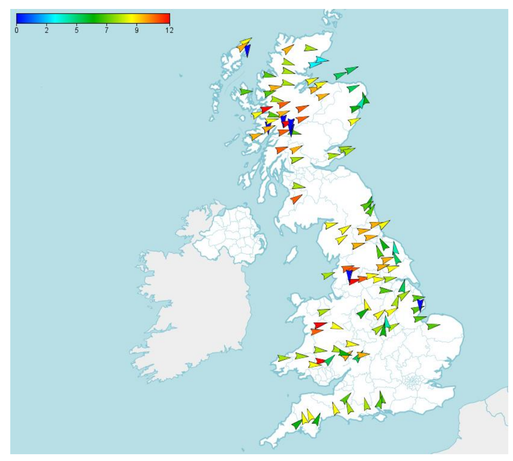

Fig. 4: Wind speed and wind direction forecasts

Connections & Impacts

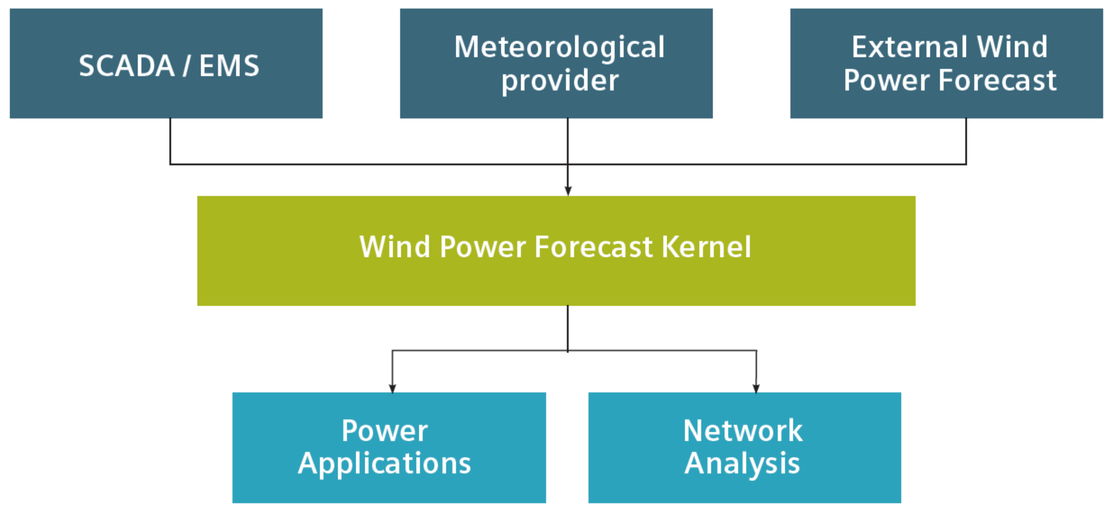

Fig. 5: Connections to EMS applications and to external services

Within **Power Applications**:

- **Reserve Monitor** uses the **confidence intervals** and the after the fact **error analysis** of the wind power forecast for determining the required reserves.
- Expected **balance energy** can be deduced from the load and wind power forecasts combined with the generation profiles. Based on that, **Load Frequency Control** can keep the network frequency on a stable level.

Within **Network Analysis**:

- In **Security Analysis, DACF** (Day Ahead Congestion Forecast) uses wind power forecast injections to perform **look-ahead studies** on the network stability.