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Cairo University

ELECTROMAGNETIC AND MECHANICAL ANALYSIS AND INVESTIGATIONS OF AXIAL FLUX SYNCHRONOUS MACHINES EQUIPPED WITH DIFFERENT PM CONFIGURATIONS

By

Amr Ahmed Abbas Abdelaziz Khader

A Thesis Submitted to the
Faculty of Engineering at Cairo University
in Partial Fulfillment of the
Requirements for the Degree of
MASTER OF SCIENCE
in
Electrical Power and Machines Engineering

FACULTY OF ENGINEERING, CAIRO UNIVERSITY
GIZA, EGYPT
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Title of Thesis:

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Key Words:
Axial flux machine; Halbach arrays; Analytical model; Finite element model; Optimization routine.

Summary:
This thesis presents a comparison between using conventional permanent magnet (PM) and Halbach PM array configurations in yokeless and segmented armature axial flux permanent magnet synchronous machines. An analytical model is adopted to carry out the study and finite element models are used to verify the results. A sensitivity analysis is carried out to investigate the effects of motor parameters on performance. An optimization routine is introduced to achieve some performance requirements and fully optimize the machine. The rotor disk design is studied from electromagnetic and mechanical points of views for the conventional PM and Halbach array configurations. From electromagnetic point of view, the rotor flux density is reduced. This allows the reduction of the rotor thickness and improvement the power density of the machine. However, from mechanical point of view, the air gap flux density increases. Therefore, the rotor thickness needs to be larger to support the rotor fixation for the same rotor displacement.

Disclaimer

I hereby declare that this thesis is my own original work and that no part of it has been submitted for a degree qualification at any other university or institute.

I further declare that I have appropriately acknowledged all sources used and have cited them in the references section.

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Date: .../.../2021

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