

DESIGNSAFE-CI

A NATURAL HAZARDS
ENGINEERING COMMUNITY



A Cyberinfrastructure for the Natural Hazards Community

Stephen Mock
Gateways 2016

NHERI: Natural Hazards Engineering Research Infrastructure

- Shared-use research infrastructure funded by NSF to enable transformative research in natural hazards engineering
 - Network Coordinating Office (NCO)
 - Cyberinfrastructure (CI)
 - Seven experimental facilities (EF)
 - Post-disaster, rapid response research facility (RAPID)
 - Computational Modeling and Simulation Center (SimCenter)
- Replaces similar program for earthquake engineering (NEES) but expanded to include windstorms and associated hazards

DesignSafe-ci Leadership



Director
Ellen Rathje
Univ. of Texas



Simulation
Clint Dawson
Univ. of Texas



Data
Jean-Paul Pinelli
Florida Inst. Tech.



ECO
Jamie Padgett
Rice Univ.



CI
Dan Stanzione
Univ. of Texas

Simulation Requirements Team

Clint Dawson, Lead (UT) - Water
Pedro Arduino (U. Wash) - EQ
Ahsan Kareem (Notre Dame) - Wind
Laura Lowes (U. Wash) - EQ
Jamie Padgett (Rice) - EQ, Water



TEXAS ADVANCED
COMPUTING CENTER

Management Requirements Team

Paul Pinelli, Lead (FIT) - Wind
Brandenberg (UCLA) - EQ
Frederick Haan (Rose Hulman) - Wind
Gilberto Mosqueda (UCSD) - EQ
Lorraine Haricombe (UT) - Library Science

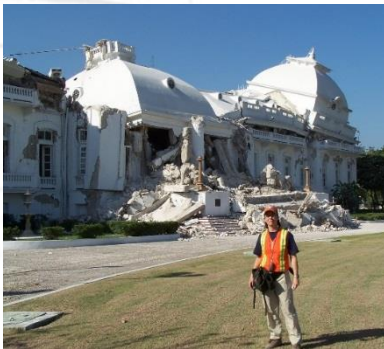
Natural Hazards



Earthquakes



Created by Mauro Lombardi
from Noun Project



Created by Arthur Silish
from Noun Project

Hurricanes



Tornadoes



Created by Hyeonil Kim
from the Noun Project

**Storm Surge &
Tsunami**

DesignSafe-ci.org Vision

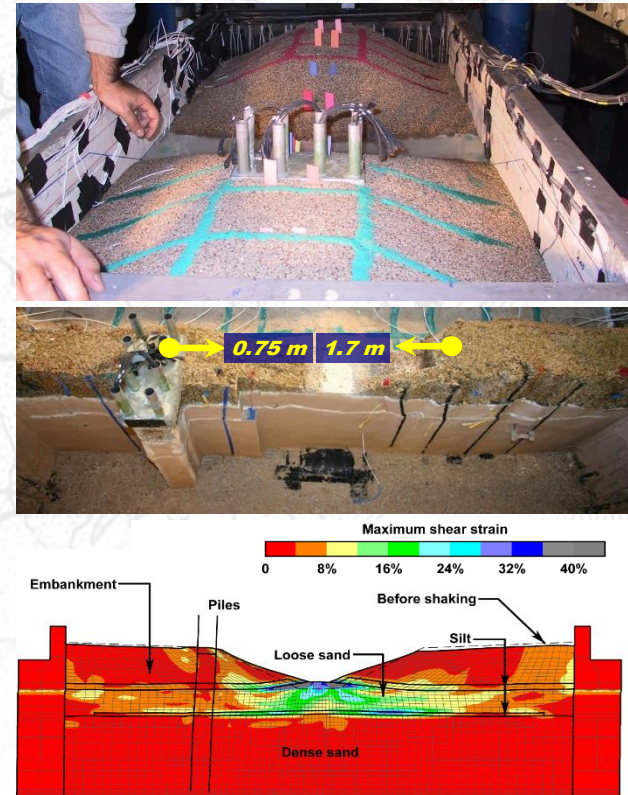
- A CI that is an integral and dynamic part of research discovery
- Cloud-based tools that support the analysis, visualization, and integration of diverse data types
- Support end-to-end research workflows and the full research lifecycle, including data sharing/publishing
- Enhance, amplify, and link the capabilities of the other NHERI components

Experimental Facilities



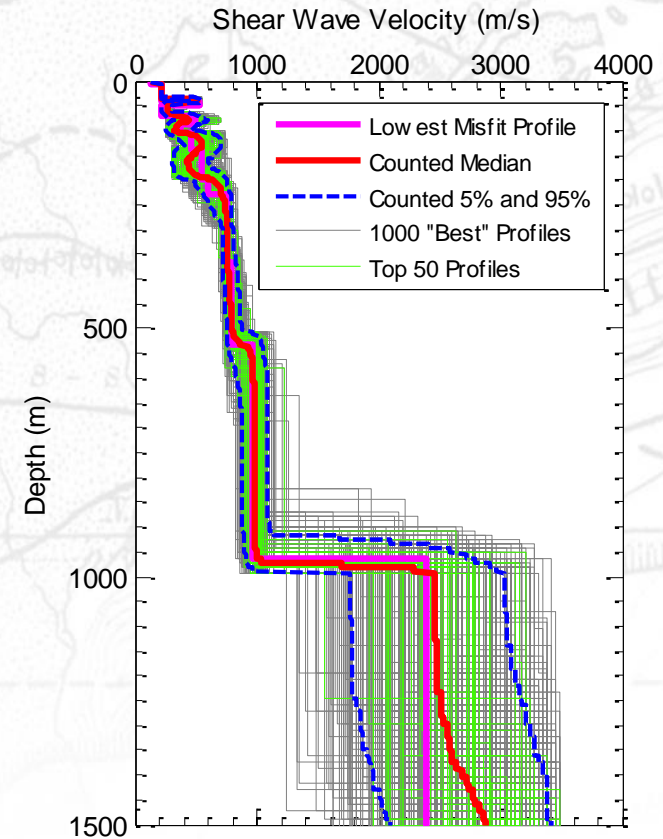
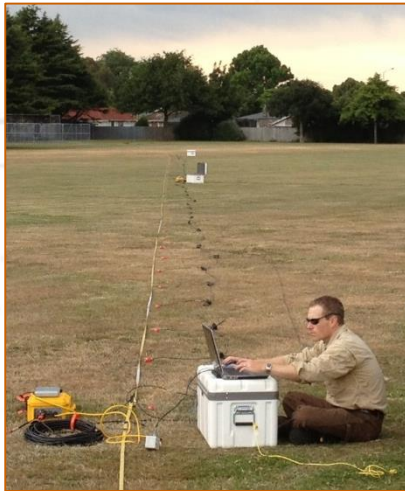
Experimental Facilities

Univ of California, Davis: Geotechnical centrifuges



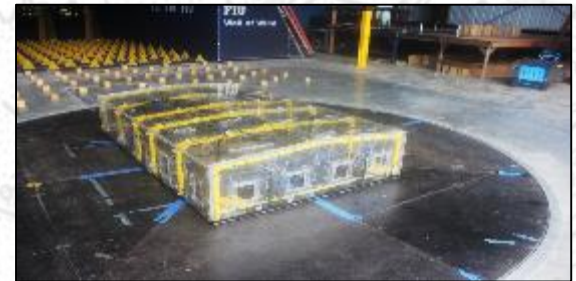
Experimental Facilities

Univ of Texas: Large-scale mobile shakers



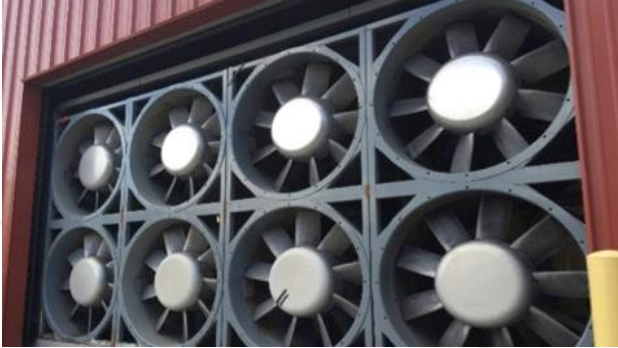
Experimental Facilities

Florida International Univ: Wall of Wind



Experimental Facilities

Univ of Florida: Wind tunnel, pressure loading actuators



Experimental Facilities

Oregon State Univ: Wave flume and wave basin



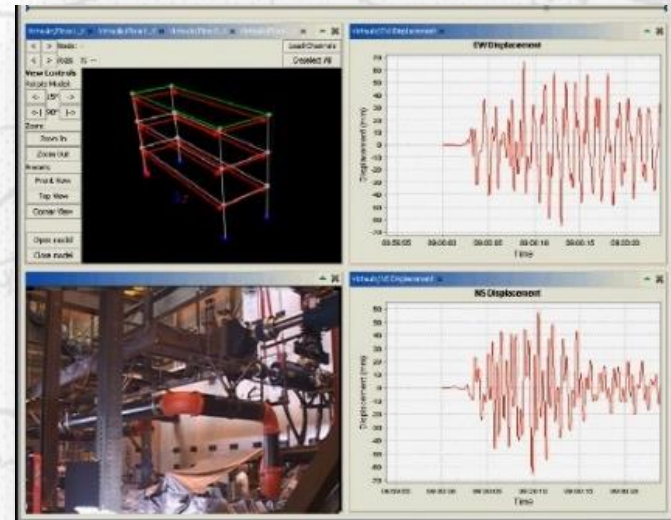
Experimental Facilities

Univ of California, San Diego: Large scale shake table



Experimental Facilities

Lehigh Univ: Hybrid simulation testing



DesignSafe-ci Cyberinfrastructure

The screenshot shows the DesignSafe-CI website. At the top left is the logo "DESIGNSAFE-CI A NATURAL HAZARDS ENGINEERING COMMUNITY" with a stylized wave icon. To the right are "Log in" and "Register" buttons. Below the header is a navigation bar with links: "NHRI Community", "Research Workbench", "NHRI Facilities", "Learning Center", "About", and "Contact". The main content area features four colored boxes: a green box for "NHRI COMMUNITY" (with a group of people icon), a blue box for "RESEARCH WORKBENCH" (with a computer monitor icon), a red box for "NHRI FACILITIES" (with a briefcase icon), and a grey box for "LEARNING CENTER" (with a document icon). Each box contains a brief description of its services and a small downward arrow at the bottom. A large grey arrow points from the "RESEARCH WORKBENCH" box towards the list on the right.

DESIGNSAFE-CI
A NATURAL HAZARDS ENGINEERING COMMUNITY

Log in Register

A CLOUD-BASED ENVIRONMENT FOR RESEARCH IN NATURAL HAZARDS ENGINEERING

Menu: NHRI Community ▾ Research Workbench ▾ NHRI Facilities ▾ Learning Center ▾ About Contact

NHRI COMMUNITY
Relevant news, field-based opportunities, and user-guided discussions aimed at bringing the natural hazards engineering community together.

RESEARCH WORKBENCH
A comprehensive cloud-based research environment for experimental, theoretical, and computational engineering and science.

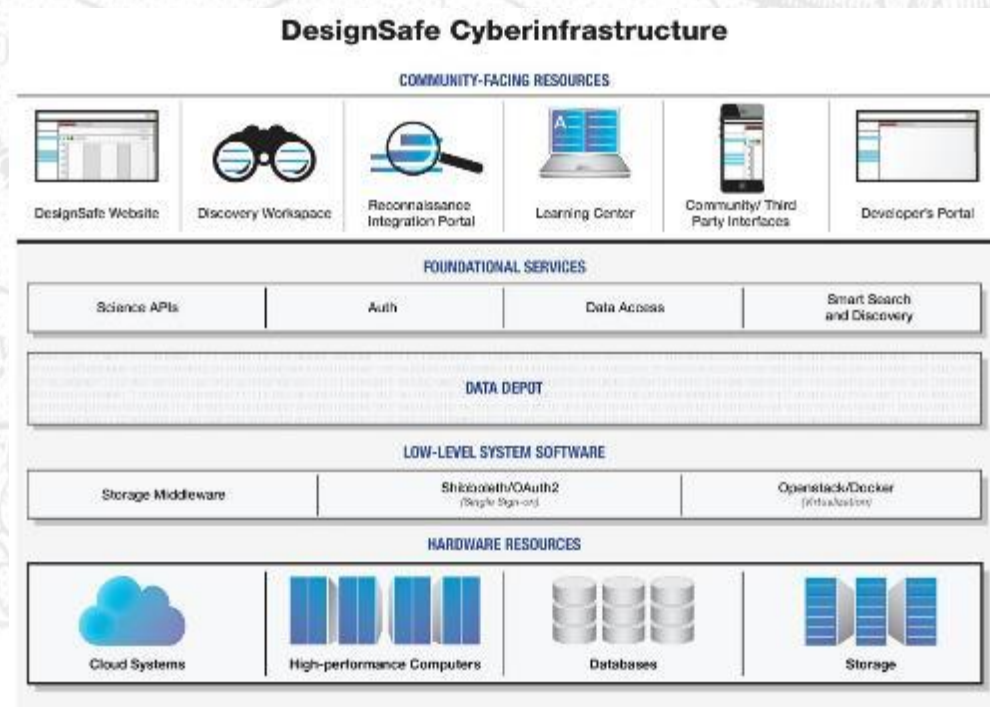
NHRI FACILITIES
Shared-use sites including Experimental Facilities, the Computational Modeling and Simulation Center, and the Network Coordination Office.

LEARNING CENTER
Training resources, site support, outreach, and student engagement opportunities to enhance research and better utilize DesignSafe's toolbox.

- Data Depot
- Discovery Workspace
- Developer's Portal

DesignSafe-ci Components

- Web Portal
- Data Depot
- Discovery Workspace
- Reconnaissance Integration Portal
- Developer's Portal
- Learning Center



Data Depot Features

- Upload files/folders from computer
- Transfer files/folders between Box and Data Depot
- Management of files within Data Depot
- Sharing of files/folders with other Users
- Preview many file types in the cloud
- Data Depot files accessible from the Discovery Workspace
- Copying Public data to My Data
- Projects (coming in ~1 week)
 - Shared space among collaborators
 - Starting point for formally publishing data

Data Depot Browser

New	mock
▼ Private	
My Data	
My Projects	
Shared with Me	
Box.com	
▼ Public	
Published	

Name	Size	Last modified	Details
📁 .ipynb_checkpoints	4.0 kB	5/3/16 3:05 PM	i
📁 .Trash	4.0 kB	10/11/16 12:04 PM	i
📄 1elem.tcl	12.5 kB	2/19/16 10:20 AM	i
📄 25_01152016@094202@154118@46.3rpm.bin	31.5 MB	10/27/16 8:57 AM	i
📁 apps	4.0 kB	10/19/16 4:03 PM	i
📁 archive	4.0 kB	4/20/16 2:23 PM	i
📁 batch-matlab	4.0 kB	8/18/16 2:07 PM	i
📁 bin	4.0 kB	4/21/16 2:29 PM	i
📁 box_import	4.0 kB	10/11/16 12:04 PM	i
📁 compress_me	4.0 kB	8/31/16 9:59 AM	i
📁 Demo	4.0 kB	5/18/16 3:27 PM	i

- Developing interface for EFs to rapidly upload data to Data Depot for sharing with researchers

Data Curation

- Collaborating with EF sites to design a vocabulary and data model for each site (and simulations)
 - Significant progress in defining this for several sites through this year.
- Progressive curation scheme
 - More of the model must be filled in as move from project creation, data sharing, publication/archive, etc.
- First release of Projects interface in Fall 2016
 - (sneak peek on previous slide)
- Fedora Commons the likely tool for data preservation

Discovery Workspace

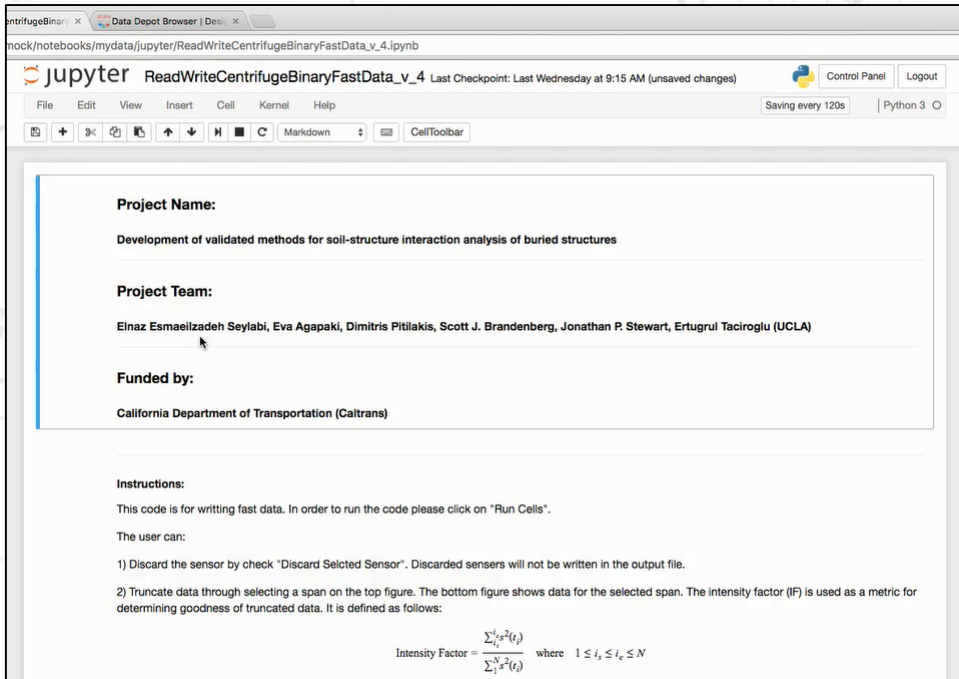
- Simulation and analysis tools
 - OpenSees, ADCIRC, OpenFOAM, Matlab, Paraview,

DISCOVERY WORKSPACE

The screenshot displays the Discovery Workspace web interface. At the top, there are tabs for 'Public' and 'Private'. Below these is a row of tool icons with labels: 'Press folder 0.1', 'Extract tar/zip/gzip File 0.1', 'JuPyter 4.1.0', 'MATLAB 0.1', 'MATLAB Large 0.3', 'OpenFOAM 2.4.0', 'OpenSees-EXPRESS 2.5.0.6248', 'OpenSeesMP 2.5.0.6480' (highlighted in blue), 'OpenSeesSP 2.5.0.6480', 'Parallel ADCIRC 51.33', and 'Paraview 4.3.1'. The main content area is divided into three panels. The left panel, 'DATA DEPOT BROWSER', shows a 'Select data source' dropdown set to 'My Data', a 'Browsing:' section with 'mock', and a 'File name' list containing '.ipynb_checkpoints', '.Trash', 'apps', and 'archive'. The middle panel, 'RUN OPENSEESMP', contains a description of the Open System for Earthquake Engineering Simulation (OpenSees), a link to 'OpenSeesMP Documentation', and an 'Inputs' section with an 'Input Directory' field and a 'Select' button. The right panel, 'JOBS STATUS', shows a list of jobs: 'matlab-stampede' (FINISHED), 'matlab' (FINISHED), 'asdf' (FINISHED), and 'test' (FINISHED), each with a 'More info' link. At the bottom of the jobs list is the text 'OpenSeesMP-for-Frank'.

Discovery Workspace

- Simulation and analysis tools
 - Jupyter notebook (40+ languages including Python)



The screenshot shows a Jupyter notebook titled "ReadWriteCentrifugeBinaryFastData_v_4". The interface includes a menu bar (File, Edit, View, Insert, Cell, Kernel, Help), a toolbar with icons for file operations and cell execution, and a status bar indicating "Saving every 120s" and "Python 3".

Project Name:
Development of validated methods for soil-structure interaction analysis of buried structures

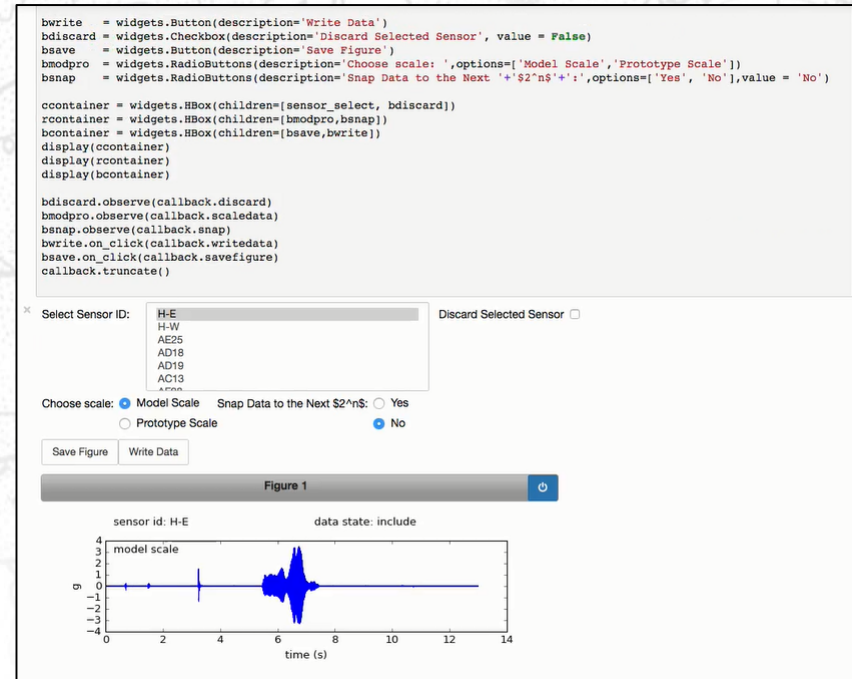
Project Team:
Elnaz Esmaeilzadeh Seylali, Eva Agapaki, Dimitris Pitilakis, Scott J. Brandenberg, Jonathan P. Stewart, Ertugrul Taciroglu (UCLA)

Funded by:
California Department of Transportation (Caltrans)

Instructions:
This code is for writing fast data. In order to run the code please click on "Run Cells".

The user can:

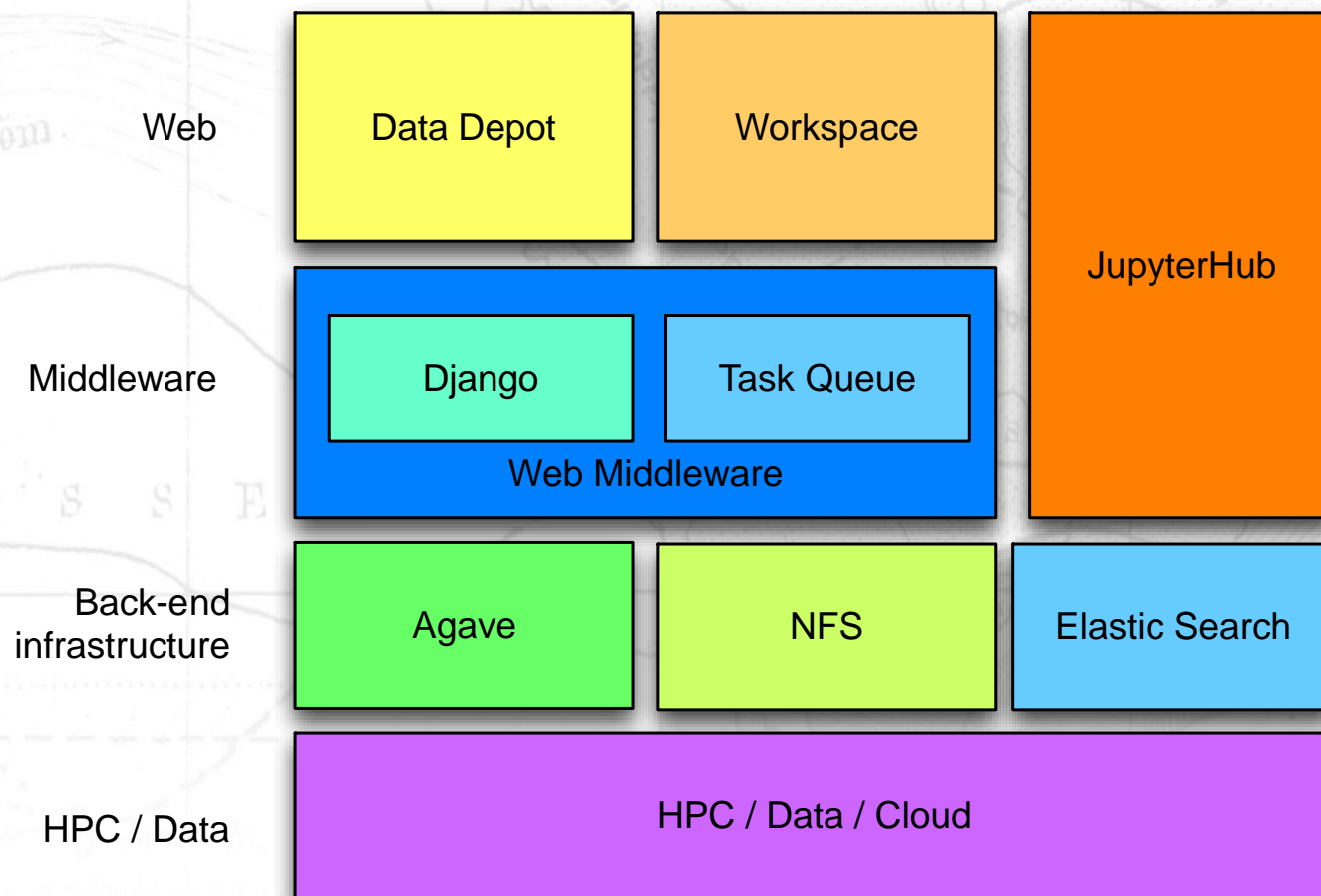
- 1) Discard the sensor by check "Discard Selected Sensor". Discarded sensors will not be written in the output file.
- 2) Truncate data through selecting a span on the top figure. The bottom figure shows data for the selected span. The intensity factor (IF) is used as a metric for determining goodness of truncated data. It is defined as follows:

$$\text{Intensity Factor} = \frac{\sum_{i_s}^N s^2(t_s)}{\sum_{i_s}^N s^2(t_s)} \quad \text{where } 1 \leq i_s \leq i_e \leq N$$


The screenshot shows a Jupyter notebook with Python code for widget creation and data handling. Below the code is a user interface with a "Select Sensor ID" dropdown menu, a "Discard Selected Sensor" checkbox, radio buttons for "Choose scale" (Model Scale, Prototype Scale), and checkboxes for "Snap Data to the Next \$2^n\$". There are also "Save Figure" and "Write Data" buttons.

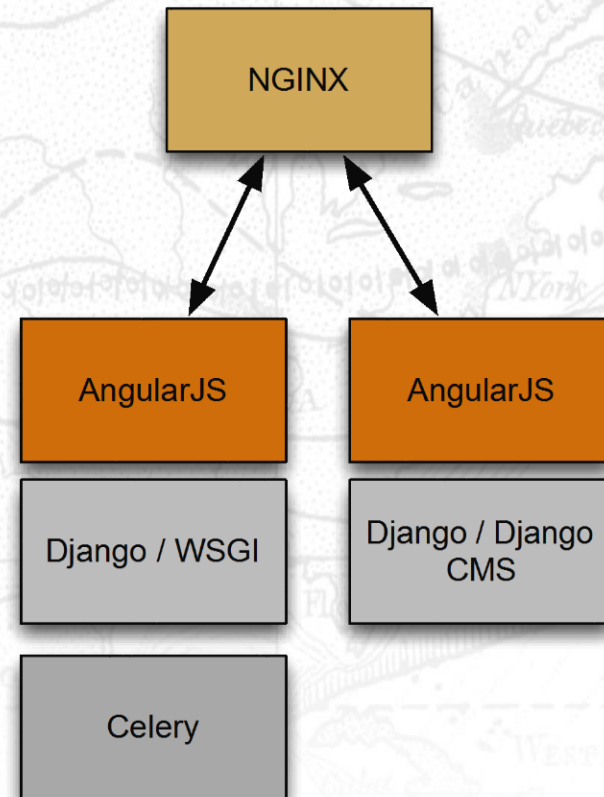
The plot, titled "Figure 1", shows "sensor id: H-E" and "data state: include". The y-axis is labeled "model scale" and ranges from -4 to 4. The x-axis is labeled "time (s)" and ranges from 0 to 14. The plot displays a blue line representing the data, with a significant peak around 6 seconds.

Architecture Overview



Web / Middleware Layer

- NGINX
 - Hands off web requests to different sites like the Portal and experimental facility (EF) sites
- AngularJS
 - Front end web logic
- Django Web Server
- Celery Task queue
 - Scheduling of async tasks like job submissions and data transfers



Backend Infrastructure

- Agave
 - Authentication and authorization
 - Job submission and monitoring
 - HPC (Stampede, Maverick), Cloud (TACC VMs, Jetstream)
 - Metadata storage and retrieval
 - Notifications
 - Data transfer
 - File sharing permissions
- NFS
 - Because sometimes its just easier to to directly manipulate the files

Backend Infrastructure cont.

- Elastic Search
 - 2 node ES cluster
 - Indexes all files, file metadata, web site content
 - Will be expanded to include additional 'project' metadata and the data schemas for the EF generated data

JupyterHub

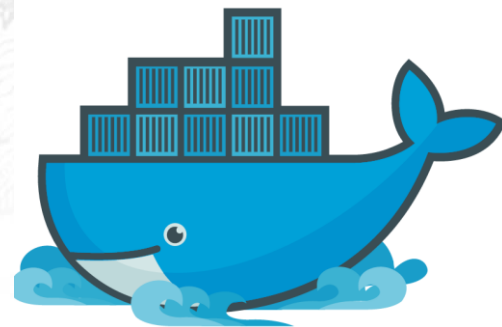
- Multi-user server for running Jupyter notebooks
- User environments configured as Docker containers
- Configured with active Agave session and tooling
- Can burst out to Jetstream for high usage like trainings
- Provides virtual terminal access to DesignSafe Data

HPC & Cloud

- Jobs run (via Agave) on TACC's HPC (Stampede, Maverick) and Cloud systems
- Jobs run as 'community account' or 'gateway account'
- VM sized applications packaged as Docker containers where appropriate for portability



First to IU's Jetstream



Dev-ops

- OpBeat notifications for all production errors/warnings
- All logs emitted to Splunk
- Static code analysis triggered automatically via git hooks
- Jenkins CI/Testing
- Portal production ,QA, and run in Docker containers
- Deployment/testing via Ansible from a deployment node
- Code at <https://github.com/DesignSafe-CI>

Contact

- <https://designsafe-ci.org/>
- Open to anyone interested in natural hazards engineering
- Questions can be submitted through the support/contact form
- Me: mock@tacc.utexas.edu
- Portal Team:
 - Matthew Hanlon, Josue Coronel, Manuel Rojas, Marjo Poindexter, Joe Stubbs, Charlie Dey, Craig Jansen, Tim Cockerill

• Thanks!