



# 7<sup>th</sup> INTERNATIONAL WORKSHOP ADVANCES IN CLEANER PRODUCTION Academic

“CLEANER PRODUCTION FOR ACHIEVING SUSTAINABLE DEVELOPMENT GOALS”

## Wind-Speed Modelling Using Fourier Analysis and Nonlinear Autoregressive Neural Network (NAR)

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### Abstract

This paper presents a methodology for analyzing and predicting local wind-speed with high time resolution (hourly) and long-term (years) horizon, through Fourier analysis and Nonlinear autoregressive network (NAR). Engineering activities and wind energy applications (wind power estimation and power system operations) requires accurate wind-speed modelling. Additionally, wind time series exhibits nonlinearities, gaps and scarce of *in situ* data, therefore, the proposed methodology is able to deal with those requirements. Considering the lack of *in situ* data, the research recommends a data assimilation and natural variability identification before atmospheric variable forecasting. The study used a wind-speed time series from the North American Regional Reanalysis (NARR) project database (1980 to 2014) and compared against *in situ* data for assimilation. Then, Fourier identified natural variability for wind-speed at local stations. Also, we found a quarterly variability associated with Madden Julian fluctuations, semiannual, annual, and 6-year variability (ENSO). NAR model predicted successfully the wind-speed with 3 hours' interval for 11 years according to 0.90 of correlation. The low computational cost and the accuracy of modelled results obtained in this research, allow to implement the proposed methodology for diverse engineering and scientific research applications.

**Keywords:** *wind-speed, Fourier, NAR, reanalysis, wind potential, modelling.*