

# Summary

This thesis presents the design of a magnetic levitation system for high gyroscopic moment rotors. Existing literature offers examples of magnetically suspended flywheels and gyroscopes, but they typically fall into two categories: either large-sized flywheels with small gyroscopic moments or small gyroscopes prioritizing precision over magnitude of the generated moment. This thesis aims to bridge this gap by focusing on a gyroscope intended for use in an inertial sea wave energy converter. The energy harvested by this system is directly correlated to the gyroscopic moment experienced by the gyroscope. Consequently, achieving a significant energy output requires effectively balancing a substantial gyroscopic moment. Conventional roller element bearings can be employed to counterbalance this moment; however, they result in considerable losses. By utilizing active magnetic bearings, the efficiency of the system can be improved.

Based on specific design requirements, a magnetically suspended disc rotor is designed. Axial translation and tilting of the rotor are supported by an axial active magnetic bearing acting on the upper and lower faces of the rotor, while a radial magnetic bearing acts on the inner surface of the rotor to stabilize radial displacements. A switched reluctance motor is implemented to control the rotation of the rotor. A specially designed sliding elements solution is adopted for the landing of the rotor.

An energy analysis is conducted to determine the energy losses of the developed gyroscope and highlight its advantages over the conventional solution. Additionally, a suitable controller is developed to verify the feasibility of controlling the system. Finally, a scaled prototype is designed and constructed to validate the proposed solution.