

## Neuro-Fuzzy Approach to Forecast Wind Power in Portugal

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**Abstract.** The increased integration of wind power into the electric grid, as nowadays occurs in Portugal, poses new challenges due to its intermittency and volatility. Hence, good forecasting tools play a key role in tackling these challenges. In this paper, a neuro-fuzzy approach is proposed for short-term wind power forecasting in Portugal. Results from a real-world case study are presented. A thorough comparison is carried out, taking into account the results obtained with other approaches. Conclusions are duly drawn.

### Key words

Wind power, forecasting, neural networks, fuzzy logic.

### 1. Introduction

Wind generation is the fastest growing source of renewable energy [1]. Indeed, wind-driven power resources have become increasingly important in the planning and operation of electric power systems. In Portugal, the wind power goal foreseen for 2010 was established by the government as 3750 MW, representing about 25% of the total installed capacity in 2010 [2]. This value has been raised to 5100 MW by the most recent governmental goals for the wind sector. Hence, Portugal has one of the most ambitious goals in terms of wind power and in 2006 was the second country in Europe with the highest wind power growth.

Short-term wind power forecasting is an extremely important field of research for the energy sector, as the system operators must handle an important amount of fluctuating power from the increasing installed wind power capacity. The time scales concerning short-term prediction are in the order of some days (for the forecast horizon) and from minutes to hours (for the time-step) [3]. In the technical literature, several methods to predict wind power have been reported, namely physical [4] and statistical methods.

Conventional statistical models are identical to the direct random time-series model, including auto regressive (AR), and auto regressive integrated moving average (ARIMA) [5] models. In the recent years, some new methods are catching researcher's attention, namely neural networks (NN) [6], fuzzy logic [7], evolutionary algorithms [8], and some hybrid methods.

A hybrid of NN and fuzzy logic, known as adaptive-network-based fuzzy inference system (ANFIS), is proposed for short-term wind power forecasting in Portugal. The proposed approach is compared with persistence, ARIMA and NN approaches, to demonstrate its effectiveness regarding forecasting accuracy and computation time.

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