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INTEGRATED PLANNING OF A HIDRO-WIND-THERMAL POWER SYSTEM

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ABSTRACT: Global warming and the accelerated increase in energy consumption presented in the last decades have instigated the reduction of fossil fuels and encouraged the use of renewable energy sources (RES). In particular, wind power energy has been a highlight over other RESs, showing a significant growth in the expansion of energy systems. However, the variability and uncertainty of wind speed bring new challenges for energy systems with high power wind penetration levels. Those challenges are associated with technical and economic issues, impacting electricity prices and energy supply. Some solutions are focused on the use of complementary systems allowing the storage of wind power in periods with low generation. In this case, the integrated operation of different RES is widely explored. The Brazilian Electricity Sector (BES) is characterized by its sharp hydropower generation and a high regularization capacity given by the use of water reservoirs. The recent difficulties for the construction of new hydropower plants and the adverse precipitation patterns presented in the last years have been exposing a significant reduction in the energy storage capacity. Those conditions require to define novel policies related to the reservoir and hydropower operation, looking for a flexible generation that complements the use of other FER, instead of presenting a primary and firm power generation. Considering the requirements to insert the RES and count with reliable energy systems, it is necessary to explore a suitable integration of wind power energy into hydrothermal power systems. Based on a stochastic approach, this thesis proposes a copula-based method for the joint simulation of monthly streamflow and wind speed time series using copula functions. The simulated scenarios were used to evaluate the planning and operation of hydro-thermal-wind power systems by dynamic programming. Therefore, the main goal of this project is to assess the performance of energy systems when it is considered the variability and spatial dependences between hydrological and wind regimes in different regions of Brazil. Preliminary results show a significant reduction in the use of thermal plants when it is considered the complementary behavior of these renewable energy sources.

Keywords: Renewable energies. Stochastic modeling. Energy planning. Synthetic time series. Dynamic programming

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