

SureFire Working Package 3

Fire Modeling, Database, & AI-Forecast

Co-PIs



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SU
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Younggi
PARK



Dr Cheng
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Ao LI



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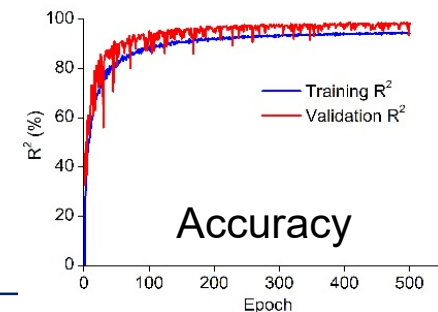
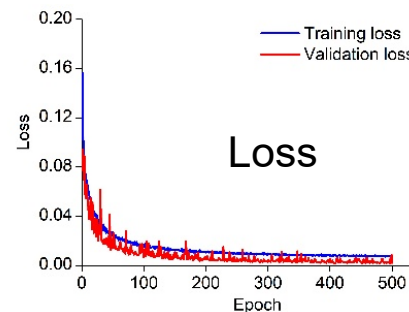
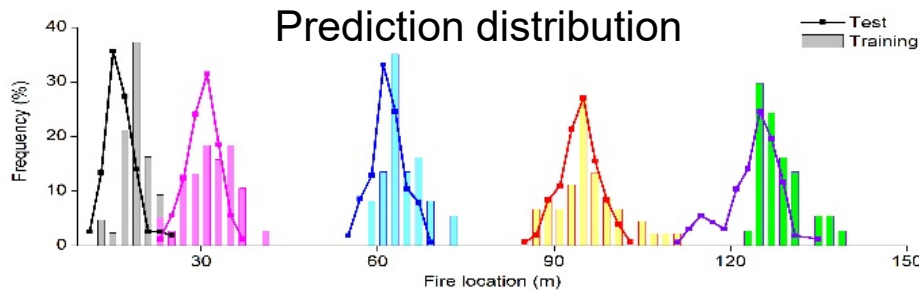
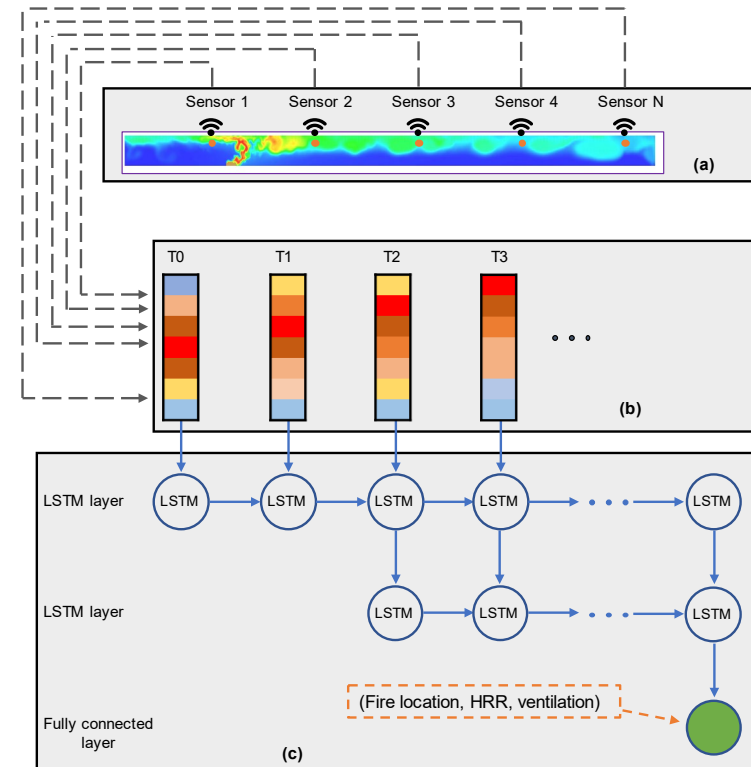
New PhD starts
at Fall 2020

Accomplishment (Paper 1)

Wu, Park, Li, Huang, Xiao, Usmani. *Smart Detection of Fire Source in Tunnel Based on the Numerical Database and Artificial Intelligence*, **Fire Technology**, 2020

<https://doi.org/10.1007/s10694-020-00985-z>

- Tunnel fire detection using AI
- Attained an accuracy of 94%
 - 1) Simulate tunnel fire
 - 2) Generate database
 - 3) Build up AI model
 - 4) Train the model
 - 5) Validate the model



On-going Work: Tunnel Fire Database (Paper 2)

- **Review of literature** experimental data on tunnel fire
- Organize data with **critical factors and events**, including back-layer, visibility, temperature, toxic gases
- Pre-processing methods for various type of data, such as dimension reduction, data fusion...
- AI models and a demonstration



Tunnelling and Underground
Space Technology

Call for Papers: Special Issue on **Fire Safety of Tunnel and Underground Space**

Guest Editors:

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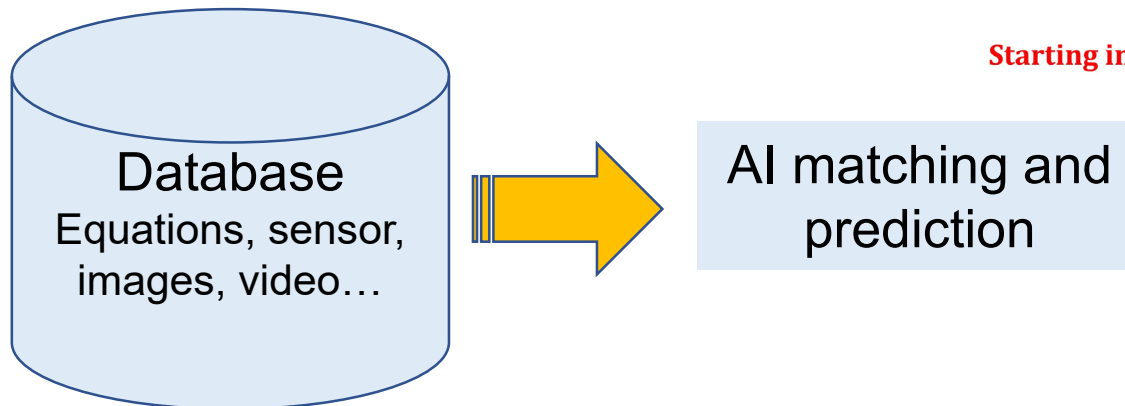
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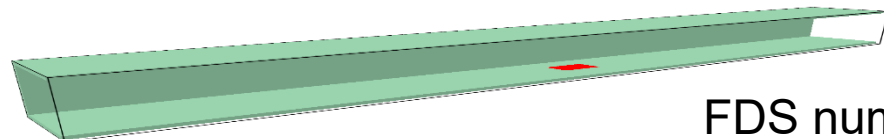
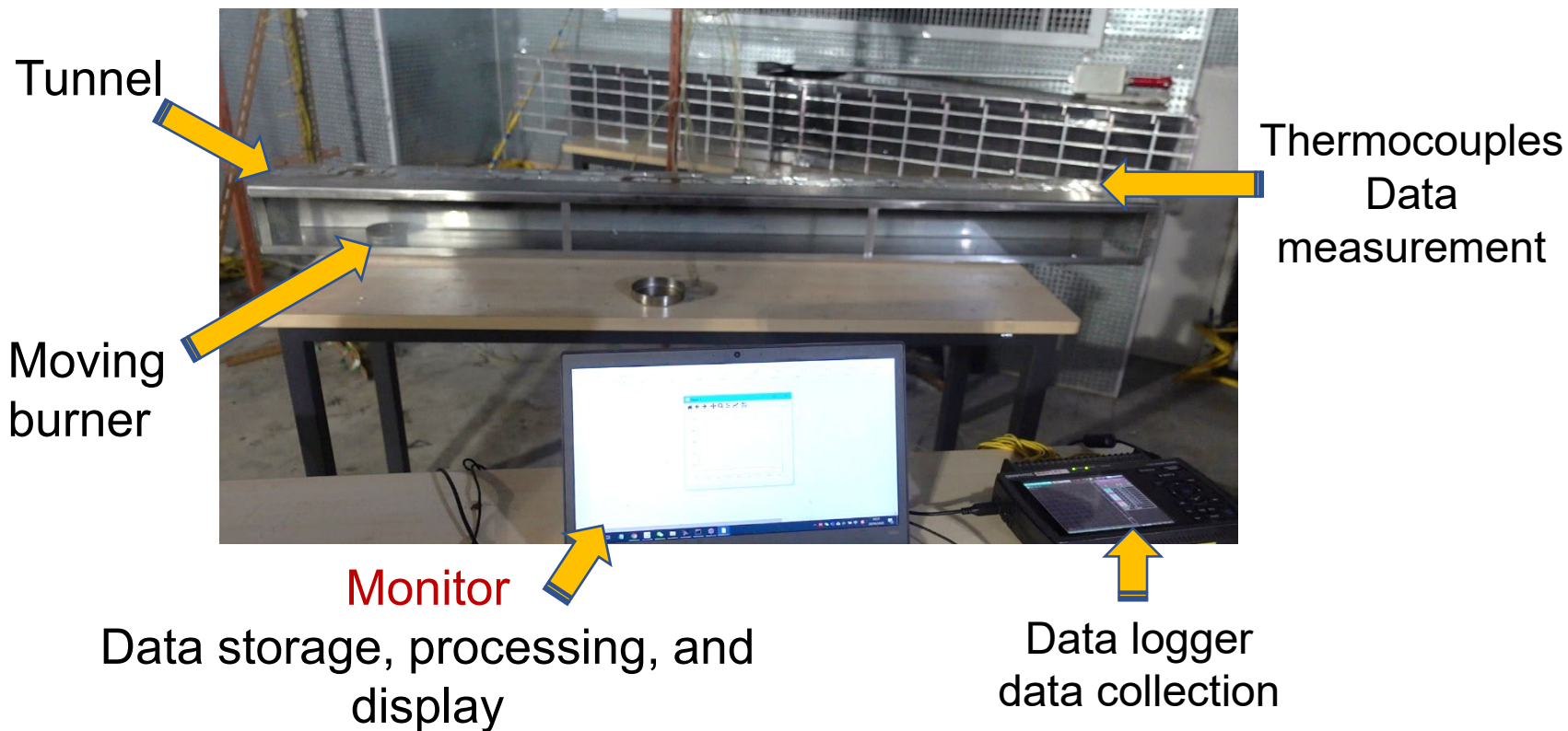
Please submit your paper

Starting in: January 15, 2020; Closing in: June 30, 2020



On-going Work: Real-time data transfer

- Small-scale tunnel fire test



FDS numerical model mimicking digital twin (will be included)

On-going Work: small tunnel fire demo

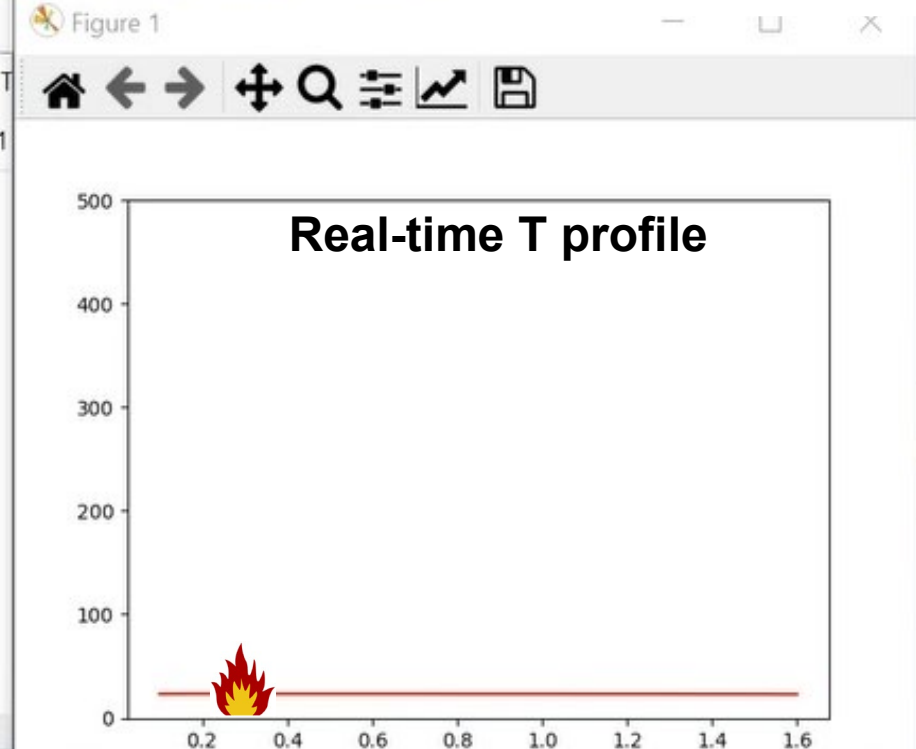
Small-scale Tunnel



temperature distribution

	Number	Date&Time	ms	T
realtime	134	2020-04-29 14:...	000	+23.1

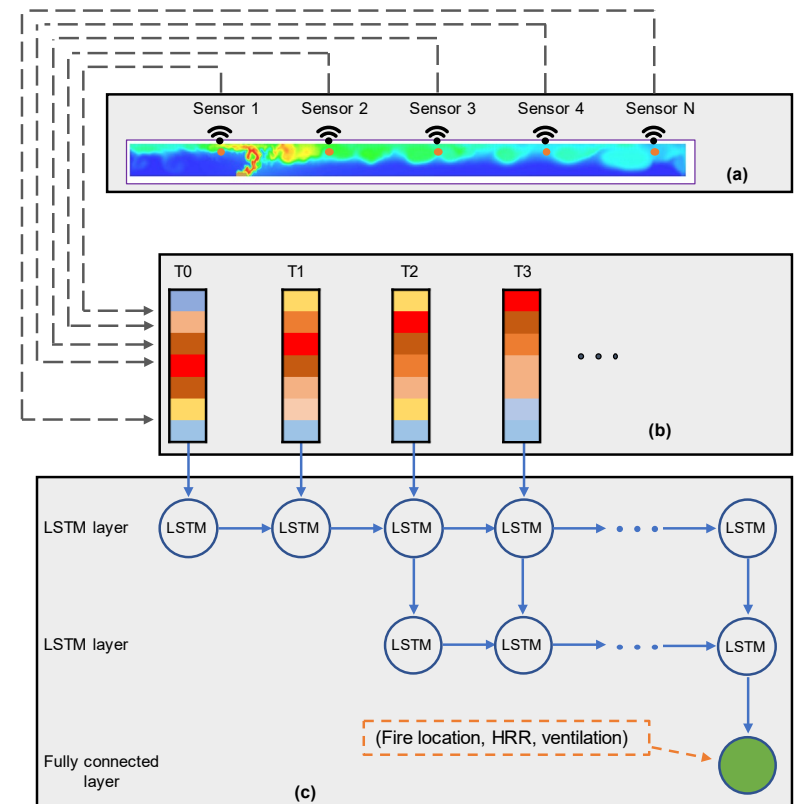
Real-time temperatures measurement



Future plan- by Oct 2020 (Paper 3)

- Prediction of fire evolution and critical event identification using AI and simulated images
- Simulation + AI (same as Paper 1)
- Predict **tunnel fire evolution and critical events**
 - 1) Critical ventilation velocity
 - 2) Smoke back layer
 - 3) Critical egress time

.....



Future plan- by Oct 2020 (Paper 4)

- Critical event identification using AI and simulated images
 - Simulation + AI
 - Fire captured at small area instead of whole tunnel will be used
 - Fire scenarios especially critical events will be identified
 - Method adopted by the new paper on **Science** journal

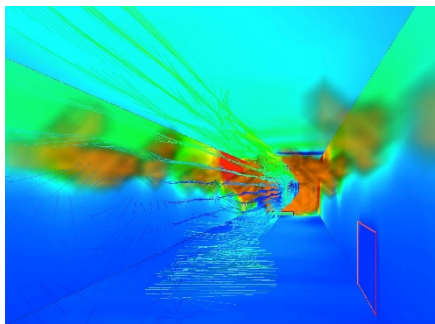
REPORT

Hidden fluid mechanics: Learning velocity and pressure fields from flow visualizations

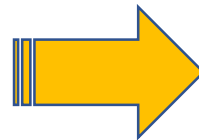
Maziar Raissi^{1,2,*}, Alireza Yazdani¹, George Em Karniadakis^{1,†}

+ See all authors and affiliations

Science 28 Feb 2020:
Vol. 367, Issue 6481, pp. 1026-1030
DOI: 10.1126/science.aaw4741



Extracted images from simulations



Event 1
Event 2
Event 3
⋮
⋮



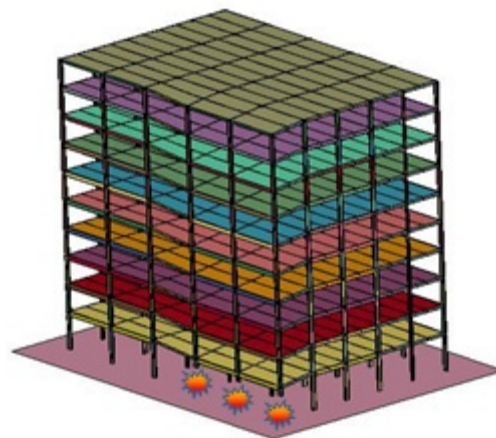
Science

Vol 367, Issue 6481
28 February 2020

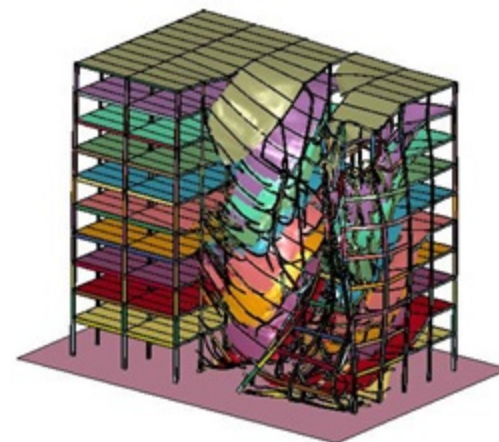
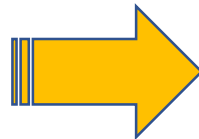
Table of Contents
Print Table of Contents
Advertising (PDF)
Classified (PDF)
Masthead (PDF)

Future plan- by Dec 2020

- A journal paper on progressive collapse possibility and pattern identification
- Highlights
 - (FDS +) OpenSEES simulation + AI
 - Building structure is fixed, while multiple factors including fire and component structural resistance will be considered



Simulation of
structure in fire



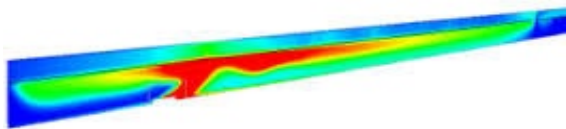
Progressive collapse
pattern

Future plan- by December 2020

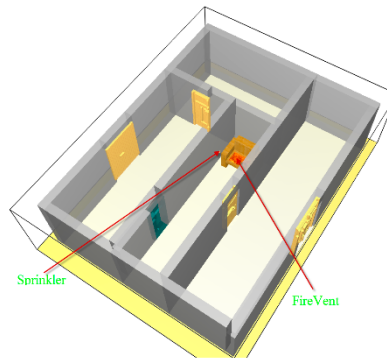
- Preparing for large scale tunnel fire tests in SCFRI



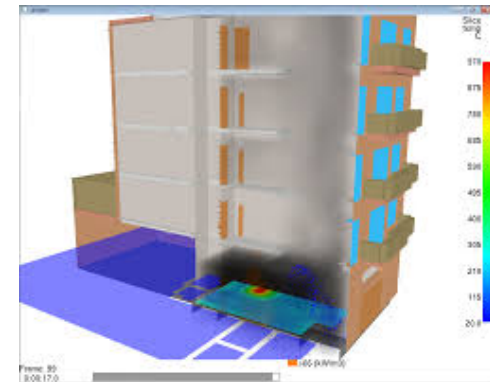
- Fire models and simulation-based AI forecasting



Tunnel fire



Room fire



Buildings and facilities fire