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Design of a Switched Reluctance Generator in a Constant Stator Setting

Sneha Latha[1] and Krishna Mohan[2]
Department of Electronics and Communication Engineering, KL University, Guntur
[1]Corresponding Author: snehalathaece@gmail.com

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Abstract*: It was investigated how the number of phases in a switched reluctance generator (SRG) affected the electromagnetic torque pulse. They made the computer model. When the ripple frequency is increased to five times, the torque ripples' amplitude decreases to eight times, which is more acceptable in terms of requirements.*

Keywords*: Computer simulation, Number of stages, Factor of overlap, Reluctance machines with switches*

I. Introduction

Railway rolling stocks are among the vehicles that can use switched reluctance machines (SRM), a high-efficiency kind of electromechanical energy converter [1]. Vehicle electrical machinery operates in harsh environments. They are subject to considerable dynamic forces during operation as a result of shock and vibration, especially at high operating speeds. It can result in a number of problems, including damage to insulating materials, cracking, and disruption of wire and winding connections. This is why there is a propensity to employ straightforward and dependable technical solutions when selecting the design of electrical devices.

According to this perspective, SRM's primary benefit is its straightforward design. The stator has a winding made up of cantered type coils, whereas the rotor is passive and winding-free. SRM is more advanced and uses less precise quantities of cooper and insulating materials than other kinds of electrical machines. When SRM is used in automobiles, it will be possible to lower costs and operating expenses, increase energy supply system reliability, and achieve improved energy and weight-size parameters. Significant electromagnetic torque ripple and increased noise levels are SRM's drawbacks.

II. Switched Reluctance Generator Versions

Available in several forms and configurations, Switched Resistance Generators (SRGs) are fit for particular uses. Their straightforward yet strong construction is typified by noticeable poles on the stator and rotor. In industrial and automotive environments, their low cost and great dependability help them to be preferred choices. This specific variant is fit for high-speed applications since it increases torque output by including salient poles on both components. Combining the operations of a generator and a starter motor, the Integrated Starter-Generator (ISG) vehicle technology increases fuel efficiency and lowers emissions.

Because of its independent modules—which improve fault tolerance and streamline maintenance—modular SRG is ideal for critical systems and the aerospace sector. Emphasizing dependability, cost, and efficiency, every version is customized to the particular requirements of its application environment.

Various computer modelling methods are used to assist with the design, analysis and control strategy of switched reluctance generators (SRGs). The method uses the finite element to accurately represent nonlinear magnetic saturation and effects linked to the structure, so torque can be calculated and the magnetic field investigated comprehensively. The behavior of SRGs in simulations is shown by focusing on their mechanical, thermal and electromagnetic behaviors, using mathematical models based on differential equations.

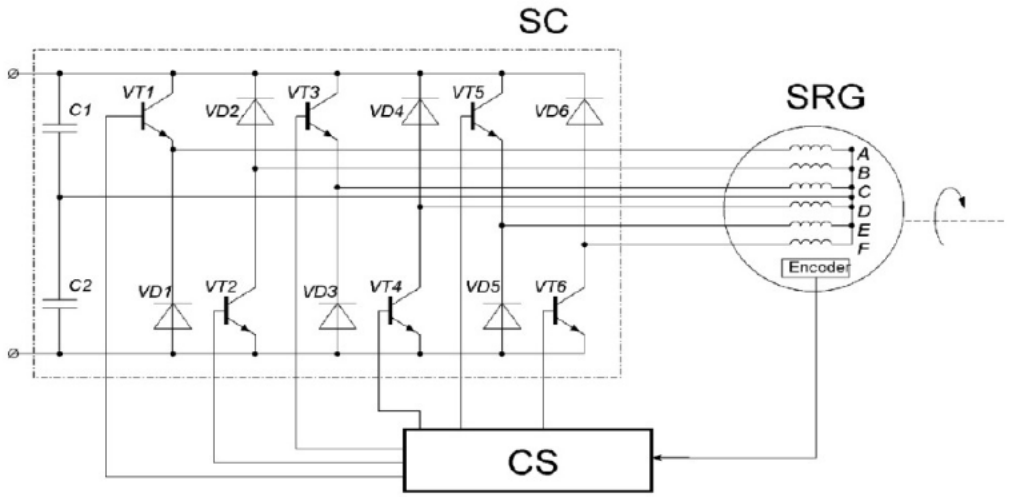

Fig 1: Scheme of 6-phase SRG and supply converter

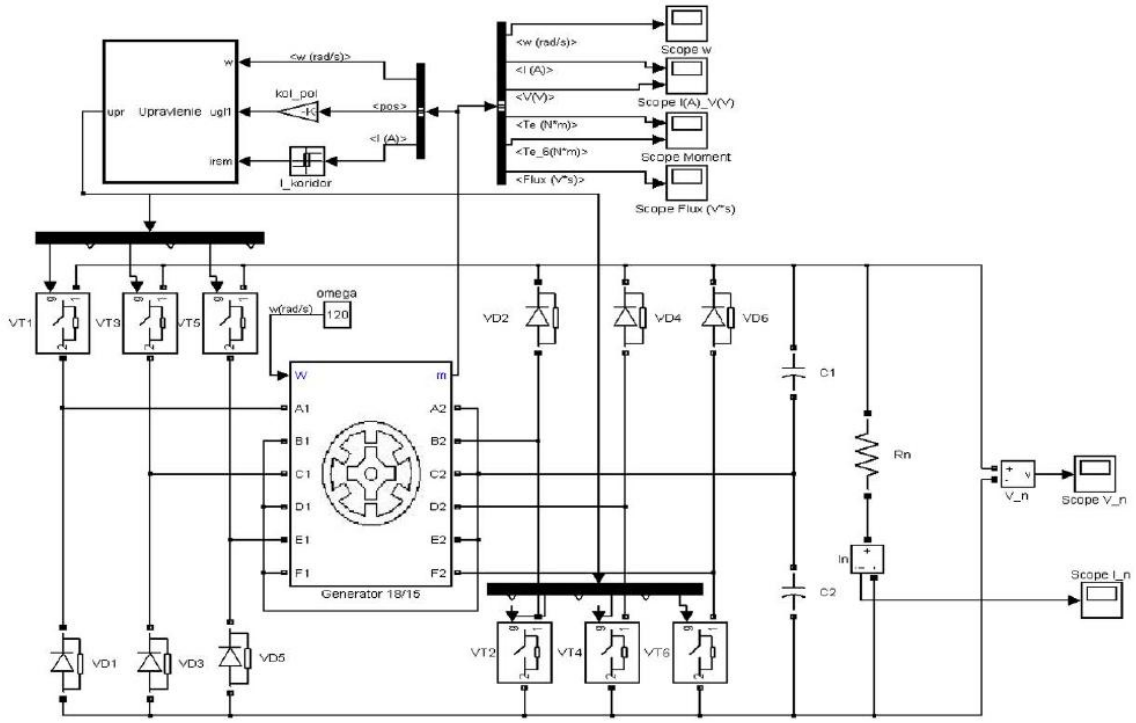

Fig 2: Computer model of 6-phase SRG 16/12 configuration

Both MATLAB/Simulink and ANSYS Maxwell allow the mechanical and electrical domains to be connected with co-simulation models. Controller designs can be examined in actual operating circumstances. HIL testing requires real-time simulation which lets engineers make sure control systems are operating as they should before being put in place. By adding fault analysis, system integration and optimization features, these simulation models raise the accuracy and speed of SRG design development.

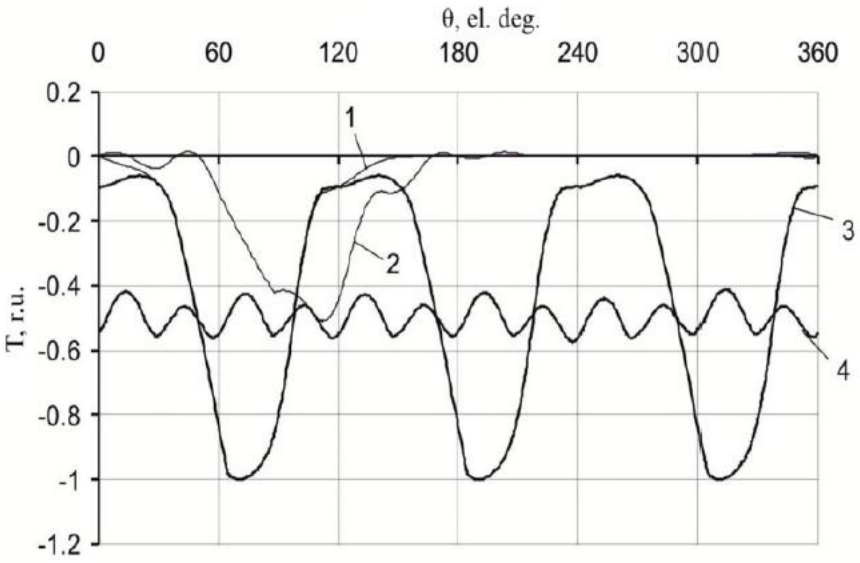

Fig 3: Dependence of SRG electromagnetic torques

III. Conclusion

In short, a Switched Reluctance Generator (SRG) with a fixed stator layout gives a steady and economical energy conversion for applications requiring variable-speed operation. Fixing the stator shape means less effort in design and reduced manufacturing prices, even with improvements in rotor design and control. The SRG is still a preferred option in modern power generation because it is reliable, can run very fast and is simple to design, even if it faces acoustic noise and torque ripple. Improving control methods and picking better materials make it work better and allow it to apply in more industries.

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