Dissertation title:

Analysis of eddy current and hysteresis losses in direct-drive linear motors with rotationally symmetrical profile

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Linear direct-drive motors become more important in manufacturing. They are fast, precise and controllable, directly powered by electricity. In the field of automation engineering, tubular motors with rotationally symmetric profile could be a replacement for pneumatic systems. But the type with moving magnets is susceptible to eddy current and hysteresis losses, investigated in this thesis.

Following the overviews of types and elements of linear direct-drive motors, characteristic curves are introduced. The explanation of different losses and influences occurring in a mechatronic drive unit concentrates on the eddy current and hysteresis losses in the yoke system. The description of the properties of these losses explains the calculation challenges and leads to estimations and simulation methods. The complexity of the losses and their calculations require metrology for estimating their real dimensions and for comparing them.

For this metrological method an innovative test rig isdeveloped, following the preinvestigations. The test rig allows the comparison of different yoke materials by capturing the force feedback of the dynamic magnetic losses. The eddy current and hysteresis losses of aluminium, soft magnetic material and electrical sheet arrangements are measured by using different movement profiles. The results of the measurements verify the simulations. Additionally the magnetic hysteresis of the materials is analysed. The results confirm the test rig measurement and allow an estimation of hysteresis losses. The implementation of a rotationally symmetric electrical sheet arrangement shows the opportunity for this kind of yokes. The measurements lead to conclusions and approaches to reducing losses by using research results for improvement. If this is necessary, materials and sheet arrangements can be the basic approaches to reduce the magnetic losses.