

## Continuous Positioning with Electromagnetic Linear Drives

### Objective

Properties of electromagnetic actuators such as

- high forces,
- good dynamic behaviour,
- robust and simple structure,
- low price

are reasons for their wide spread, for example in relays, switching valves or locking mechanisms. However, without additional means there is no stable operating point of the plunger between the two plunger rest positions. In almost all applications, only these stable positions are technically exploited.

An interesting approach that retains the advantages of electromagnetic actuators compared to other linear drives is to use solenoids as direct drives for continuous positioning of translational loads. The highly nonlinear behaviour of solenoids calls for closed loop control of the plunger position with nonlinear control algorithms in this case. The structure of such an „electromagnetic linear motor“ is shown in figure 1.

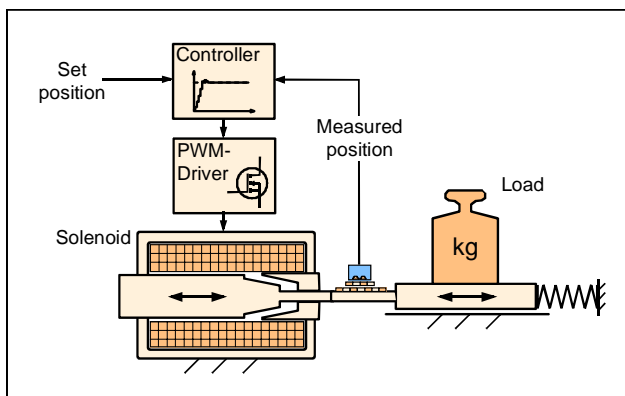


Figure 1: Linear drive based on a position controlled solenoid

As for conventional rest-to-rest applications, the electromagnetic actuator can be a standard solenoid or can be a special design integrated into the mechanism to be driven.

Since the reluctance forces used in electromagnetic actuators always act towards a shortening of air gaps and thus in one direction only, the force necessary for the return stroke has to be applied

externally, e. g. with springs, gravity or a second solenoid.

### Applications

Electromagnetic linear drives can be used in applications such as

- Handling and Automation,
- Automotive,
- Proportional valves,

where they are an interesting alternative or complement to other translational direct drives, for example DC linear motors, voice coil systems or pneumatic cylinders.

Besides tracking control of variable position profiles, force control can also be realized.

### Preliminary Data

The list below summarizes characteristic performance data that can be achieved with electromagnetic linear drives:

Maximum stroke	10 mm	30 mm
Actuator volume	50 cm <sup>3</sup>	600 cm <sup>3</sup>
Maximum Force in N		
@ 100 % duty cycle	12 N	120 N
@ 5 % duty cycle	45 N	400 N
Positioning time	20 ... 300 ms	
Accuracy	30 ... 100 µm	

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