Magnetic Wave Moves Railway Shuttle

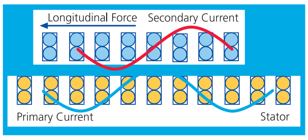
- A German University is developing a magnetic railway system
- Testing and optimizing with dSPACE Prototyper

Researchers at the University of Paderborn are developing a new mechatronic, modular railway system, known as NeueBahntechnikPaderborn (NBP). The system combines comfortable individual transportation with the advantages of linear drive technology, while using the existing railway tracks. With dSPACE Prototyper the team of NBP tested and optimized the control strategies on the test bench at an early development stage in preparation for further tests at an outdoor test site.

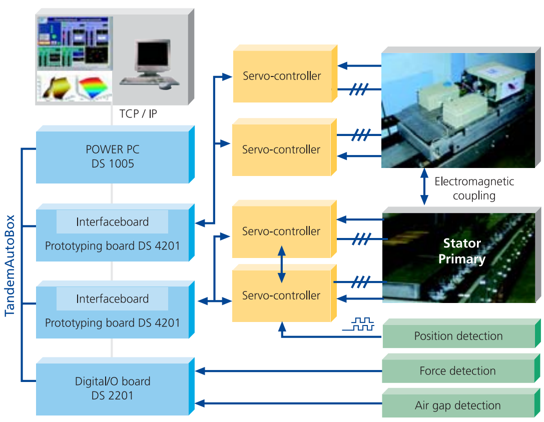
The new railway system is based on magnetic drive technology, providing contact-free power transmission with a frictionless, lightweight drive and low maintenance costs. Another feature is also impressive: Small autonomous shuttles will take passengers and loads to their destinations without having to change trains.

Precise Control Requirements

The drive module is based on a doubly-fed linear motor, which is divided into two parts: The primary (stator) is placed between the tracks and the secondary is placed in each individual shuttle. The drive control is realized on board the shuttle via secondary currents. Only the stator segment that the shuttle is approaching is supplied with primary current. And the stator has to be controlled according to the commands given by the shuttle drive control. The electrical position of the stator current therefore has to be controlled with great accuracy, as the synchronous transition from one stator segment to the other is very important for a homogenous stator field. If a stator was supplied with only a short delay, the shuttle would jolt slightly when passing from one stator segment to the next.



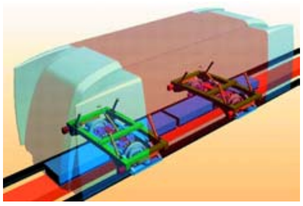
Magnetic forces between stator and secondary accelerate the shuttle.



Block diagram of laboratory test set-up.

On the Test Bench

Two servo controllers supply the secondary and there is one for each of the stator segments. They communicate with dSPACE TandemAutoBox on the shuttle via interface boards attached to the dSPACE DS4201 Prototyping Board. To validate the control model we had produced in MATLAB/Simulink, we divided the stator into two separately supplied parts in order to examine the switching between the two stator segments when the shuttle is approaching and leaving. The rotor was also divided into two parts, for longitudinal dynamics control and for additional pitch control. It was very easy to monitor the experiment on the host PC with ControlDesk, which proved to be the right experiment software for special manoeuvres and for measuring significant parameters and fault diagnostics, as we had expected.



Driverless shuttle with actively controlled undercarriage.

On the Test Track with dSPACE Prototyper

The experiments on the test bench show that dSPACE Prototyper is a time-saving development tool for testing and optimizing the control model. This will especially apply to further tests at our outdoor test site. Depending on the shuttle position, the stator segments will be switched on by converters which receive the references directly from the shuttle drive control via radio commands. We look forward to testing and optimizing the actual railway-system with dSPACE Prototyper this year.

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