

**Technical University of Applied Sciences  
Würzburg-Schweinfurt (THWS)**

Faculty of Computer Science and Business Information Systems

## **Master Thesis**

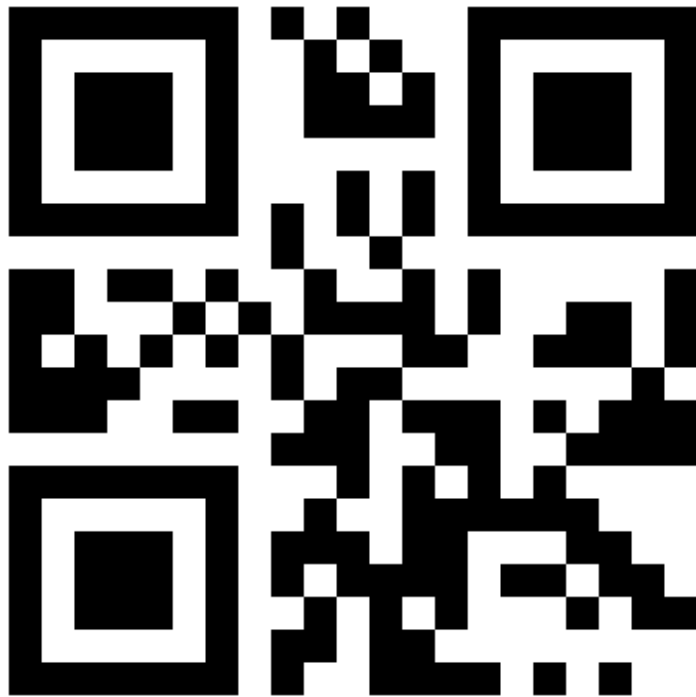
# **Electric Motor Modelling via Graph Neural Networks**

**Submitted to the Technical University of Applied Sciences  
Würzburg-Schweinfurt in the Faculty of Computer Science and  
Business Information Systems to complete a course of studies  
in Master of Artificial Intelligence**

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## **Abstract**

The aim of the Master Thesis is to train a neural network to learn the parameters of Electric Motors and thus be able to predict its Key Performance Indicators(KPIs). The KPIs are 2D and 3D plots on Torque(Mgrenz) and Efficiency(ETA). Other KPIs can be calculated from these two KPIs. For instance the Vibration Costs are inversely proportional to the Efficiency values predicted.

## **Abstrakt**

The aim of the Master Thesis is to train a neural network to learn the parameters of Electric Motors and thus be able to predict its Key Performance Indicators(KPIs). The KPIs are 2D and 3D plots on Torque(Mgrenz) and Efficiency(ETA). Other KPIs can be calculated from these two KPIs. For instance the Vibration Costs are inversely proportional to the Efficiency values predicted.

## Acknowledgement

I would like to thank my supervisor Prof. Dr. Magda Gregorova for her guidance and support throughout the course of this thesis and Valeo for providing the data. Special thanks to Mr Daniel and Leo for sharing valuable insights of the data from a electromechanical standpoint

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# Introduction

KPIs of an Electric Motor are essential to judge the performance of the motor before it is manufactured. Currently the KPIs are calculated by simulating the motor using an appropriate software. Although this works yet it is a very time consuming and expensive process as simulation is carried out in different iterations and optimized using a genetic algorithm.

## Background

There has been extensive research in modeling the Electric Motor with Convolution Neural Networks(CNN) based on the images of the motor cross-section. However our approach is progressive in the sense that once the KPIs are predicted we would like to be able to generate the inputs and generating images is not ideal for our usecase. Instead by generating the parameters of the motor we can be rest assured of more precise results. Hence the need to focus on the inputs as they are with their parametric description. Literature also covers works on modelling this work as tabular data using MLPs. Although this is fairly good forseeing the impact of generating the inverse process yet MLPs cannot necessarily learn all the intricacies within motor components. Hence the need to better represent the data typically in the form of graphs and model Graph Neural Networks to achieve the desired results. There has been close to no work of GNNs in this domain. Although we see progress of GNNs in molecular chemistry, social networks usecases from which we draw inspiration from.

# Dataset

Valeo an automotive company has supplied the dataset consisting of close to 1500 Double V Electric Motor parameters. There are close to 196 parameters which comprises of the geometric, physical and simulation properties of the motor.

The geometry of a whole Double V motor is as below

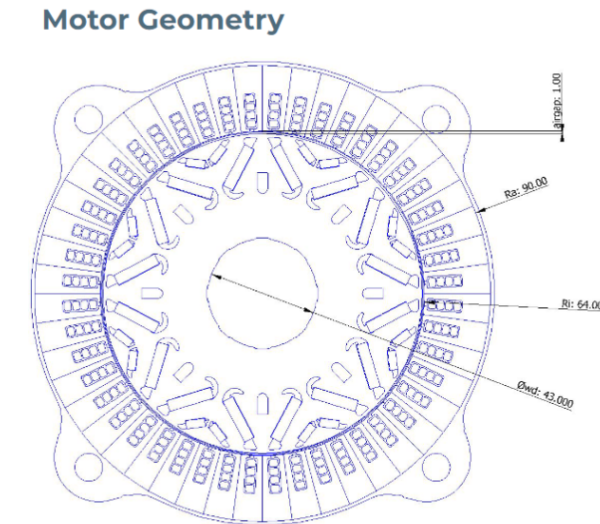
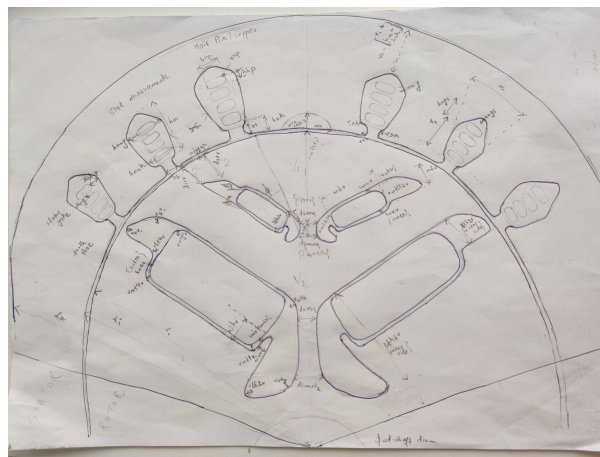


Figure 1: EM Geometry

Below is the geometry of 1/8 cross-section of the same motor.





# Modelling

## Experiments and Results

## Conclusion

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## Bibliography

## Declaration on oath

I hereby certify that I have written my master thesis independently and have not yet submitted it for examination purposes elsewhere. All sources and aids used are listed, literal and meaningful quotations have been marked as such.

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Lilly Abraham K64889, 11.12.2024



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