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Wed-Mo-Po3.05-01 [28]: Multiobjective optimal design of bearingless permanent magnet synchronous generator with multiobjective particle swarm optimization algorithm

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Since the rotor is supported by mechanical bearings, the mechanical friction and wear exist in the conventional wind turbine inevitably, which not only increase the starting wind speed and the maintenance cost, but also reduce the efficiency of power generation and the operation stability. In order to overcome these disadvantages, a magnetic suspension wind turbine (MSWT) is proposed. Nowadays, the MSWT has been extensively investigated all over the world due to the advantages of low starting wind speed, high power generation efficiency, low maintenance cost, no friction, no lubrication, and so on. However, some defects limit its development. For example, the application of magnetic bearings increases the axial length of the system, limits the critical speed, and generates great suspension power consumption. The introduction of a bearingless generator to replace the wind turbine supported by magnetic bearings can effectively solve these problems. To realize the design objectives of high generation performance and stable suspension capability, the multiobjective optimal design of a bearingless permanent magnet synchronous generator with multiobjective particle swarm optimization (MOPSO) algorithm is carried out in this paper. Firstly, the torque and the suspension force performances of each design factor combination are analyzed by finite element analysis (FEA) method according to the central composite design scheme. Secondly, in terms of the results of FEA, the response surface method is applied to obtain the regression equations of the optimization objectives with respect to the design factors. Thirdly, with the response surface models as the objects, the Pareto front is obtained by the MOPSO algorithm. Finally, the Pareto optimal results are analyzed in the FEA software and the validity of the design scheme is verified.

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