Free-Piston Linear Generator (FPLG)

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Motivation

The landscape of clean energy system **upfront infrastructure cost, supply chain concentration, environmental problems etc.** The FPLG addresses these pain points by offering **a higher efficiency engine design** with **simpler engineering solutions** while being **embedded** in an **existing supply chain.**

Project Goals

1.Complete the FPLG pneumatic prototype
2. Derive the data for combustion version & validation of principles

Fundamental Principle

"We develop design for control, not control for what we design"

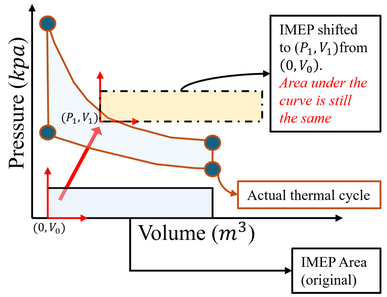
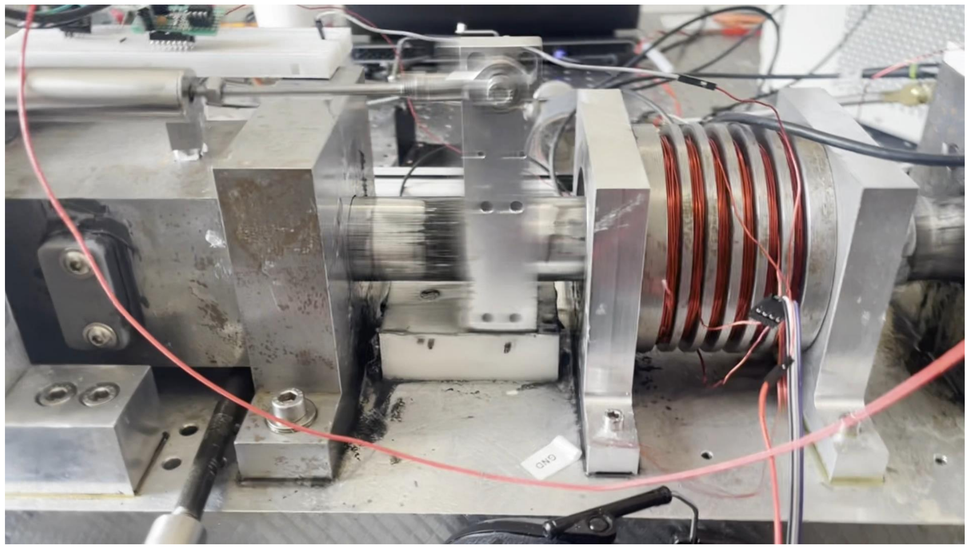
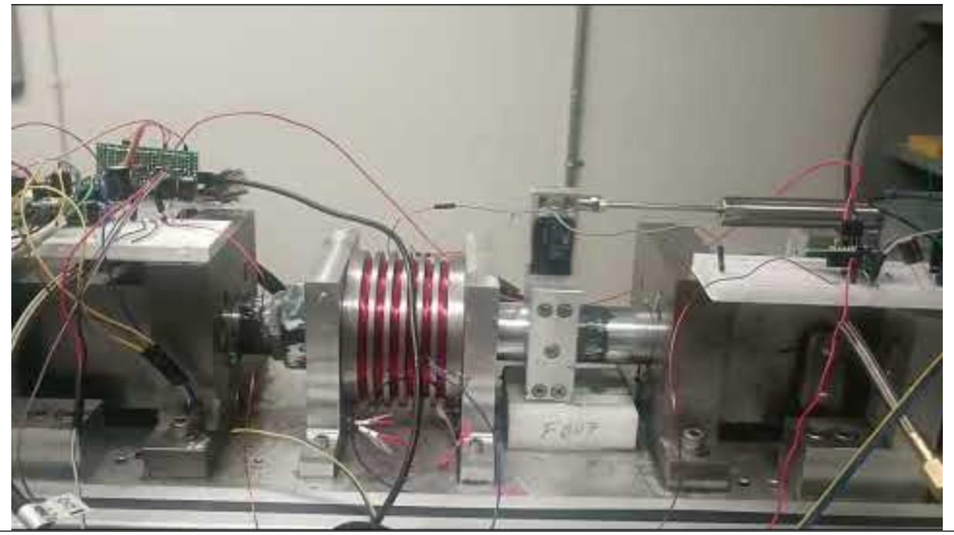


Fig 1: We have turned a ***polytropic*** process to an ***isobaric*** process. while maintaining same area under the curve.

Assembly Overview





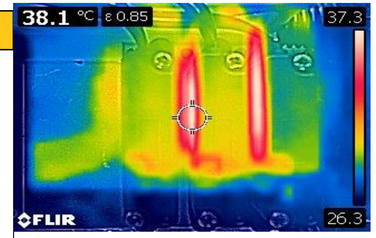
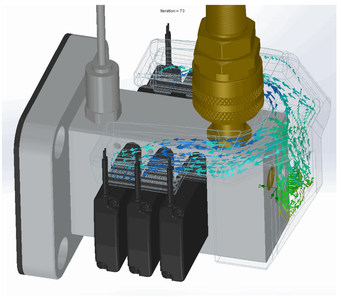


Fig 5: (a) Thermal response of the valve, (b) Passive cooling of the system with exhaust air



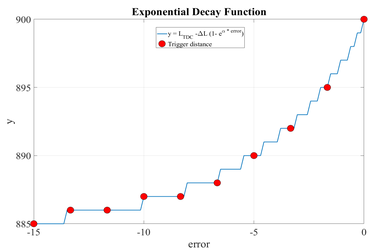
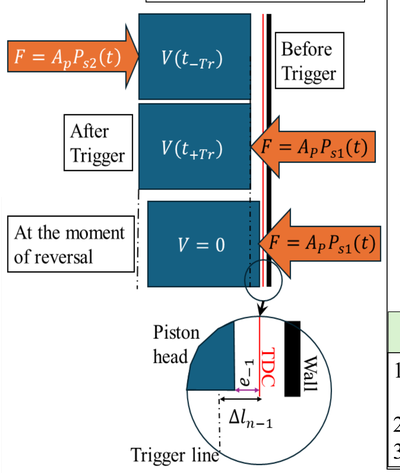


Fig 7: Logic for Position based control for variable compression ratio



Control Logic Overview

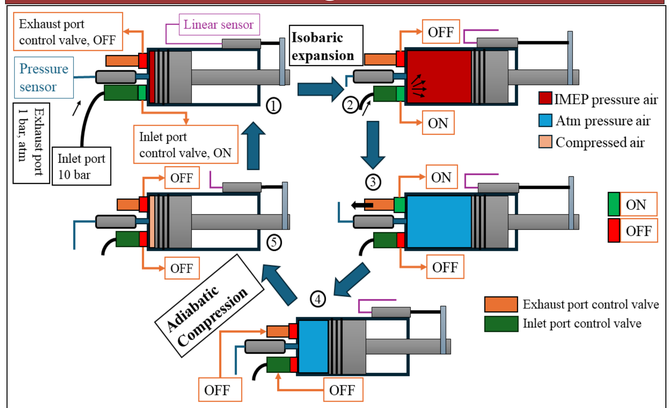
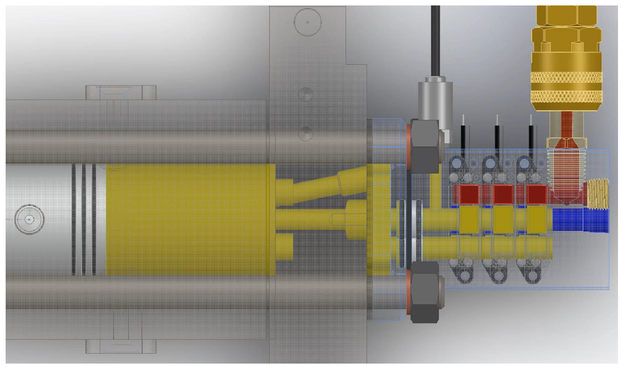


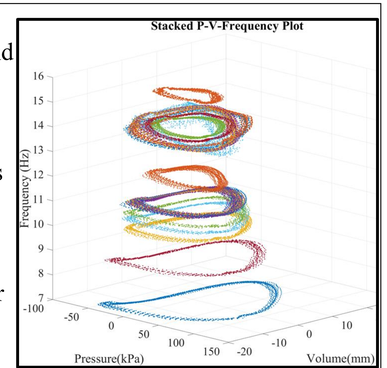
Fig 8: Logic for IMEP based control



Testing Results (Double acting)

I. Ensure energy input and electrical output data is captured for thermo-dynamic and electrical efficiency measurements and evaluation

II. A dual motor control strategy allows for higher frequency exploration. Figure 12 (right).



Future work

1. Test out the combustion version of the set-up with the proven controllers
2. Redesign the setup as a compact product (Box engine shape)
3. Focus on the effective generator design.

Testing Results (Single Acting)

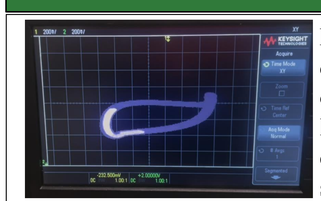


Figure 9: PV diagram from the output of the IMEP based control with shifting.

Figure 10: time-P, time-V diagram from the output.

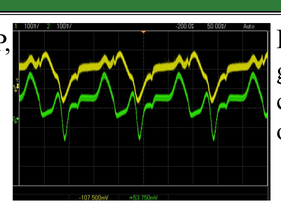


Figure 11: Voltage generation from coil 1 and coil 2 output.

Key take away:

The IMEP based controller turned a polytropic problem into a iso-baric process problem. Reducing the pressure needed to operate the system and the bandwidth needed to control it.

A Special Thanks To: Dr. Gregory Hampson | Robert Linden | Year 1's Team | Year 2's Team| Year 3's Team | Year 4 (sem. 1) Team| Jackson (CU Robotics)| Jaha Team | Chase Logsdon | Patrick McSpadden | Patrick Maguire | Andy Kain | Bryce | Victoria Lang | Dr. Rebecca Komarek | IDEA FORGE TEAM