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The Development of a Spring Powered Starter for a Motorcycle

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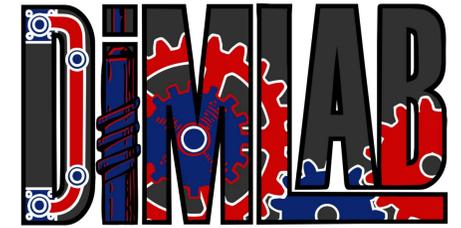
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Development of a Spring Starter for an Internal Combustion Engine

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Introduction

- GM sponsored project looking into harvesting, storing, and releasing energy in an efficient manner
- Motivation: Reduce toxic waste created by automotive lead-acid batteries
- Goal: Design a coiled spring to replace the starter system for an internal combustion vehicle
- Vehicle: 1995 Yamaha XJ 600s motorcycle

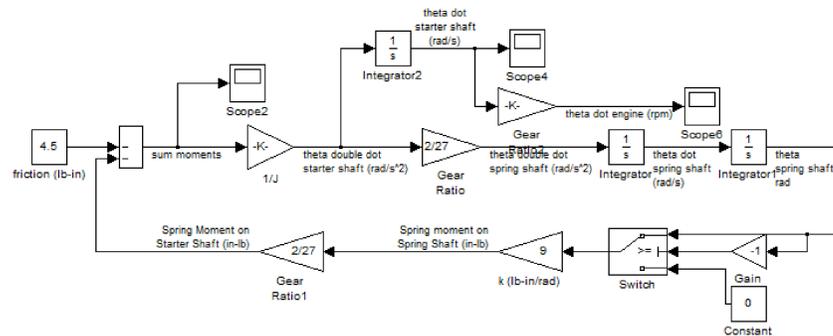


Methodology

- Testing conducted to characterize starter motor and engine inertia

$$T_s = J_s \dot{\theta}_s + T_{ps}(\theta) + T_{fs}$$

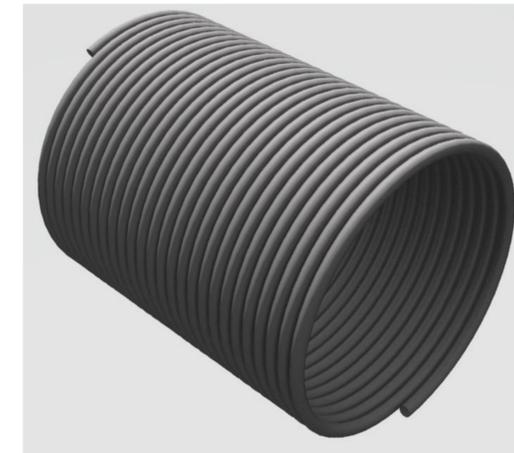
- Simulink model created to determine spring stiffness and initial wind needed to replace starter motor
- Gear Ratio varied between 1:1 and 27:1
- Starting Time varied between 0.25s and 1.5s
- Engine speed minimum of 320 rpm



- Excel based spring calculator developed to determine safe spring size and characteristics
- Inputs: Initial Wind, Stiffness, Wire Thickness, Coil Diameter, and Material Strength
- Outputs: Length of Spring, Number of Turns, and Factor of Safety

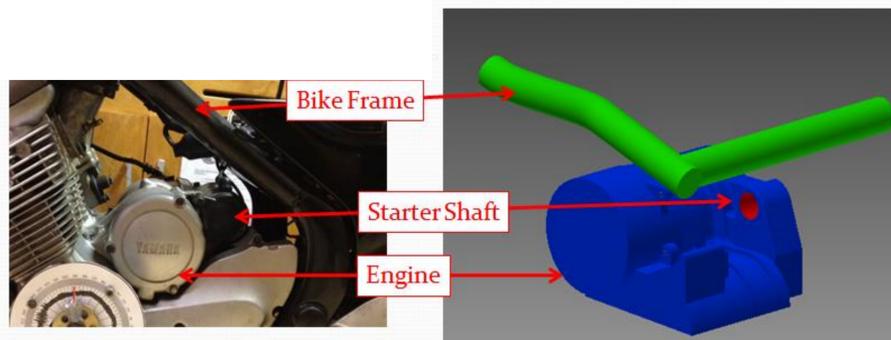
Spring Factor Relationships

- Torque increases with Gear Ratio and decreases with Starting Time
- Initial Wind decreases with Gear Ratio and increases with Starting Time
- Factor of Safety decreases with Torque and increases with Wire Thickness
- Length of the spring increases with Wire Thickness and Initial Wind



Future Work

- Development of a prototype that simulates the inertia of the engine and transfers power through a gear train from a designed spring



Simulink Dynamic Model Response

