Fire-front modelling in a discrete match system

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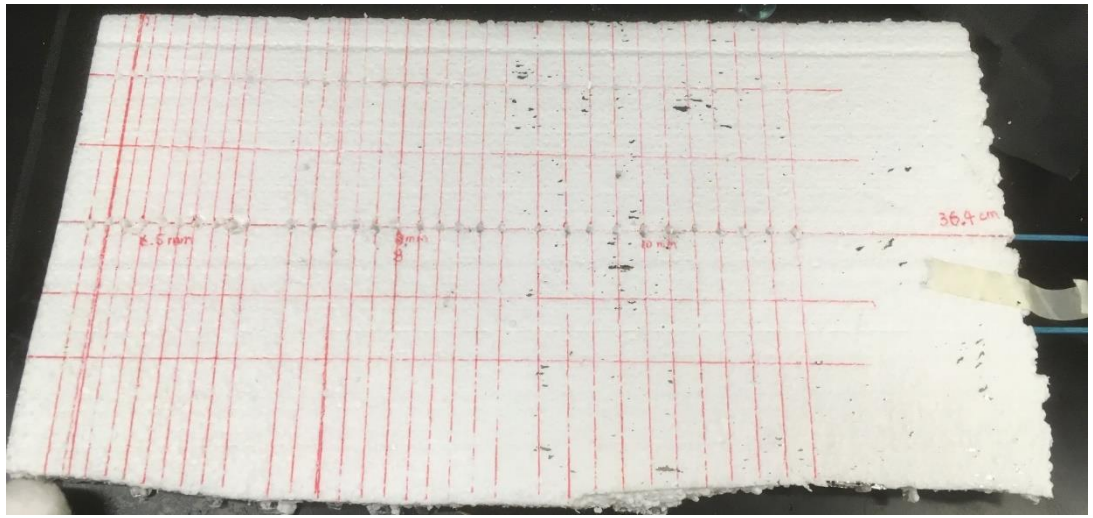
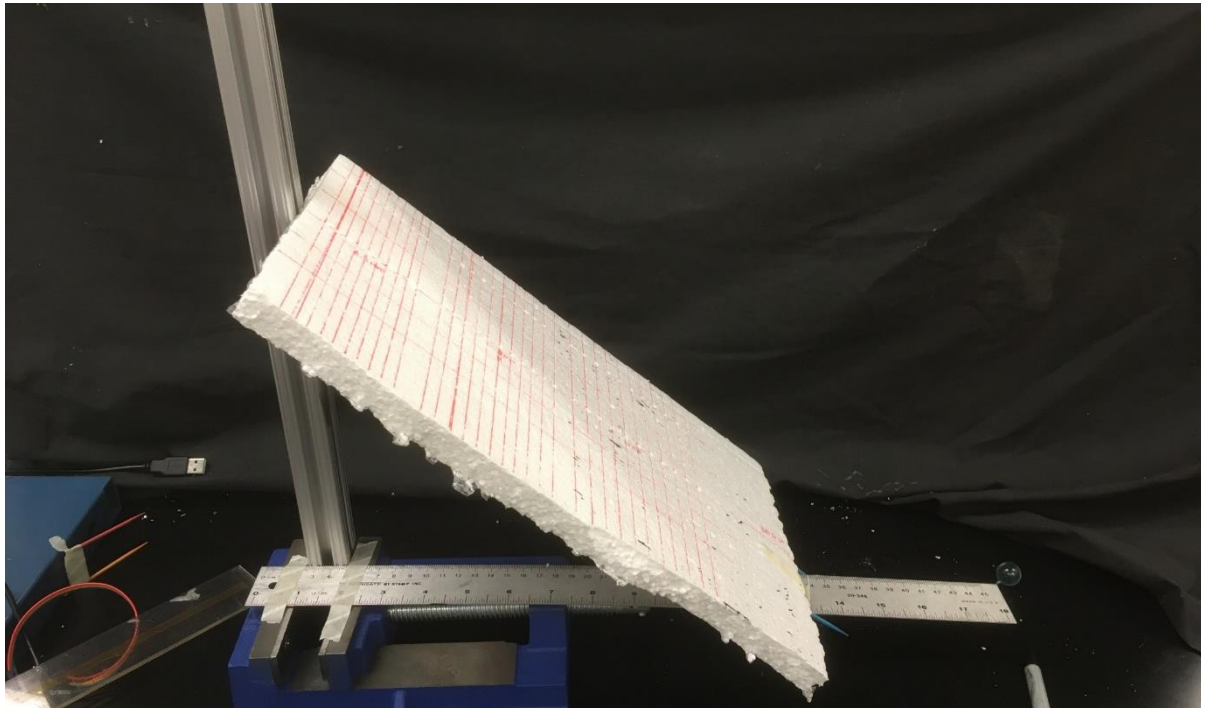
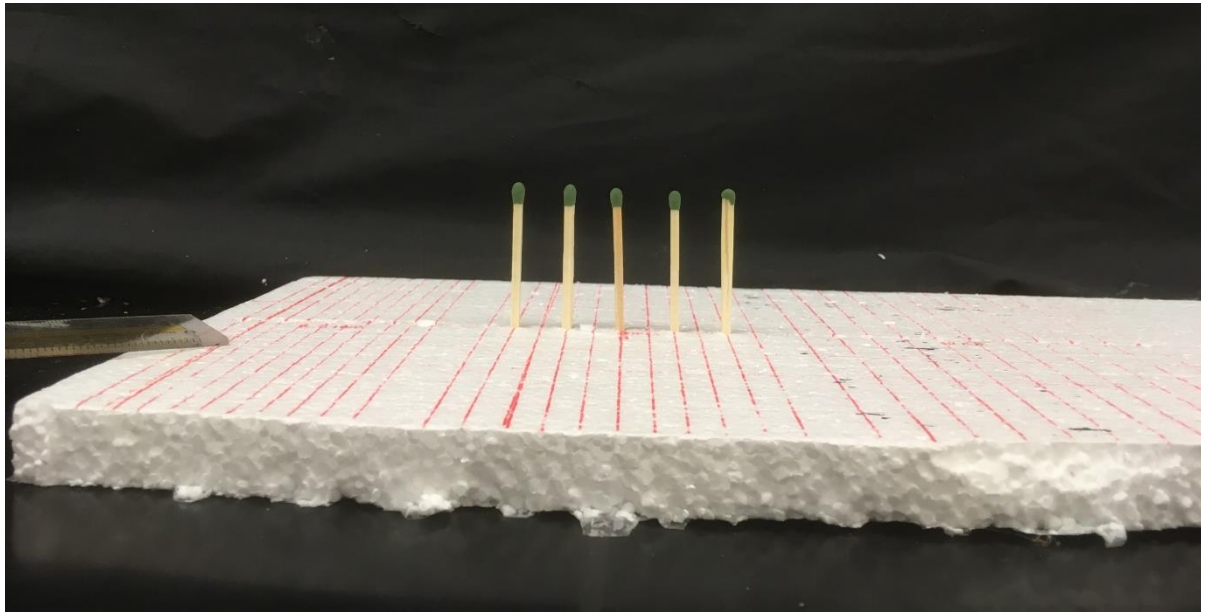
Introduction

- Forest wildfire, either induced by human behavior or nature itself, can occur in different scales, and post threats on human lives and properties.
- Previous research has shown that the spread of wildfire is a rather complicated dynamical phenomenon, which can be affected by a number of factors.
- In this study, we use arrays of matches to model a 1D forest, and explore the fire-front propagation with controlled density and inclination angle. Major experimental findings are included in this presentation.

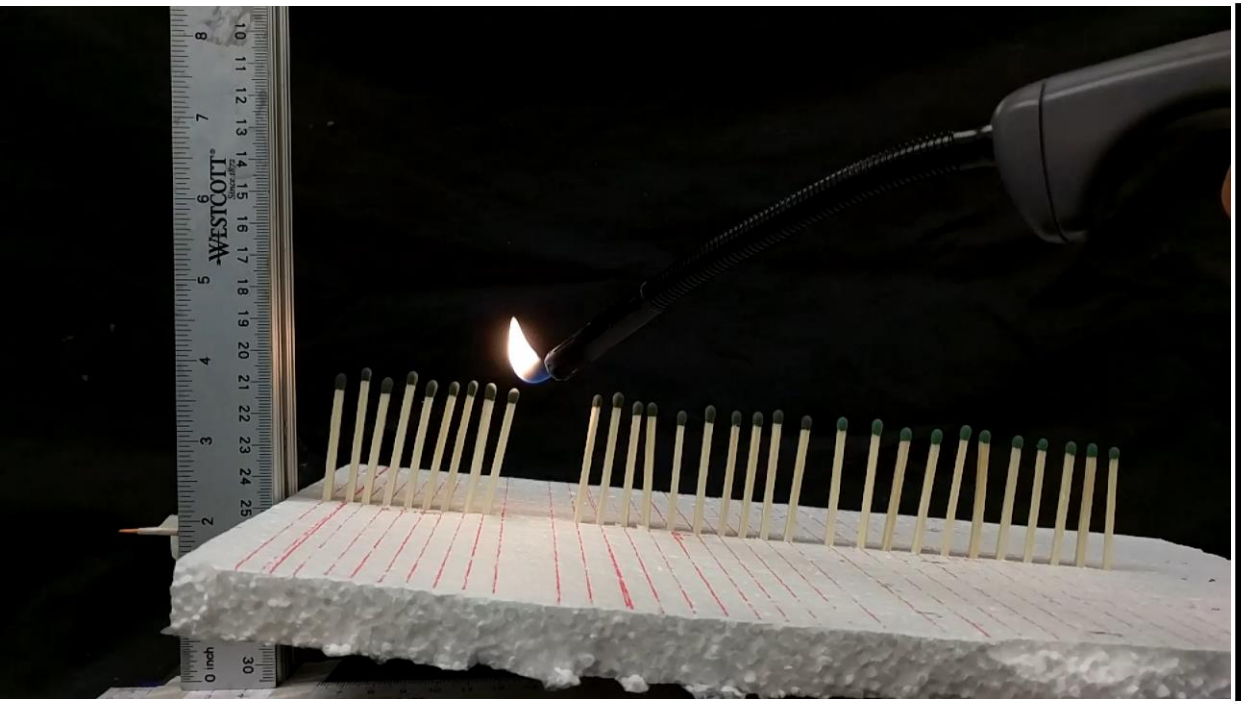
Experimental Setup

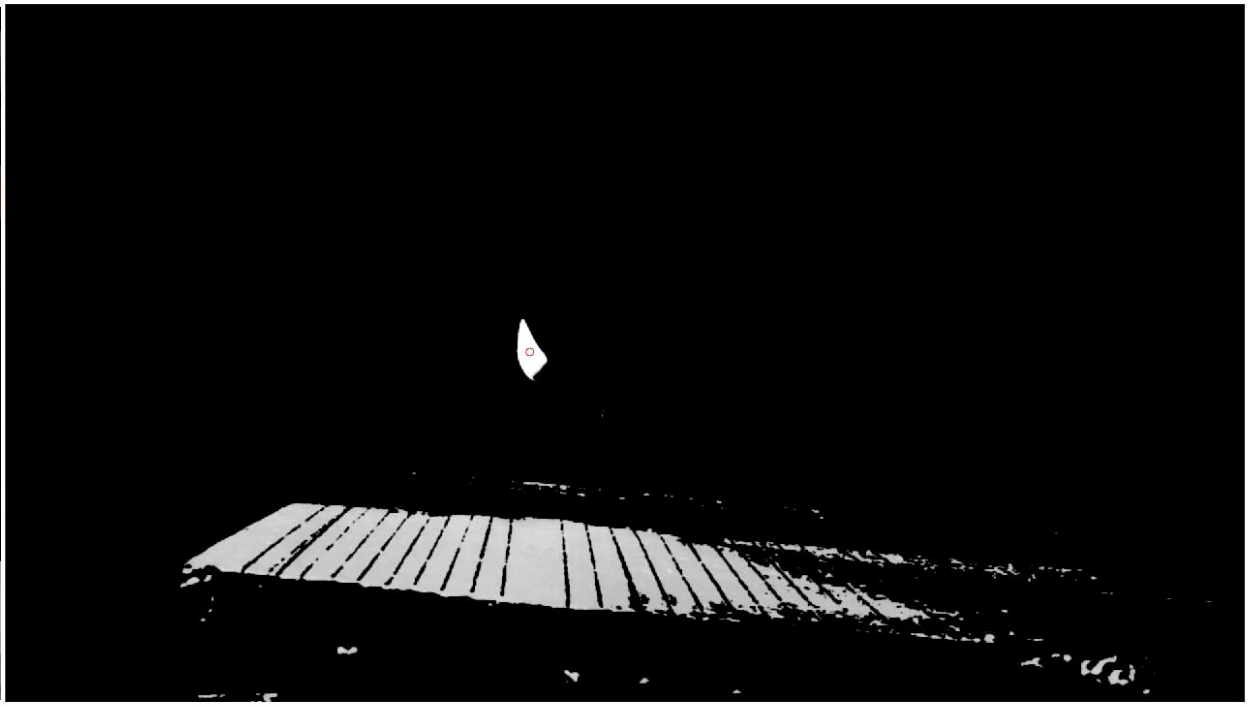


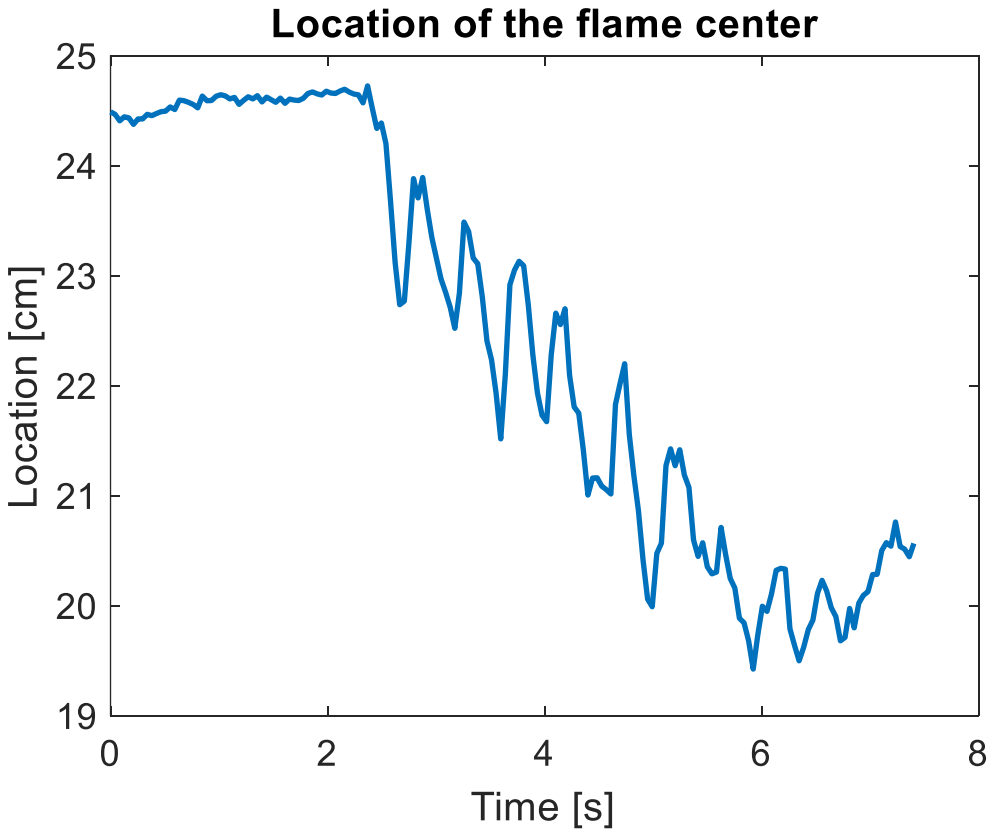


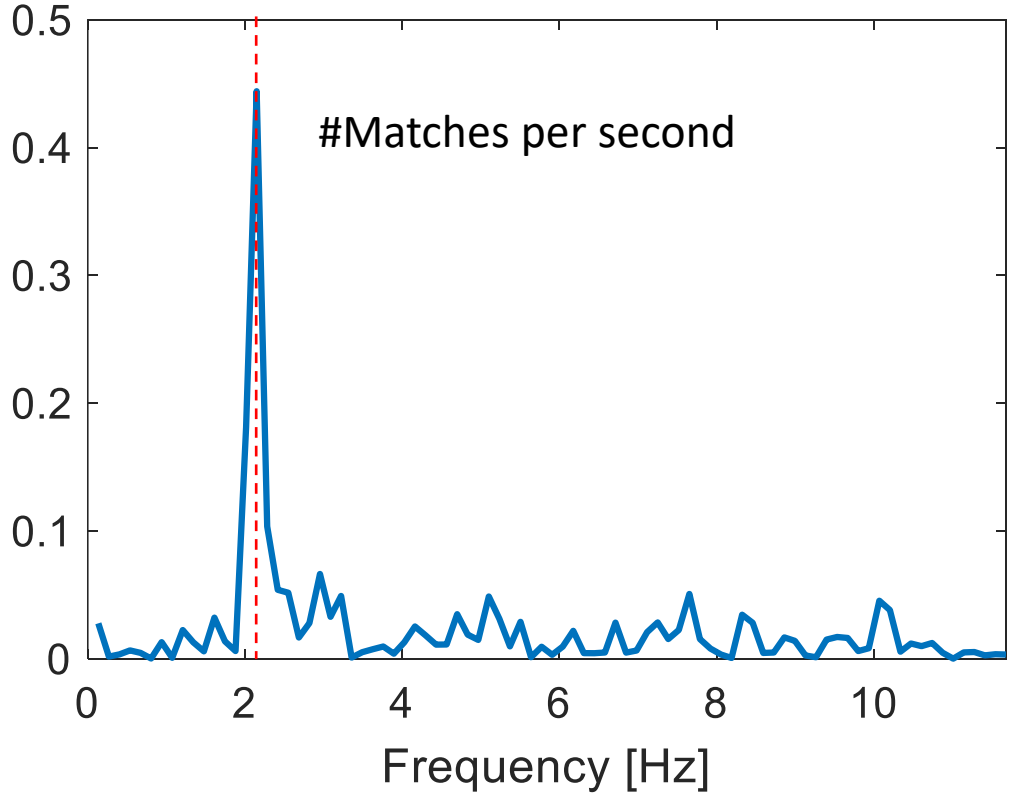


Data Acquisition and Analysis





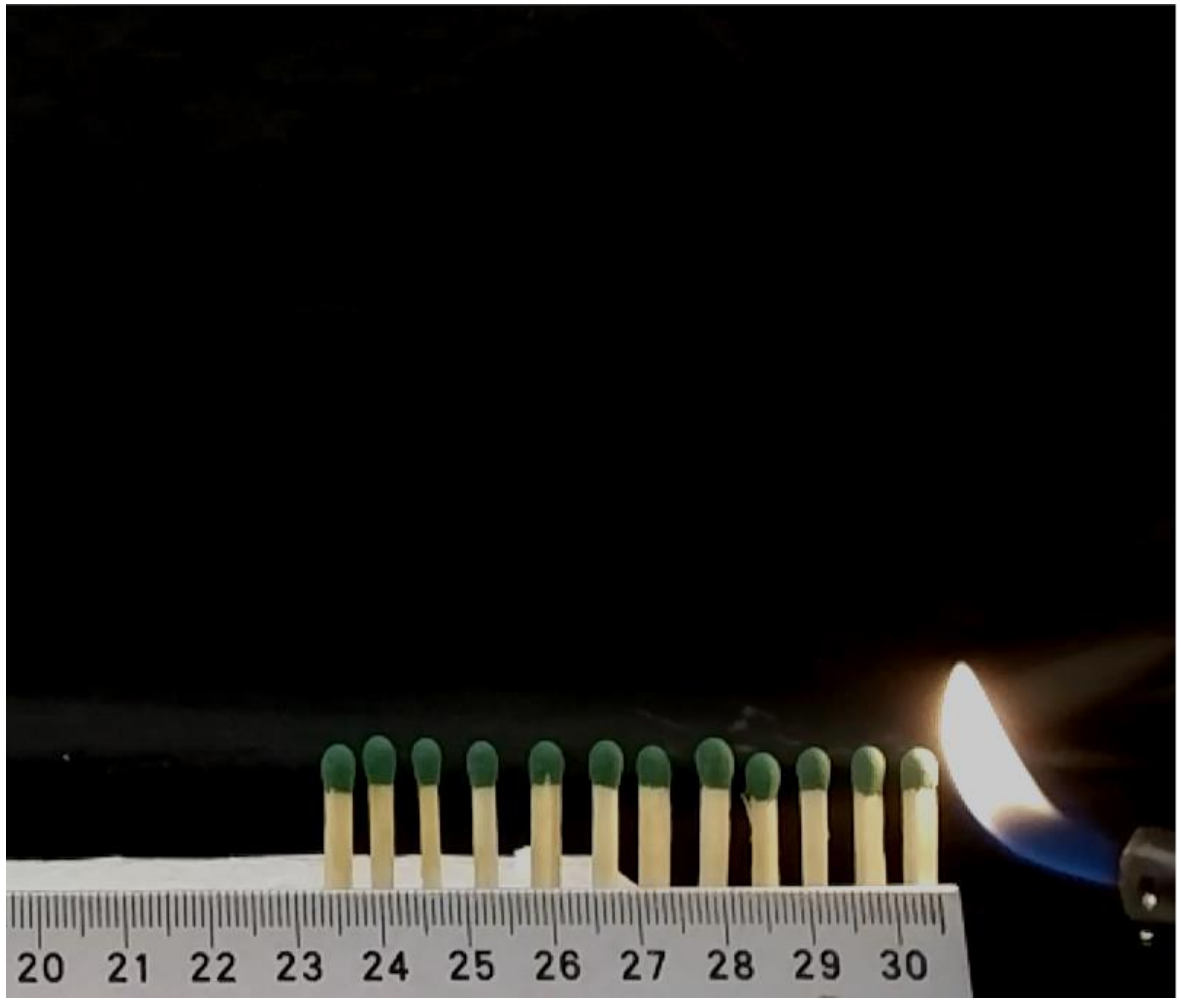


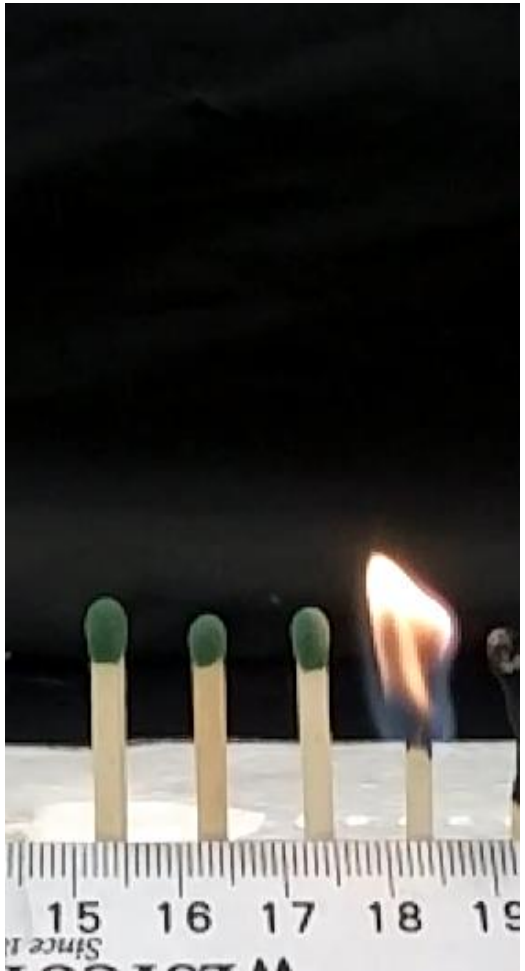


*Note: Average speed resulting from automated tracking has been verified against a manually tracked flame front

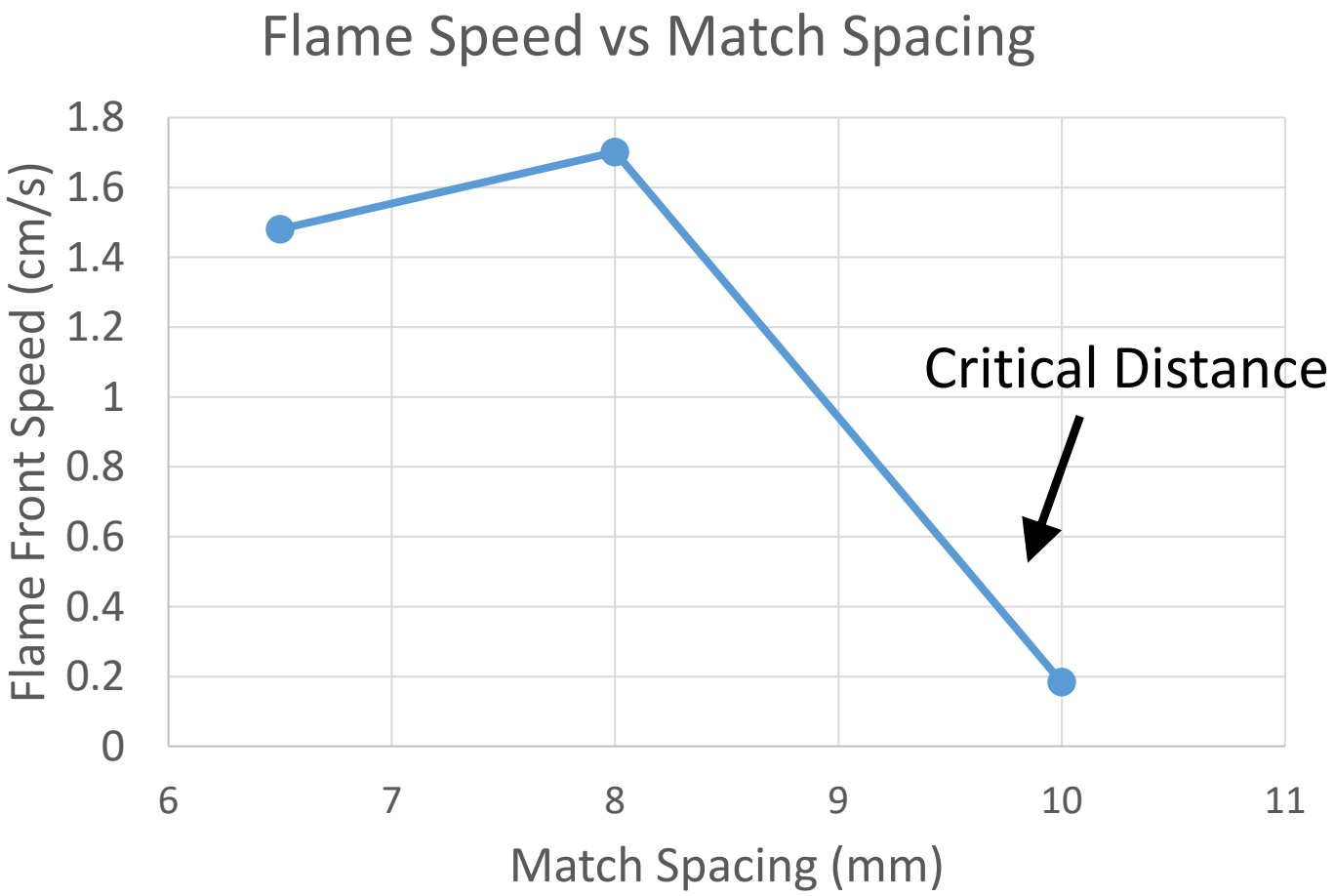
1D Match Spacing Studies

- Two types of flame propagation

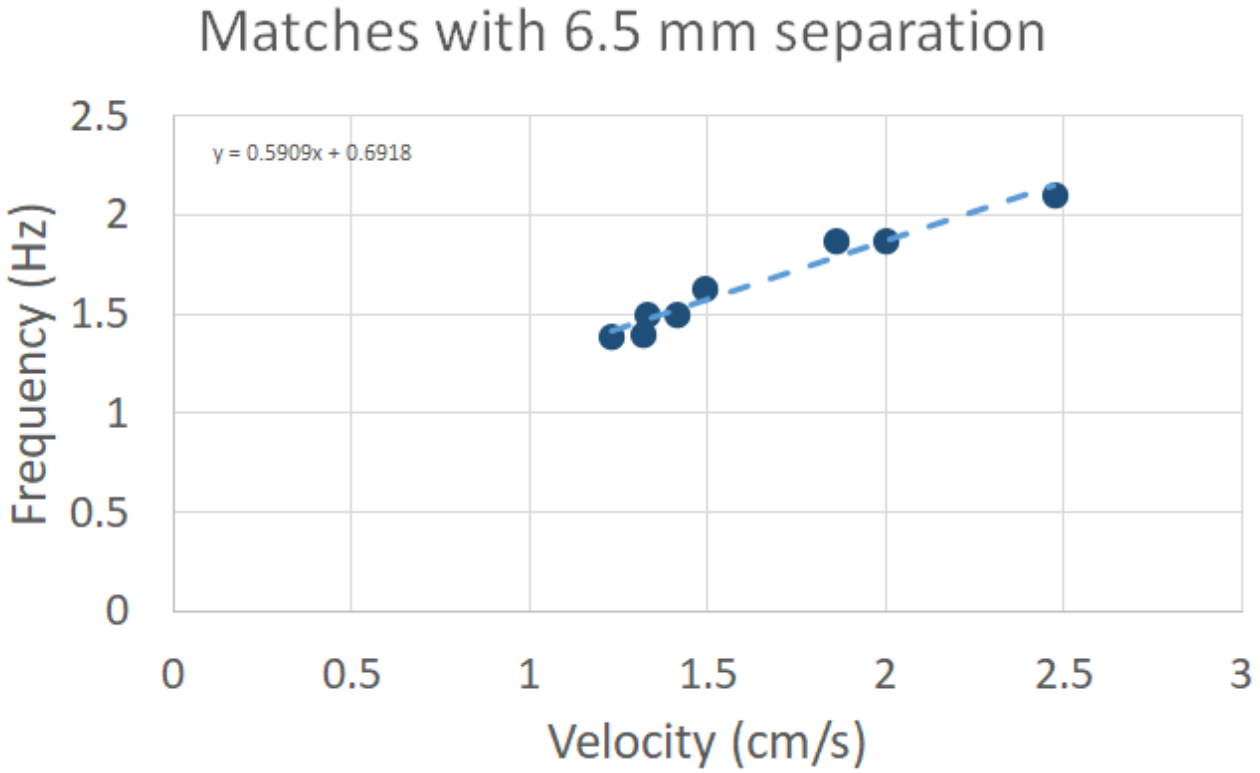




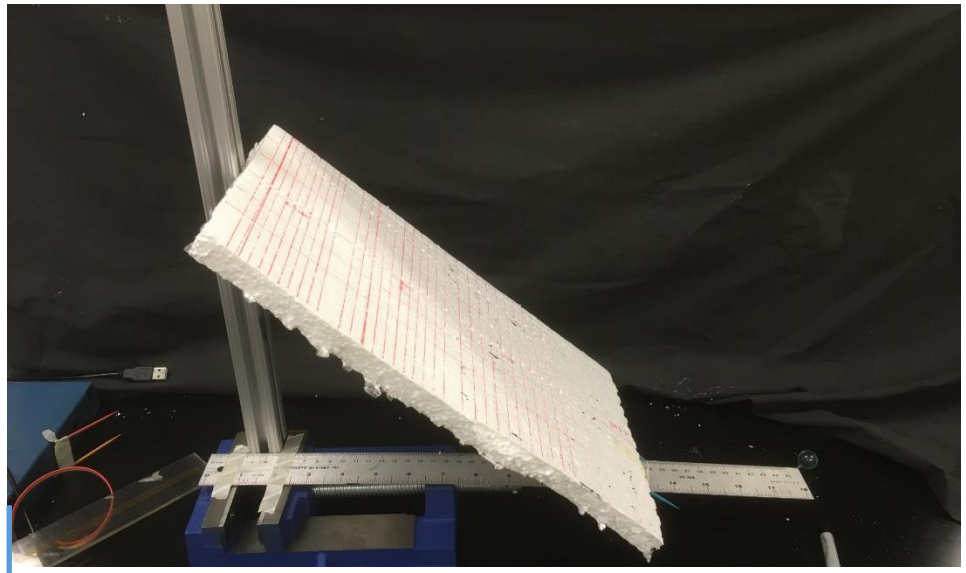
Results – A 1D match array density study

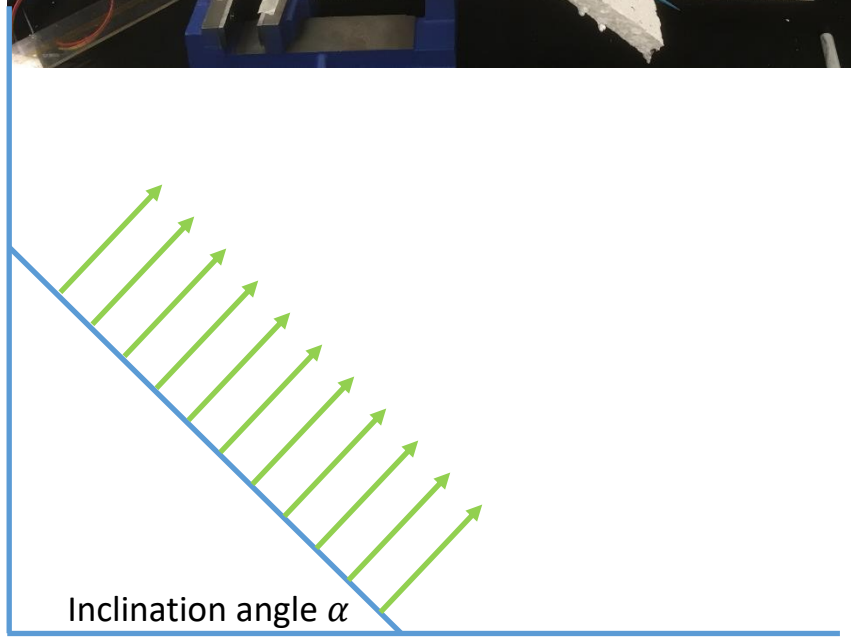


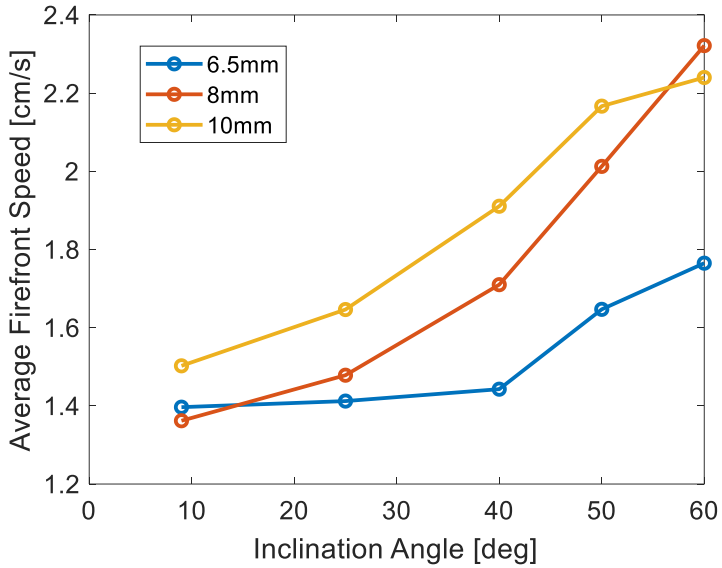
Propagation study

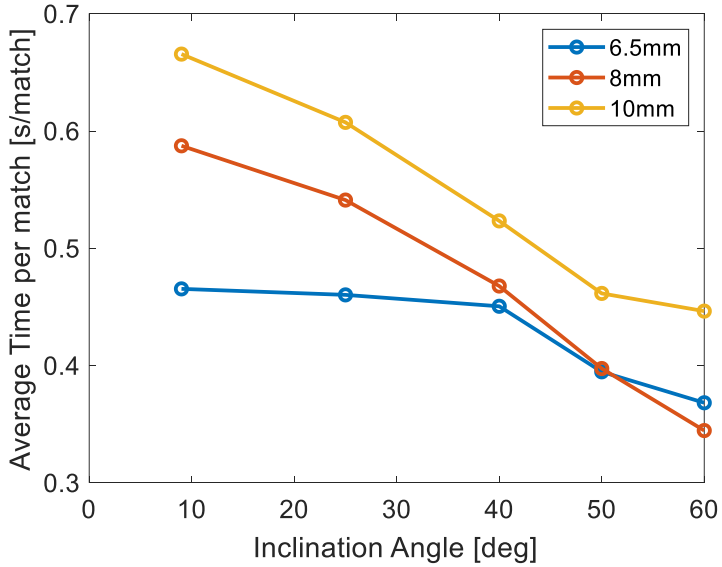


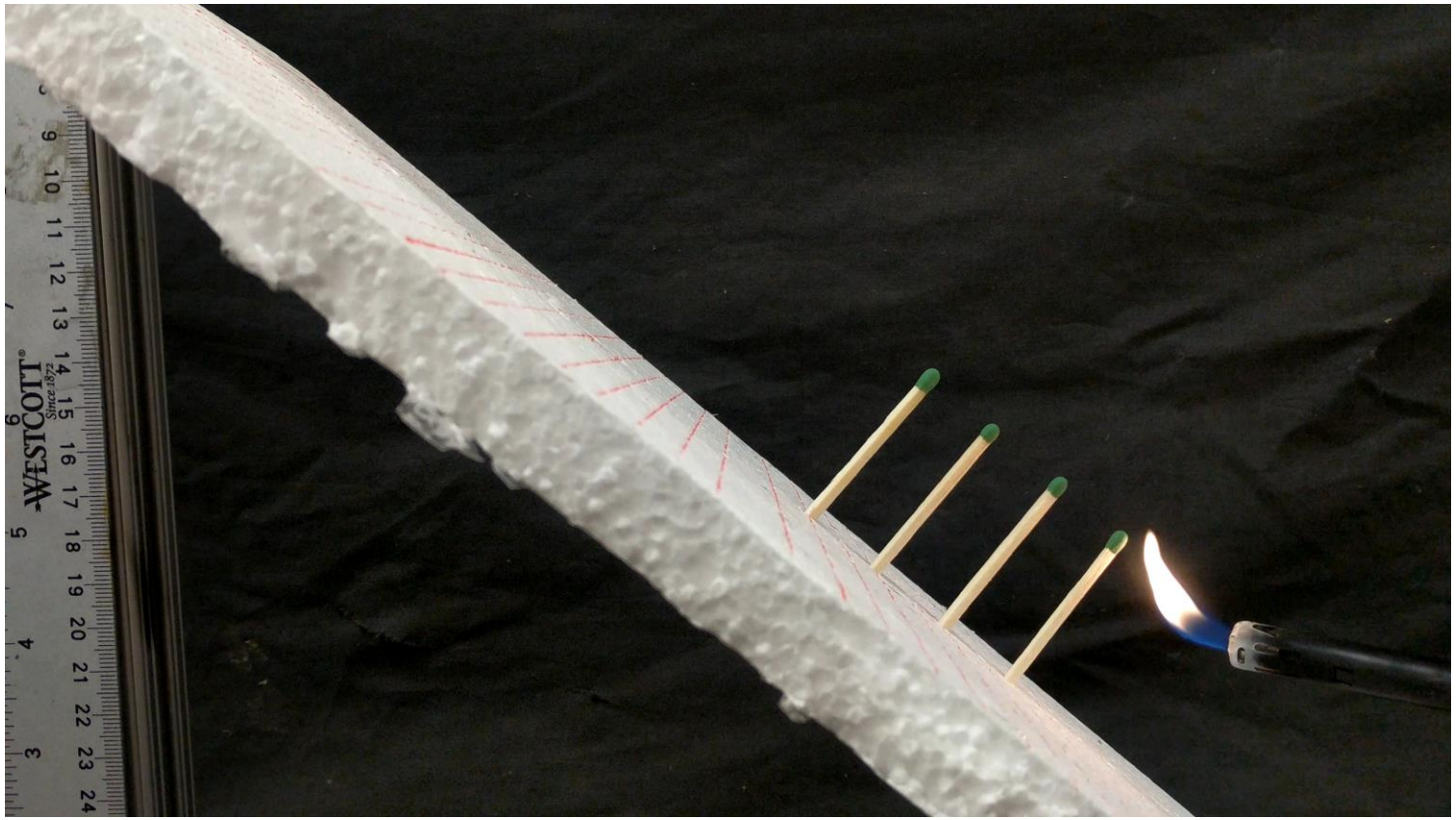
Results – A 1D match array inclination angle study

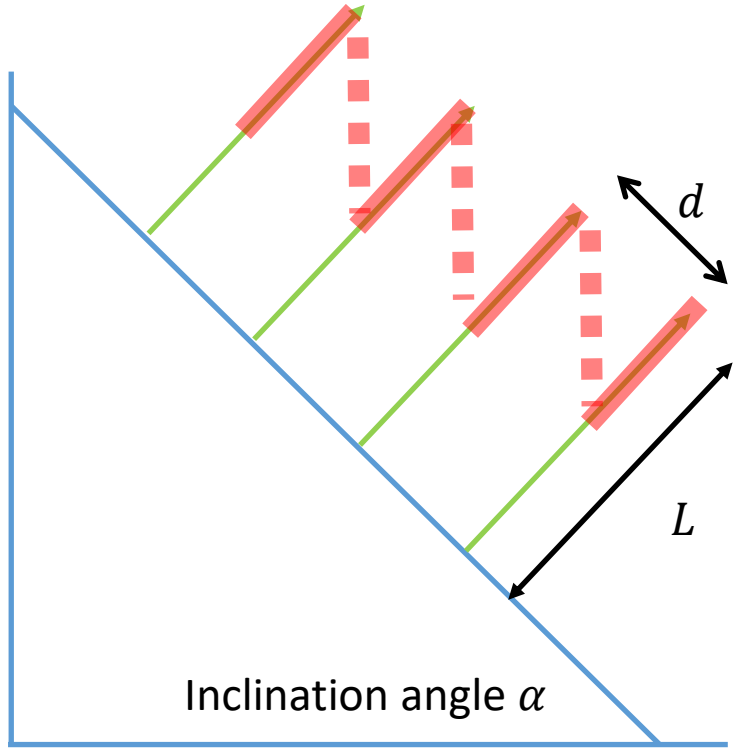












$$\Delta t = \frac{d}{\tan(\alpha)} \frac{1}{v(\alpha)}$$

When $d > d^*, \frac{d}{\tan(\alpha)} < L$

As such, given a fixed spacing, $\alpha^* = \text{atan}\frac{d}{L}$ for fire propagation.

Questions