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Modular Linear Brushless Motor Dynamics

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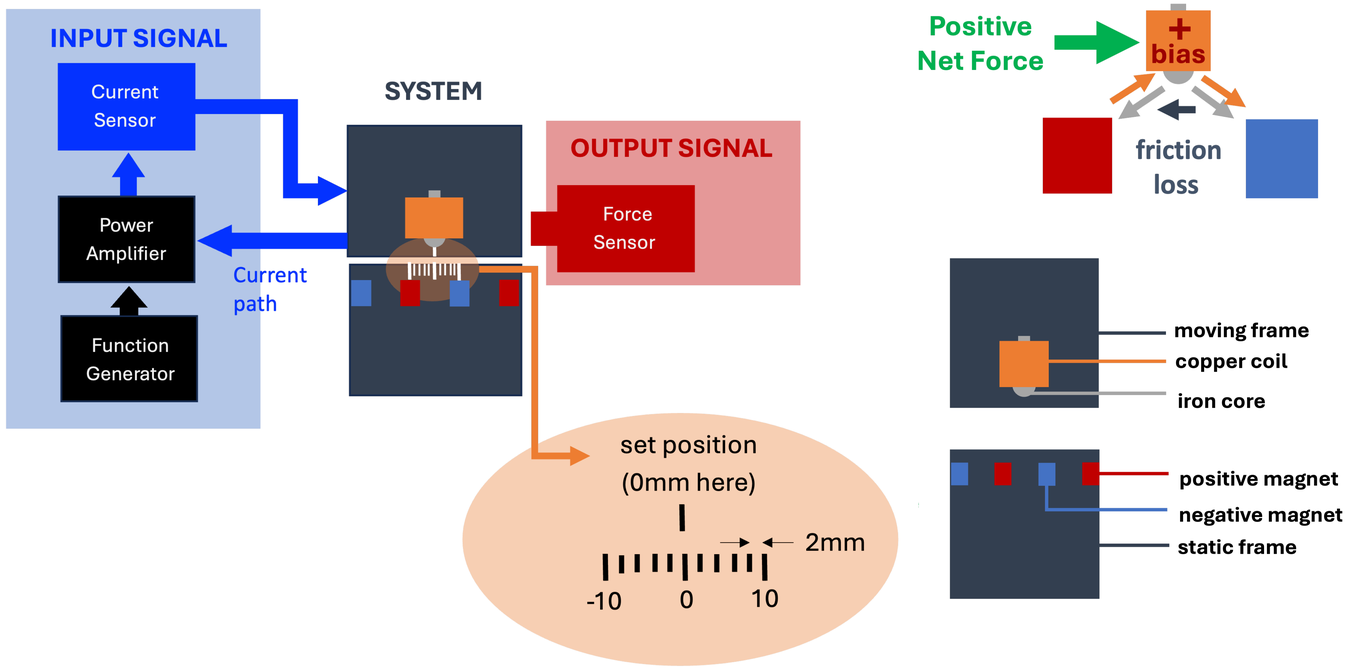
[1] "Japan's maglev train goes 374 mph, sets world record," CNN, https://www.cnn.com/videos/world/2015/04/22/ct-japan-maglev-train-world-speed-record.cnn (accessed May 2, 2024).

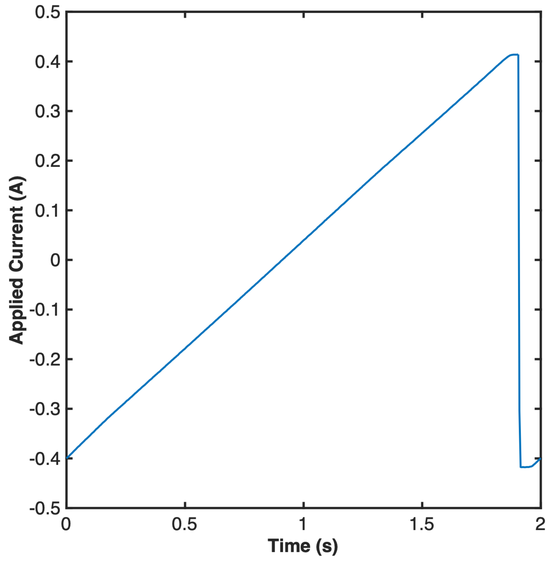
Abstract

Linear brushless motors are used across a variety of industrial applications ranging from plant automation to superconducting maglev trains. The system for this study is a lightweight, low complexity, and low-cost magnetic linear brushless motor suitable for rapid prototyping or hobbyist applications. The open-loop control of the position is not straightforward due to end effects, friction, and nonlinearities in the magnetic interactions. By measuring the motor force as a function of distance between magnets and current, a linear regime was found 7 mm region around the equilibrium point between magnets.

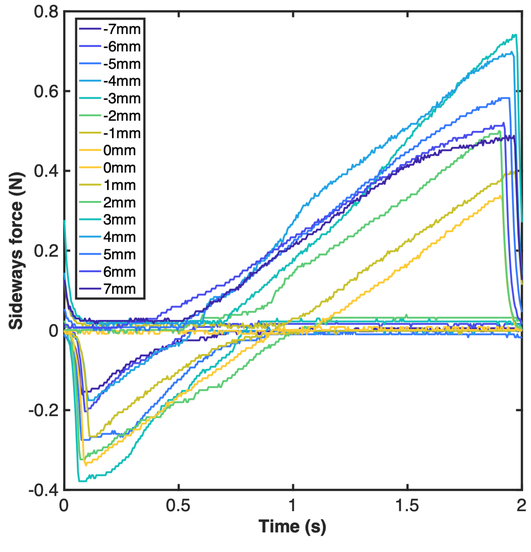
Force Sensing Setup



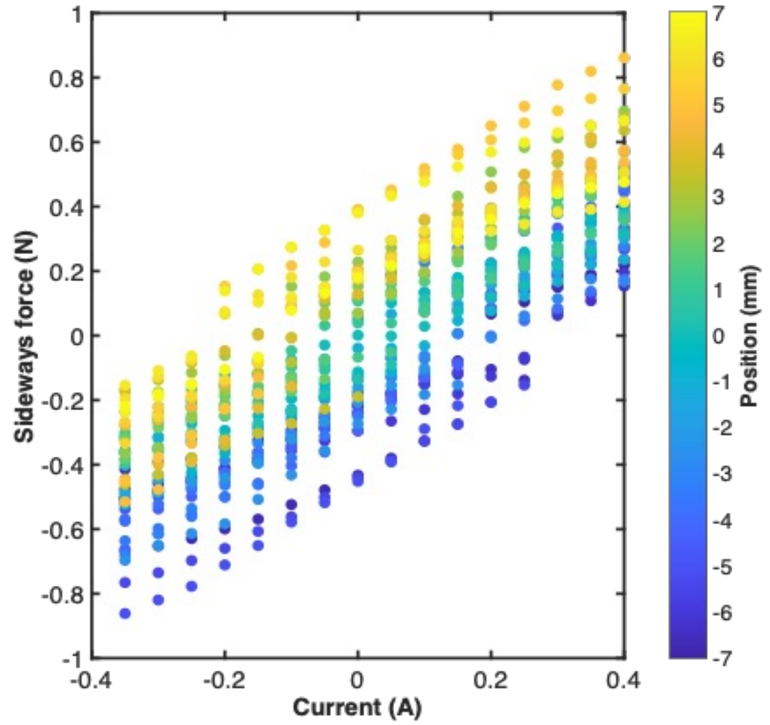
INPUT SIGNAL

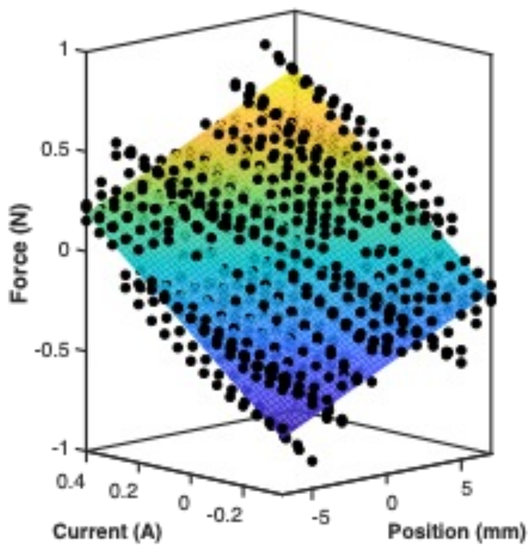


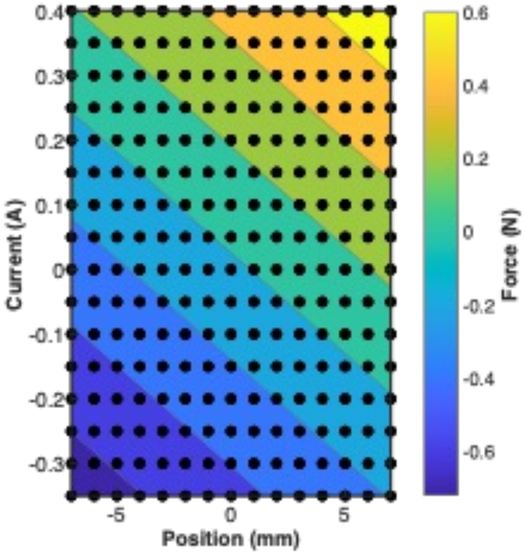
OUTPUT SIGNAL



Results







Conclusions

- The motor's force can be modeled as the sum of current and position
- The linear approximation is accurate for 70% of the range

Acknowledgements

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