**Motivation and Objective**

What is magnetostriction?

Advantages and applications of magnetostrictive actuators.

Our work is, based on micromagnetics, to explore computation tools and methods which help:

- Understand magnetostrictive material behaviors;
- Design and control magnetostrictive actuators.

**Magneto-elasticity Model**

The model consists of two coupled parts:

- Magnetic dynamics, governed by Landau-Lifshitz-Gilbert equation:
  \[
  \frac{\partial M}{\partial t} = -\frac{\gamma}{1+\alpha^2}(M \times H_{eff}) - \frac{\alpha}{(1+\alpha^2)}M \times (M \times H_{eff})
  \]
- Mechanical dynamics, governed by motion equation:
  \[
  \rho \frac{\partial v}{\partial t} = \rho M \cdot \nabla H + \nabla \cdot T
  \]

**Numerical Methods**

- Finite difference method in discretization of the PDEs
- 4th order Runge-Kutta method in integration of the ODEs
- 1-D rod model for domain wall dynamics study;
- 3-D rod model for hysteresis study;
- Hybrid rod model for magnetostriction study

**Results**

- Domain wall formation
- Domain wall movement
- Domain wall dynamics
- Hysteresis curve
- Magnetostriction curve

**Significance**

Simulation results qualitatively agree with physical observations. This verifies the validity of the micromagnetic model, and thus provides a way to deepen understanding of the underlying physics and study control effects.

**Future Work**

- The current computation algorithm is naive and therefore time-consuming. Fast algorithm for calculating demagnetizing field needs to be implemented.
- Some constants used in the simulation are not from real material parameters. Real parameters are necessary for the computation results to be comparable to experimental results.