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Measuring Burning Rate of Solid Rocket Propellant Using X-ray Radioscopy

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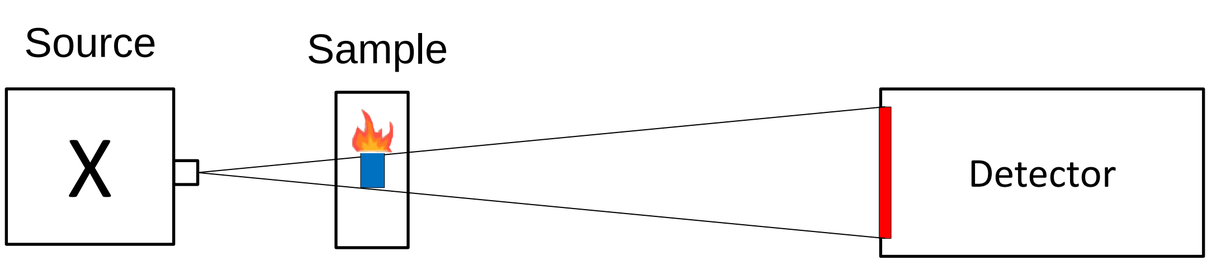
Overview

The objective of this research is to obtain burning rate measurements of solid rocket propellant using X-ray radioscopy. The equipment includes an X-ray source, detector, and burning sample as shown below. Pressure will also be measured since burning rate depends on pressure as shown in St. Robert's Law.

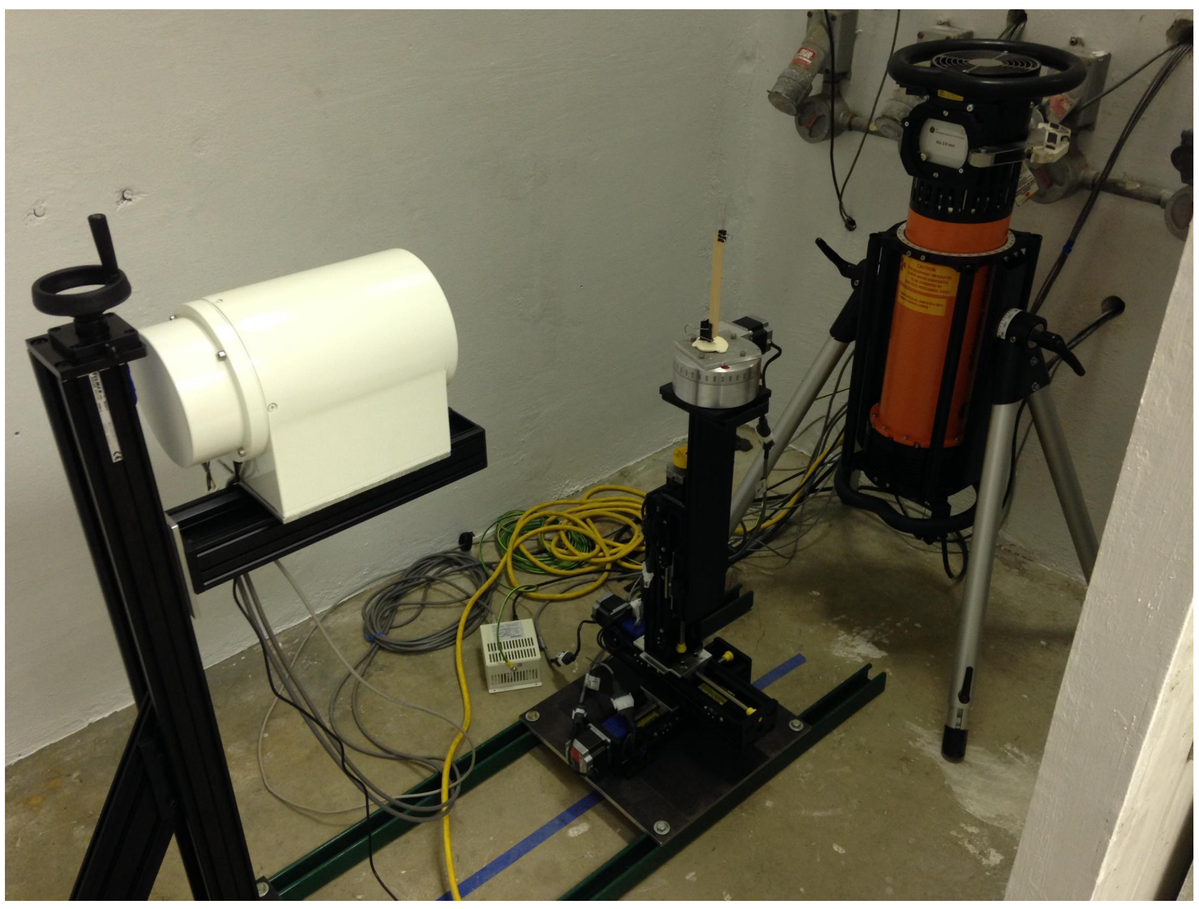
r = burning rate
a = temperature coefficient
p = chamber pressure
n = pressure exponent

$$r = ap^n$$

St. Robert's Law

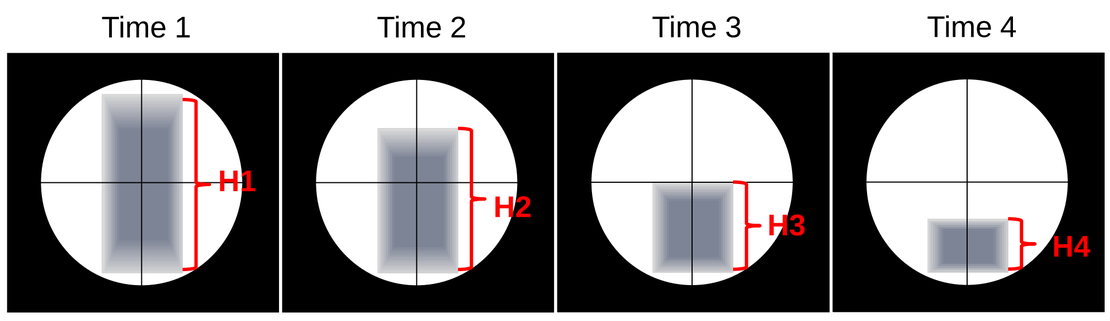


UAH Experimental Apparatus

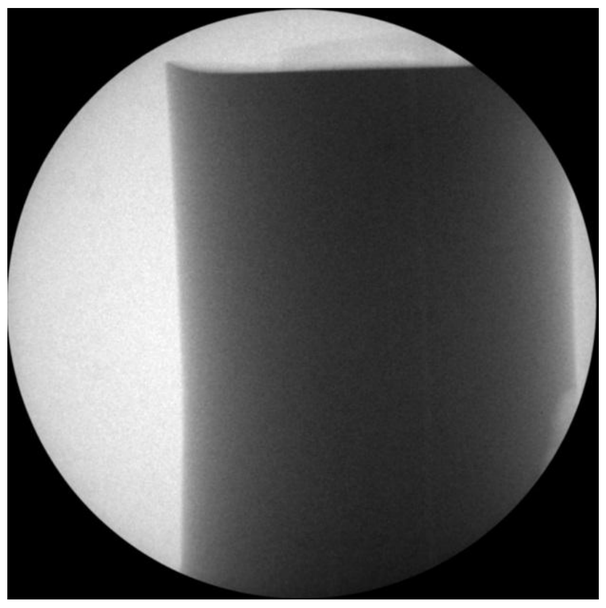


Key Findings

Burning rate data will be obtained from radioscopic video of a burning propellant sample using MATLAB edge-tracking software. Burning rate measurements obtained with X-rays will be compared to measurements obtained using other techniques including optics and ultrasonics.



Burning Surface Regression



UAH X-ray image of an epoxy sample replicator

Impact

The X-ray technique is beneficial because it:
- Reveals burning behavior and phenomena
- Allows testing of unusual sample shapes
- Alleviates optical problems such as smoke

Explanation

Many modern rocket vehicles still employ solid propellant. X-ray radioscopy provides a means of observing the behavior of the fuel while burning, which yields better understanding of the propulsion technology.

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