Elena Lomonova

Magnetically levitated bearingless motors

Elena Lomonova, Chair of Electromechanics, Power Electronics and Motion Systems at Eindhoven University of Technology, Netherlands

Abstract

"Magnetically levitated planar motors are applied to the wafer scanners in the lithographic industry because of their clean-room and vacuum compatibility. Using the magnetic fields as a bearing mechanism, they have to be controlled actively in six DOFs for stable operation. Therefore, all force and torque components acting on the translator should be accessible and be decoupled. Typically, they provide long stroke xy-movements, a limited stroke along z, and small rotations around all axes. High-precision planar motors with magnetic levitation and submicrometer accuracy are usually of the PM synchronous type.

In contrast to these levitated planar motors, a novel enabling magnetic suspension system underneath a stationary frame – ceiling robot is researched. It requires an attractive normal force between the frame and the translator to counteract the gravitational force, whereas magnetic levitation above a stationary frame is based on a repulsive normal force. In this respect, basically many topologies (synchronous PM, induction, reluctance ones) are applicable to the magnetically suspended planar motor.

During the keynote lecture several possible topologies for the magnetically suspended planar motor (ceiling robot platform), a thorough electromagnetic analysis and several performance criteria are discussed. First, all force and torque components should be accessible and be decoupled because the magnetically suspended planar motor is an active magnetic bearing. Additionally, the planar motor preferably has a symmetrical behavior along x and y axes. For this reason and owing to its structure, an arrangement with four linear motors with wireless energy transfer from the stationary ceiling has been selected for the magnetically suspended planar motor and intensively researched. All theoretical findings are verified with experiments of fully operational magnetically suspended 6-DoF ceiling robot".