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Subject Area	Elektromagnetische Felder und Wellen
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Electro-magnetic field simulation of a synchronous machine

Rotor eccentricity

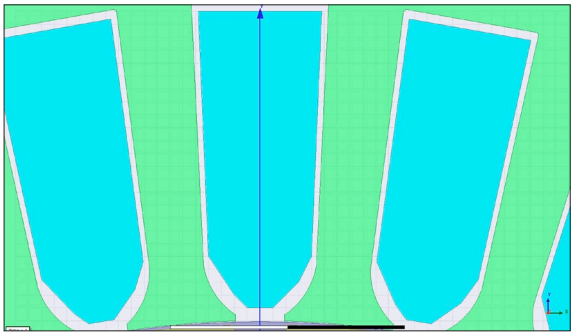

Figure 1: The conductors (blue) of the stator excitation placed in the slots of the stator (green)

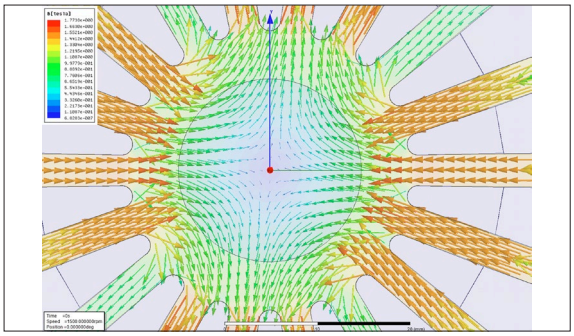

Figure 2: The magnetic flux density in proximity of the centre of the rotor depicted in vector form

Introduction: ABB produces big synchronous engines which directly drive big ore mills without the need of a gear. To achieve this goal, the engine is built around the mill. This approach has already been successfully implemented. The rotors of these machines have a diameter of approximately 10 m with an air gap of only about 1,5 cm. Due to heat dissipation from the windings and heat created in the iron, both the rotor and the stator expand, which ultimately leads to rotor eccentricity.

Objective: The degree to which possible rotor eccentricity affects the electrical and mechanical behaviour of the machines is as yet mostly unknown. The problem with such big machines is that the parameters which describe the machine cannot be that easily determined by actual measurement. Also, a mathematical approach using analytical expressions does not provide a promising approach. However, the field of computational electro-magnetics, which applies maths in a whole new way, offers a lot of potential. It is thus the goal of this bachelor thesis to set up a 2-D model of a small synchronous machine from the laboratory to see whether the computer model can accurately represent the behaviour of the machine.

Result: The software which is used is called Ansys Maxwell. Using the CAD tool provided, a model can be conveniently drawn. After the materials and their properties have been defined and assigned the software allows for the display of a wide array of results, such as magnetic field configuration (vector field), resulting torque, inductance matrix, induced voltage etc. The results obtained from the simulation match the data obtained from the measurements very well. Thus computational electro-magnetics can serve as a powerful tool to describe the behaviour of electric machines with or without rotor eccentricity.

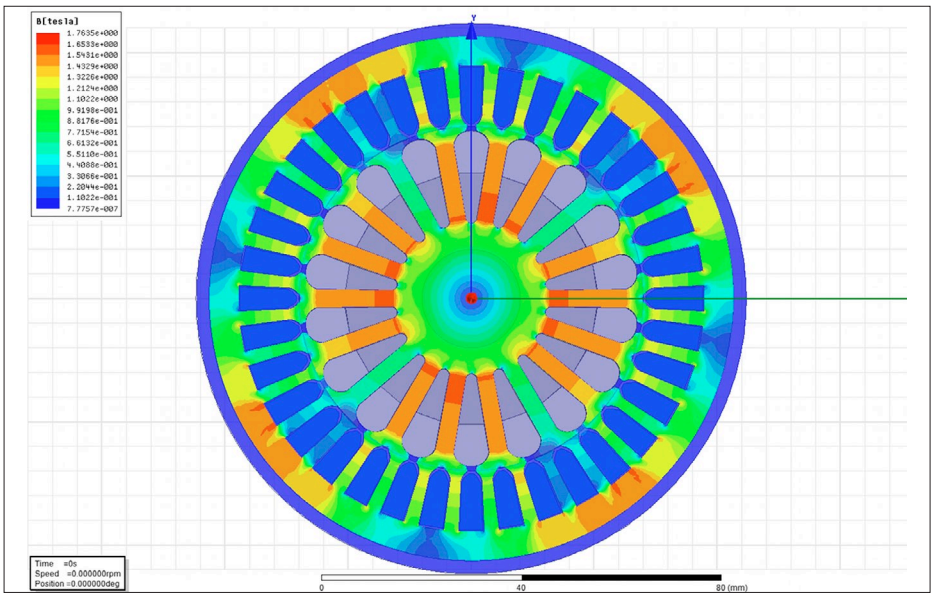

Figure 3: The magnitude of the magnetic flux density in the whole machine