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Optimizing Control and Energy Management in a TS Fuzzy Wind System unsing LMI Approach

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Abstract:

The main focus of this research is to develop an optimal control and management strategy for wind energy systems. To achieve this goal, the study uses a combination of control design methods, including the Lyapunov function, sliding mode observer (SMO), and a PDC (Parallel Distributed Compensation) structure. These methods are employed to optimize the control of the wind energy system, ensuring that it operates at its maximum power output. To implement the control design methods, the wind turbine model is linearized using the Takagi-Sugeno (TS) fuzzy model. This allows the researchers to apply the linear matrix inequality (LMI) optimization algorithm to find a common solution that guarantees the asymptotic stability of the system. The objective of the proposed control design method is not only to extract the maximum power from the wind system but also to regulate the energy supplied to various loads and protect the battery against overcharging and deep charging. This is achieved through a global management strategy that is implemented in the state-flow. The simulation results of the proposed control and management strategy demonstrate its effectiveness in regulating the energy supplied by the wind system and protecting the battery. This research contributes to the development of more efficient and reliable wind energy systems, which are crucial in the shift towards sustainable and renewable energy sources.

Keywords:

Wind generator system, Management energy system, Takagi Sugeno fuzzy model, sliding mode observer (SMO), linear matrix inequality (LMI).