Portable, Flexible-Use Rocket Thrust Stand for Propulsion Education and Outreach

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Abstract: Thrust test stands are commonly used to test rocket motors and engines, but often they are designed to test a single motor size or type and lack the ability to be transported easily. Presented here are the design and operation of a mobile thrust test stand used for static testing solid and hybrid-fuel rocket motors of varying sizes and thrust levels. Applications for the stand include use for academic and outreach purposes, as well as experimental motor design. More specifically, the stand will be used at Oklahoma State University to support a senior undergraduate propulsion course, an undergraduate rocketry team, and STEM outreach to the local community. The stand is composed of a linear -bearing rail system that uses interchangeable clamps and a compression load cell. The linear rail system is mounted to a table, which is supported by leveling wheels with brakes. With this simple design, the goals of modularity and mobility are achieved, while producing accurate performance data. A LabVIEW program runs both the data acquisition and motor ignition systems to produce time-resolved thrust data at sample rates up to 25 kHz, showing time-history of rocket thrust performance. This test stand has the capability to test motor casing diameters ranging from 38 to 98 millimeters and thrust levels up to 450 pounds. The robust design of this test stand allows it to be easily transported and to accurately test different rocket sizes and types. Preliminary solid-fuel motor results are presented, demonstrating the effectiveness of the thrust stand design.

Objective

- Provide secure & accurate means of testing the performance of solid-state composite rocket motors
- Plot & record thrust vs time curves, max thrust, average thrust, thrust duration, and total impulse
- Tool in teaching & live demonstrations for educational applications

Educational Applications

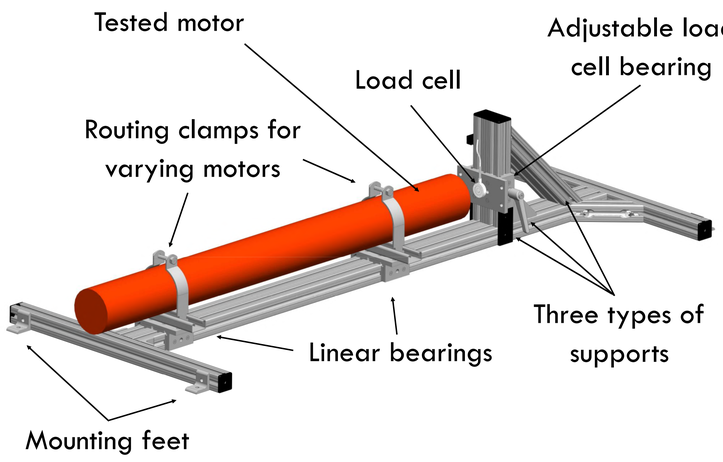
- OSU Rocketry Team
  - → Experimental motor development
- Undergraduate courses
  - → Propulsion demonstration
  - → Compressible flow exercises
- STEM Outreach
  - → Applications of Newton's 2nd Law
  - → Importance of a rocket nozzle

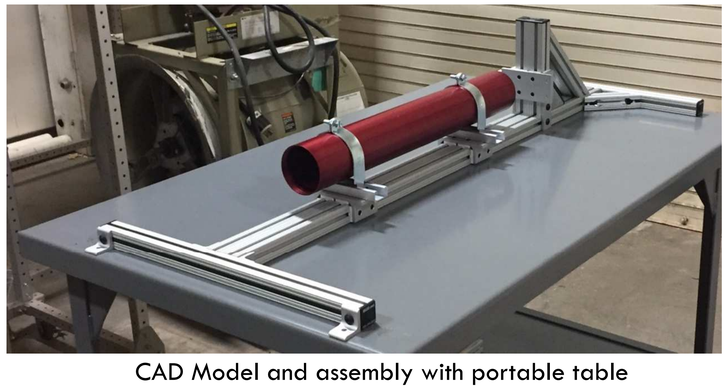
4H, Stillwater, OK

Experimental Setup

- Secure motor on stand
- Connect & install igniter & power on DAQ systems
- Confirm PPE use & safety
- Power up VI & continuity check
- Fire motor when ready

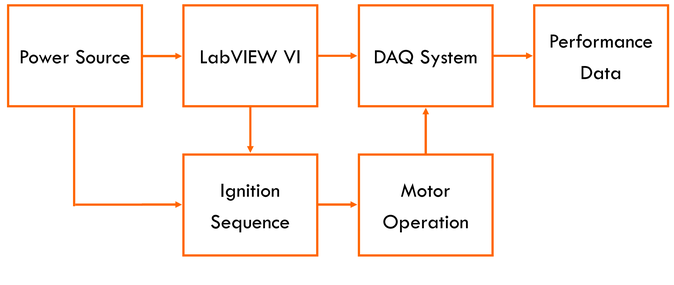
Thrust Stand Components



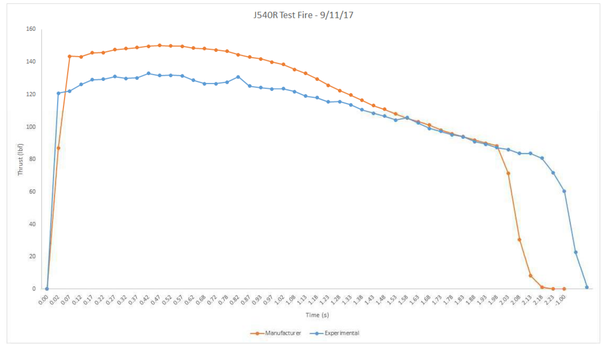


CAD Model and assembly with portable table

System Architecture



Sample Data



Data above was collected from an Aerotech J540R motor. Data closely matches commercial specifications, verifying thrust stand accuracy. Below is the same motor in operation.

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