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DESIGN OF MOTION CONTROLLER FOR PERMANENT MAGNET SYNCHRONOUS MOTOR

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ABSTRACT

The paper concerns the development of motion controllers for a three-phase AC permanent magnet synchronous motor (PMSM), with an integrated magnetic gearing. The aim is to use the controlled PMSM as a variable-speed solution on a light-weight crane, which is used on wind turbine nacelles to lift components of the larger, self-hoisting crane. The areas of interest arise from the magnetic gearing having a torsional spring effect, as well as the possibilities of which the dynamic behaviour is to be analyzed to gain more knowledge of the behaviour. This spring effect could cause undesired oscillations depending on how fast the load is accelerated, possibly leading to slipping which could have further problematic dynamics to investigate. The goal is therefore to reduce lifting time as much as possible, while avoiding these dynamics of the gear.

In order for the speed to be variable on the PMSM, a frequency converter has to be used to control the three-phase AC used in the motor. The frequency range of the converter needs to be able to produce the desired lifting speeds. For controlling the torque, pulse-width modulation (PWM) needs to be used for controlling the voltage of the phases in the motor.

It is also very important for the motor to be able to produce the necessary torque required to keep the load steady, as the PMSM is not self-locking. With this characteristic of the PMSM, it is furthermore required to have a failsafe mechanism if the power was to be disconnected, to ensure that the load does not fall down.

The feedback control system will consist of measuring the output speed and position of the PMSM rotor, in order to control the speed and torque. The work will include building a non-linear simulation model along with a linearized mathematical model, from which control theory can be applied to develop controllers. Finally, the developed controllers will be implemented digitally on a microprocessor belonging to the frequency converter.

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