IFSI RESEARCH

Student Spotlight: Shruti Ghanekar

1. Give background on yourself.

I am currently a PhD candidate and have been involved with IFSI Research since Spring 2017 under the advisement of Professor Tonghun Lee in the department of Mechanical Science and Engineering at the University of Illinois Urbana-Champaign. I specialize in the application of Infrared Tunable Diode Laser Absorption Spectroscopy (IR-TDLAS) to measure species concentration in residential fire environments. My graduate research focuses on measuring water vapor, which is a major product of combustion, and hydrogen cyanide (HCN), which is a toxic gas present in the residential fire environment.

2. How did you become interested in firefighting or the industry?

When I joined Prof. Lee's research group as a new graduate student, I was assigned to assist in an ongoing research project at IFSI. The complex nature of fire research and the challenges faced in measuring species concentrations in the residential fire environment intrigued me. I have continued to develop laser-based concentration measurement systems that are validated, tested and applied at IFSI fireground.

3. What are the types of things you have worked on while at IFSI?

The first few semesters of my graduate study were devoted to the development of the water vapor measurement system, capable of measuring simultaneously at 3 locations in a time-resolved manner which was validated at IFSI Research. To understand the relative magnitude of the water vapor introduced by suppression by water application to that produced by the fire itself in various training scenarios, experiments were conducted on the IFSI fireground. Three fuel packages were burned in three firefighter training structures and measurements were made in the adjacent compartment at three heights. These experiments formed the basis of my Master's thesis (http://hdl.handle.net/2142/101596) and are published in Fire Safety Journal (https://doi.org/10.1016/j.firesaf.2020.103114).

4. What are you doing now or plan to do and how has your experiences at IFSI helped you in these roles?

I have also built a TDLAS based system for measuring time resolved HCN concentration in the gases sampled out from a residential fire environment in real time. It was validated on the bench scale in lab using calibration gas at room temperature and then deployed in the Fireground Exposure Simulator prop on the fireground at IFSI in experiments involving combustion of realistic furnishings to study HCN concentration variations in an adjacent compartment. This measurement system was later deployed in full-scale residential fire experiments conducted at UL Fire Safety Research Institute's fire lab in Philadelphia. The development and application of the HCN measurement system in the residential fire environment will be part of my PhD dissertation.

5. What advice would you give to new students interested in this field?

Throughout my graduate study, I got opportunities to participate in several off-campus measurement campaigns which were supported by IFSI Research and learn from very talented fire research scientists and fire service professionals. I believe that even though fire research can sometimes be intimidating due to the sheer scale and complexity of the experiments involved, it is important to remember that the research being conducted at IFSI contributes to furthering firefighter safety and effectiveness and thus making the world a little more safe for everyone. It is my intention and hope to continue conducting research in the fire service in future.

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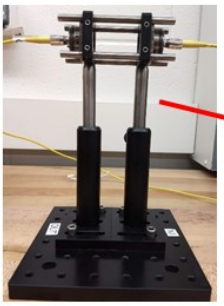
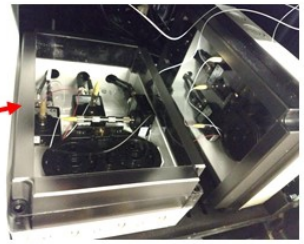
Measurement Setup

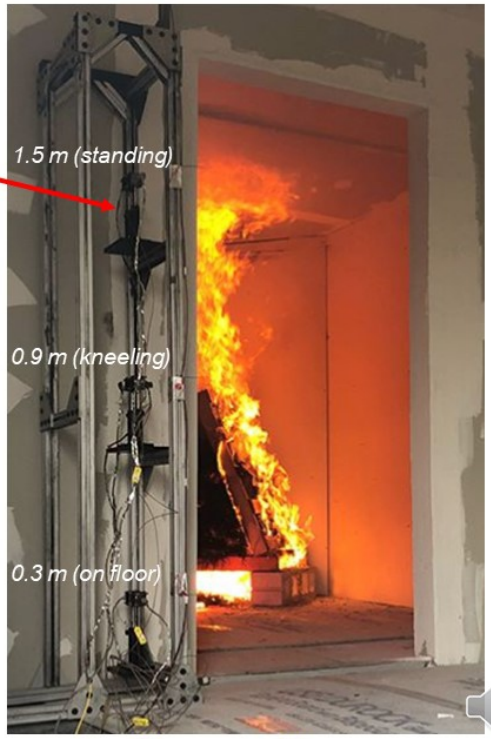
Data acquisition system



Pitch-catch apparatus

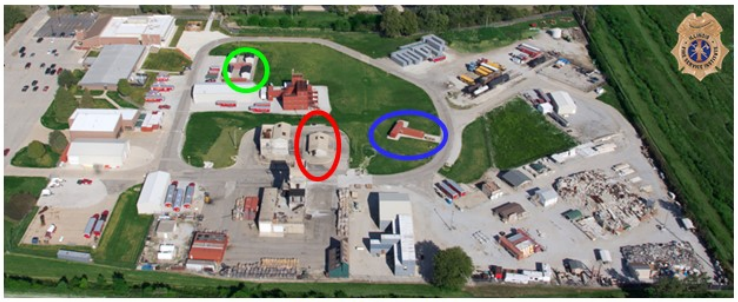


3-tier sensitivity scheme



Measurement tower

Fuel packages and structures



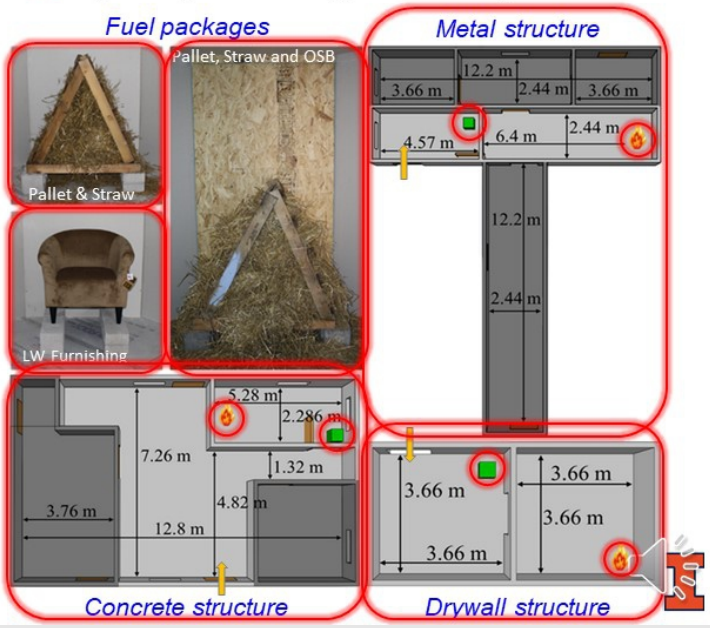
IFSI Fireground

- Experiments conducted at Illinois Fire Service Institute (IFSI) fireground.
- Metal structure: made from shipping containers.
- Concrete structure: cinder block single story ranch-style.
- Drywall structure: gypsum lined wooden residential type.

Handheld emergency flare

Combination nozzle on tight straight stream setting

- Pallet & straw: 3 pallets, 1 bale straw, 814.17 MJ
- Pallet, straw & oriented strand board: 3 pallets, 1 bale straw, 2 OSB (4'x8'), 1547.87 MJ
- Lightweight furnishing: barrel chair, 177.92 MJ



Fireground Testing – Overview

- Experiments at Illinois Fire Service Institute (IFSI), Champaign, IL.
- Fireground Exposure Simulator prop[1]:
  - 2.4 m wide, 2.9 m by 12.2 m intermodal shipping container
  - Combustion chamber – 3.1 m long, lined with concrete fiber board, with sliding front doors
  - Exposure chamber – 4.6 m long, with roll-up side door
- Fuel package:
  - 3 seat sofa - dimensions: 2.2 m × 0.9 m × 0.9 m H; weight: 47.5 kg

IFSI Fireground showing FES prop

Fuel package used for the experiments

Fireground Exposure Simulator prop used for the experiments

[1]Horn, G.P., Kerber, S., Lattz, J. et al. Development of Fireground Exposure Simulator (FES) Prop for PPE Testing and Evaluation. Fire Technol 56, 2331–2344 (2020). https://doi.org/10.1007/s10694-020-00981-3

Acquired Residential Structure Experiments

Large scale residential fires in acquired structures

Transitional attack

- Simultaneous measurement of water vapor and hydrogen cyanide gas at multiple locations.
- Sensors deployed in UL's two large-scale acquired structures experiments in Ohio