Coriolis Effect Demonstrator

University of Colorado Boulder | DESIGN CENTER COLORADO

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EMERSON | Micro Motion

Project Background

- Trade show exhibit emphasizing the twisting motion of vibrating U-shaped tube in Coriolis flow meters

Key Objectives

Twist Visualization

✓ Reveal and explain quick, microscopic twist
✓ Incorporate slow oscillation with steady twist

Automatic Operation

✓ Allow for exhibit to autonomously operate
✓ Require zero manual input force beyond startup

Variable Flow Rate

✓ Implement variable flow to illustrate degree of maximum twist is proportional to mass flow rate

Transportability

✓ Limit size and weight so exhibit can be efficiently delivered to trade shows

Testing

Electromagnet Positioning

- Optimal distance between electromagnet and permanent magnet for maximum force

Microcontroller Code

- Delayed electromagnet pulse
- Electromagnet pulse duration

Controllable Flow Rate

- Continuous across 0-100% flow rate

Twist Displacement

- Larger twist as flow rate increases

Significant Features

Segmented Tubing

- Latex decreases stiffness to increase twist
- Rectangular geometry maximizes torque applied by Coriolis forces

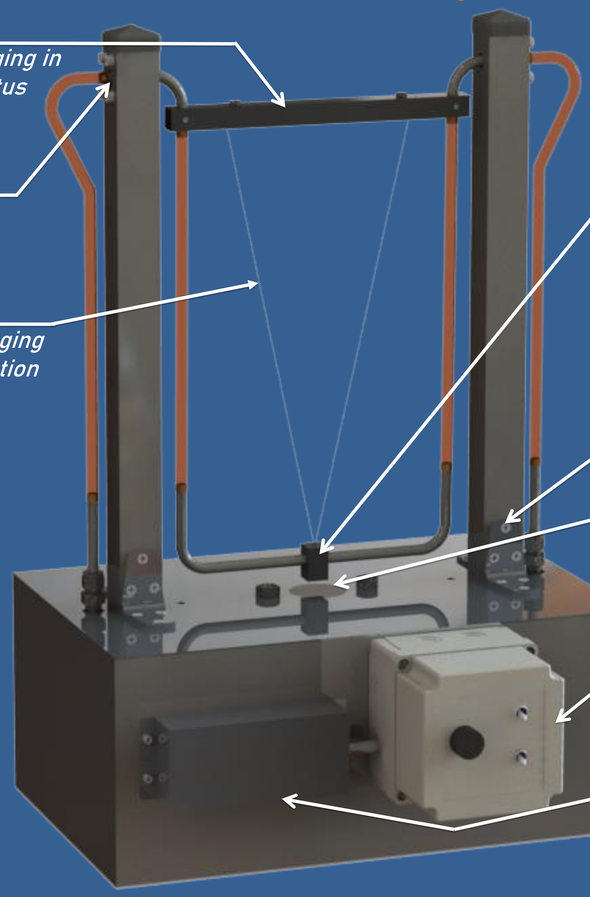
PWM Pump Controller

- Pulse width modulation
- Quickly turns motor on and off to provide variable flow rate

Hall Sensor and Electromagnet

- Sensor detects when U-shaped tube is in bottom position
- EM repels magnet for automatic swing force

Full Assembly



Shaft
Ensures segmented tube is swinging in plane, fastens Stabilizing Apparatus

Bearings
Placed inside of stanchions to create smoother swing

Stabilizing Apparatus
Provides tension perpendicular to swinging motion to prevent undesired lateral motion

Permanent Magnet Holder
Houses permanent magnet and provides connection to stabilizing apparatus

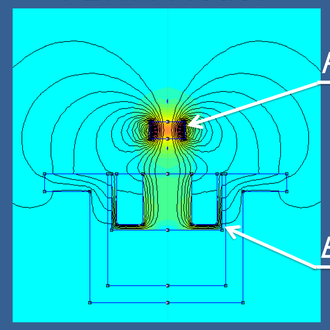
Hinges
Allows stanchions to fold down for compact transportation

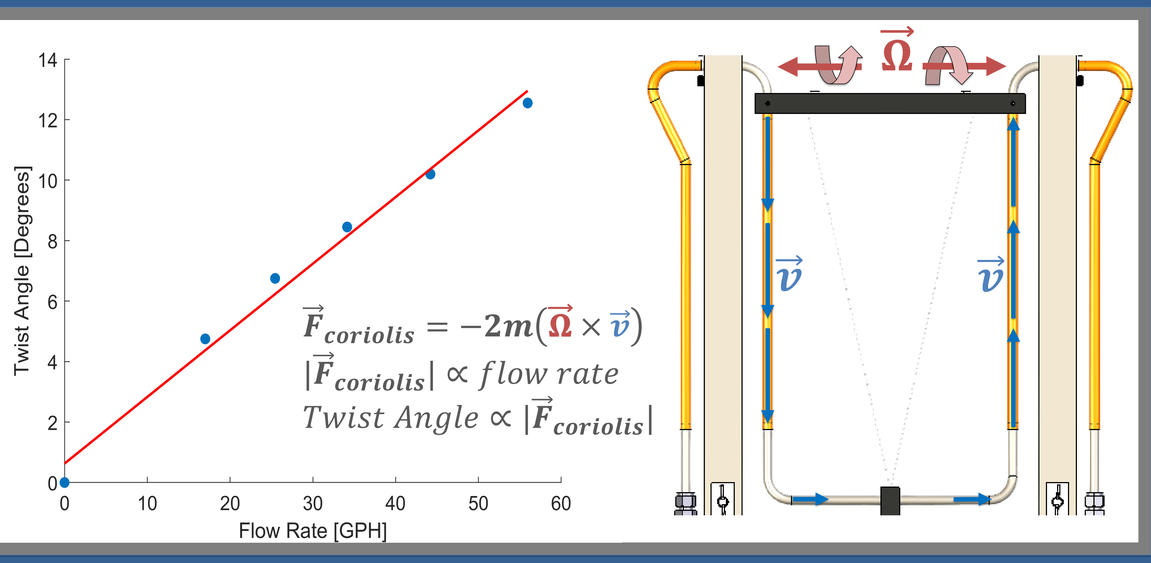
Electromagnet
Controlled by Hall sensor to repel the swinging tube at bottom position

Electrical Box
Houses PWM controller, on/off switches, and microcontroller

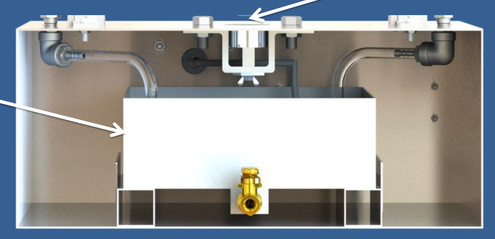
Power Supply
Converts 120V AC to 12V DC, provides power to entire exhibit

FEMM Model





Rear View



Reservoir
Houses water, pump, and drain valve

Overall Outcomes

- Autonomous exhibit allowing adjustable flow rate with proportional twist angle
- Toolless disassembly process for easy transportation

Future Improvements

- Stronger electromagnet to produce larger swing
- Closeable, watertight reservoir
- Camera and monitor depicting live overhead view

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