

Abstract of Ph.D. Thesis
“Design and Performance Analysis of Integrated Rotating Machine Based Pulsed Power Supply for
Electromagnetic Launch Applications”
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ABSTRACT

The research work focuses on the design and development of various types of compulsators, including the Halbach compulsator, multi-layer compulsator, dual armature compulsator, and axial flux compulsator. Each design aims to enhance the performance and efficiency of electromagnetic launch systems by addressing specific technical challenges. The Halbach array configuration is utilized for its superior magnetic field properties, while the multi-layer winding technique increases produced voltage to self-inductance and increases energy delivery. The dual armature design incorporates two sets of windings to improve energy discharge, and the axial flux configuration optimizes power and energy density and enhances the energy utilization factor.

Additionally, the research delves into the design of a thyristor stack and gate drive circuit, which are crucial for managing the high-power switching required in compulsator applications. The thyristor stack design ensures reliable and efficient switching, while the gate drive circuit provides the necessary control signals to operate the thyristors effectively.

A significant aspect of this work is the study of synchronization of multiple compulsators. Synchronization is critical to ensure that the compulsators discharge their energy simultaneously, maximizing the overall power delivered to the electromagnetic launcher. This involves precise timing and control mechanisms to coordinate the operation of multiple units.

Through extensive simulation and analysis, the research demonstrates the feasibility and benefits of these advanced compulsator designs. The findings highlight improvements in energy density, power density, and overall system efficiency, making these designs suitable for high-power applications such as railguns and other electromagnetic launch systems. The study provides a comprehensive overview of the technical advancements and practical considerations in the development of state-of-the-art compulsators.