Numerical Pyromaniacs
The Use of Python in Fire Research

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Fire Protection Engineering?

• What we do:
  • Sprinklers, smoke detectors
  • Building design
  • Experiments and CFD modeling
  • Fluid dynamics, heat transfer, fire dynamics, combustion, chemistry, etc.
As much as fire protection engineers like to protect people from fire, we also really like to burn stuff.
Python in Fire Research & Engineering
Interactive Data Analysis for Engineers

I enjoy using Python in my workflow because of its enormous amount of flexibility and ability to incrementally build a GUI or web tool.

- Interactive data analysis
- Curve fitting
- Plotting
- Verification & Validation
Interactive Data Analysis for Engineers

Python is in a great position to become more ubiquitous in fire protection engineering, and the engineering field in general.

- Spyder
- Python(x,y)
- Sage
- Etc.
Fresh Data Visualization Methods

- Plotting data on video
- Modules: PIL, matplotlib
Fresh Data Visualization Methods

A useful way to convey information in parallel and allow the data to tell a story. Tells the qualitative AND quantitative story at the same time.
Fresh Data Visualization Methods

Real-time video plots are a great visual method for teaching, communication, and telling a story with your data.
Web Tools and Engineering Calculators

Mesh generation tool

Fire dynamics

CGI scripts

Easy to extend Python scripts to the web

Module: cgi
Web Tools and Engineering Calculators

A more efficient workflow for engineers, a method for third-party developers to contribute to the fire modeling community, and promotion of the effective use of fire dynamics and tools for life safety designs.

- More ideas including: FPEtool, online fire modeling, etc.

- Can use Django or other tools to recreate engineering calculators
3D Geometry for Fire Models

Current text input file for Fire Dynamics Simulator
BlenderFDS - 3D Geometry for Fire Models

Using BlenderFDS, users can create complex buildings and irregular geometry (e.g., cylinders, angled roofs) and automatically have it broken up into the rectilinear format that FDS requires.
3D Geometry for Fire Models

• “Voxelize” - converts 3D geometry into optimized OBSTruction lines

• Can apply material properties, boundary conditions, etc.

```plaintext
&OBST XB=0.5,1.1,0.5,1.1,0.0,0.1, SURF_ID='wall' /
```
BlenderFDS - 3D Geometry for Fire Models
BlenderFDS - 3D Geometry for Fire Models
BlenderFDS can even be used to model the complex geometry of an entire building. We hope to add in additional features for fire models (additional parameters, surfaces, output quantities, etc.).

http://www.blenderfds.org
Visualizing Smoke/Fire/Data from Fire Models

Currently, we use a tool called Smokeview to visualize the output from Fire Dynamics Simulator.

But we are exploring the use of Blender, Mayavi, Paraview, etc. for standardized visualizations.
We are also exploring the use of Blender and other tools for the visualization of realistic and scientifically-meaningful fire and smoke from the results of CFD fire simulations.
Future Plans for Python in Fire Research

To push Python further into engineering use, interactive analysis and GUI tools create a viable alternative to commercial engineering and scientific software.

- CFD calculations - fire simulations
- CFD visualization, Mayavi, Paraview, etc.
- Additional web tool suites
- HPC and web interface for fire models
- Improved engineering tools and environments
Conclusion

Fire research involves public safety and strives to produce safer buildings and materials to protect people and property around the world from the dangers of fire.

I hope to interact with the scientific Python community even more to explore possibilities and create even more solutions that can advance the fire protection engineering and fire research field.
Thank you! - Questions?

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