Fully position sensorless control of a magnetically levitated Reluctance Synchronous Machine by three phase active magnetic bearings

3
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This paper discusses a fully position senslorless controlled magnetically levitated drive. Sensorless means, that no external position sensors are used and the position is obtained from electrical quantities of the actuator itself. In this work a Reluctance Synchronous Machine (RSM) provides the torque of the drive. For the control an angular position sensor is avoided by using sensorless methods instead. Additionally the radial active magnetic bearings (AMBs) of the drive providing magnetic levitation are controlled without any position sensor. Here, the radial rotor displacement is evaluated by sensorless methods too. Thus, the complete prototype drive works fully without angular and radial position sensors. Finally, the drive system architecture gets reduced to an absolute minimum of components, because both components, the RSM and the AMBs, cover already two main functions. Each combines the functionality of an actuator as well as a sensor within one module. Further, the AMBs and the RSM have a three phase structure and allow the usage of the same three phase voltage source inverters. By this overall system simplification a significant hardware cost reduction is gained which offers new possible applications for high speed drives. In this work the basic principles of the sensorless control methods applied to the RSM and the AMBs are explained, the prototype setup is described and measurement results are presented.

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