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Optimization of Doubly Fed Induction Generator Equivalent Circuit Parameters by Direct Search Method

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Abstract : Doubly-fed induction generator (DFIG) is currently the choice for many wind turbines. These generators, when connected to the grid through a converter, is subjected to varied power system conditions like voltage variation, frequency variation, short circuit fault conditions, etc. Further, many countries like Canada, Germany, UK, Scotland, etc. have distinct grid codes relating to wind turbines. Accordingly, following the network faults, wind turbines have to supply a definite reactive current. To satisfy the requirements including reactive current capability, an optimum electrical design becomes a mandate for DFIG to function. This paper intends to optimize the equivalent circuit parameters of an electrical design for satisfactory DFIG performance. Direct search method has been used for optimization of the parameters. The variables selected include electromagnetic core dimensions (diameters and stack length), slot dimensions, radial air gap between stator and rotor and winding copper cross section area. Optimization for 2 MW DFIG has been executed separately for three objective functions - maximum reactive power capability (Case I), maximum efficiency (Case II) and minimum weight (Case III). In the optimization analysis program, voltage variations (10%), power factor- leading and lagging (0.95), speeds for corresponding to slips (-0.3 to +0.3) have been considered. The optimum designs obtained for objective functions were compared. It can be concluded that direct search method of optimization helps in determining an optimum electrical design for each objective function like efficiency or reactive power capability or weight minimization.

Keywords : direct search, DFIG, equivalent circuit parameters, optimization
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