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Matrix-Based Linear Analysis of Switched Reluctance Generator with Optimum Pole Angles Determination

Authors : Walid A. M. Ghoneim, Hamdy A. Ashour, Asmaa E. Abdo

Abstract : In this paper, linear analysis of a Switched Reluctance Generator (SRG) model is applied on the most common configurations (4/2, 6/4 and 8/6) for both conventional short-pitched and fully-pitched designs, in order to determine the optimum stator/rotor pole angles at which the maximum output voltage is generated per unit excitation current. This study is focused on SRG analysis and design as a proposed solution for renewable energy applications, such as wind energy conversion systems. The world’s potential to develop the renewable energy technologies through dedicated scientific researches was the motive behind this study due to its positive impact on economy and environment. In addition, the problem of rare earth metals (Permanent magnet) caused by mining limitations, banned export by top producers and environment restrictions leads to the unavailability of materials used for rotating machines manufacturing. This challenge gave authors the opportunity to study, analyze and determine the optimum design of the SRG that has the benefit to be free from permanent magnets, rotor windings, with flexible control system and compatible with any application that requires variable-speed operation. In addition, SRG has been proved to be very efficient and reliable in both low-speed or high-speed applications. Linear analysis was performed using MATLAB simulations based on the (Modified generalized matrix approach) of Switched Reluctance Machine (SRM). About 90 different pole angles combinations and excitation patterns were simulated through this study, and the optimum output results for each case were recorded and presented in detail. This procedure has been proved to be applicable for any SRG configuration, dimension and excitation pattern. The delivered results of this study provide evidence for using the 4-phase 8/6 fully pitched SRG as the main optimum configuration for the same machine dimensions at the same angular speed.

Keywords : generalized matrix approach, linear analysis, renewable applications, switched reluctance generator
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