# Switched Reluctance Generator Drive in the Low and Medium Speed Operation: Modelling and Analysis

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# ABSTRACT

Wind is a natural source of energy related to the low and medium speed range. Electricity can be generated from the wind by using a variable speed machine. Among the common types of machines available are: double fed induction generator (DFIG), induction generator and also synchronous generator. However, the latest addition to the group is the Switched Reluctance Generator (SRG), which has attractive features such as simple in construction, inexpensive, robust and reliable. Current research on the SRG has been focusing on optimizing its performance individually in terms of structure, control and also reducing the components of power electronic devices. Despite the extensive research on the individual component of the machine, the comprehensive performance of the SRG has not yet been published. The main contribution of this thesis is the proposed modelling framework of the SRG. Based on the framework, extensive and in depth comparative analysis can be conducted.

Firstly, the design of the existing machine including the winding configuration and rotor structure using finite element method is investigated. Secondly, based on the principle of electromagnetism, a simulation framework that adopts a heuristic method to perform comparative analysis between different types of SRG has been proposed. This framework serves as a platform to the development of the SRG in the low and medium speed operation. It can be used to predict the performance of the machine before it can be implemented on a prototype, thus, saving time and costs.

Thirdly, the procedure to determine the optimal control variables is proposed. Basically, the controller plays an important role to determine the placement of the firing angles along the inductance profile. The most influential parameter that affects the percentage of power generated which are the firing angles and voltage level has been identified. A polynomial function relating the percentage of power generated in terms of the optimal control variables has also been developed.

Lastly, a novel control method is proposed to operate the machine in single pulse mode as opposed to the current chopping mode during the low speed range. The proposed control

scheme provides the highest percentage of power generated during the low speed range. Overall, the research will aid in the development of the SRG by allowing user to choose the best generating operation within any speed range.

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