

OpenSees & DesignSafe: OpenSeesEXPRESS

November 2018

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OpenSees applications on DesignSafe



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Simulation [10]	Visualization [7]	Data Processing [2]	Partner Data Apps [4]	Utilities [2]	My Apps [14]
ADCIRC ADCIRC	clawpack C	CWE Parallel C	CWE Serial C	Dakota D	LS-DYNA LS-DYNA
LS-Pre/Post LS-DYNA	OpenFOAM OpenFOAM	OpenSees OpenSees	Simcenter Dakota S		

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as well as data analysis and visualization tools including Jupyter, MATLAB, Paraview and VisIt.

Jobs Status



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File name

.ipynb_checkpoints

The **Open System for Earthquake Engineering Simulation** (OpenSees) is a software framework for simulating the static and seismic response of structural and geotechnical systems. It has advanced capabilities for modeling and analyzing the nonlinear response of systems using a wide range of material models, elements, and solution algorithms. One sequential (**OpenSees EXPRESS**) and two parallel interpreters (**OpenSeesSP** and **OpenSeesMP**) are available on DesignSafe. Please select the desired interpreter for more details.

Select a version of **OpenSees** from the dropdown:

- ✓ -- Please Select --
- OpenSees-EXPRESS
- OpenSeesMP (V 2.5)
- OpenSeesMP (V 3.0)
- OpenSeesSP (V 2.5)
- OpenSeesSP (V 3.0)

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Select a version of **OpenSees** from the dropdown:

OpenSees-EXPRESS

RUN OPENSEES-EXPRESS ver. 2.5.0.6248

OpenSees-Express provides users with a sequential OpenSees interpreter (version 2.5). It is ideal to run small sequential scripts on DesignSafe resources freeing up your own machine.

[OpenSees-EXPRESS Documentation](#)

Inputs

Input Directory

Select

The directory containing your OpenSees input files as well as your OpenSees TCL script. You can drag the link for the directory from the Data Browser on the left, or click the 'Select Input' button and then select the directory. To try out sample data copy and paste 'agave://designsafe.storage.default/mock/examples/opensees/FreefieldAnalysisEffective' above.

TCL Script

The filename only of the OpenSees TCL script to execute. This file should reside in the Input Directory specified. To try this

Why OpenSeesEXPRESS?

OpenSees-Express is a sequential interpreter.

OpenSees-EXPRESS



Pros:

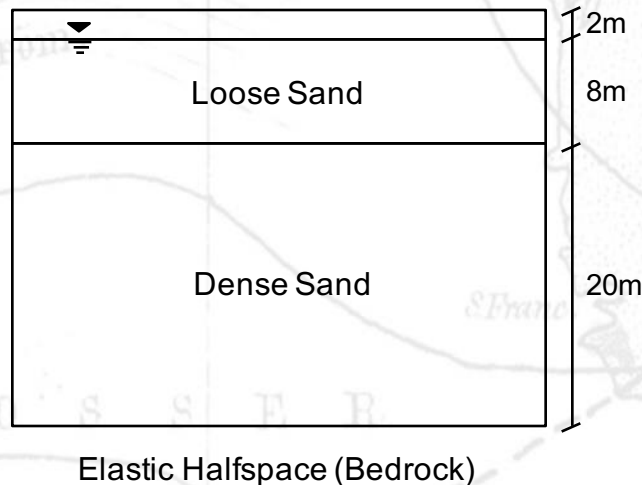
- It runs on Virtual Machine freeing up your own machine;
- No queue.

Cons:

- Not ideal for very large models.

Effective Site Response Analysis

(http://opensees.berkeley.edu/wiki/index.php/Effective_Stress_Site_Response_Analysis_of_a_Layered_Soil_Column)



Problem: effective stress site response analysis of a layered deposit of cohesionless soil underlain by an elastic half-space.

Model: A single column of soil is modeled in 2D (with periodic boundary conditions to emulate a 1D analysis) and is subject to an earthquake excitation. Nine node quadrilateral elements with both displacement and pore pressure degrees of freedom enable the model to track changes in pore pressure and effective stress during the earthquake excitation. A Lysmer-Kuhlemeyer (1969) dashpot is utilized to account for the finite rigidity of the underlying elastic medium.

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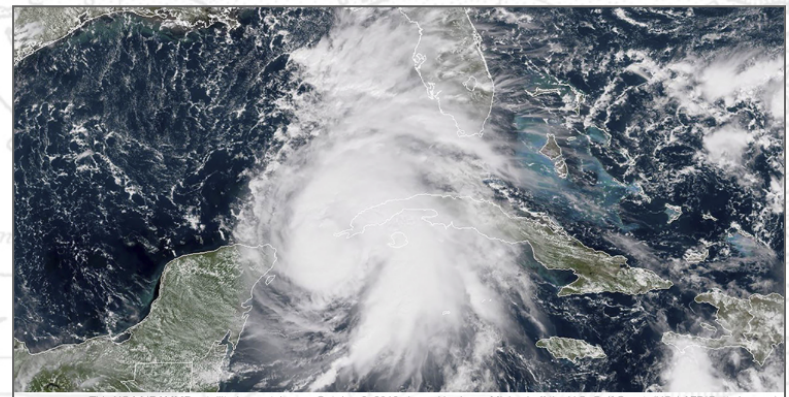
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NHERI Five-Year Science Plan



Hurricane Michael Barreling Toward Florida Gulf Coast
Hurricane Michael will make landfall mid-day Wednesday, Oct 10 with life threatening storm surge forecasted up to 12 feet, heavy rainfall up to 12 inches and damaging winds. Researchers from the Florida Coastal Monitoring Program are heading into the field ahead of the storm to set up two 15 meter weather stations.
[READ MORE IN THE NEWSROOM](#)



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Name	Size	Last modified
.ipynb_checkpoints	--	9/21/18 6:11 PM
.Trash	--	10/23/18 11:18 AM
.Trash-458981	--	9/6/18 1:24 PM
archive	--	4/5/17 11:21 AM
beachball.png	9.3 kB	9/21/18 6:12 PM
BQPLOT - HISTOGRAM(1).ipynb	34.0 kB	9/20/18 7:53 PM
Comparison_stampede2	--	8/3/18 2:23 PM
conetip375.0.png	15.5 kB	9/21/18 6:32 PM
Durante et al_GEESD2018.pdf	786.0 kB	7/24/18 5:46 PM
Fixed_base	--	8/21/17 3:12 PM



OpenSeesEXPRESS analysis: *Run the analysis*



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This NOAA/PAMMB satellite image taken on October 8, 2018 shows Hurricane Michael off the U.S. Gulf Coast. (HO / AFP/Getty Images)

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Parallel SWAN+ADCIRC 160 cores ADCIRC	Parallel ADCIRC ADCIRC	ADCIRC ADCIRC	ADCIRC (NetCDF) ADCIRC	clawpack C	CWE Parallel C
CWE Serial C	Dakota D	LS-DYNA LS-DYNA	LS-Pre/Post LS-DYNA	OpenFOAM OpenFOAM	OpenSees-EXPRESS 
OpenSeesMP (V 2.5) 	OpenSeesMP (V 3.0) 	OpenSeesSP (V 2.5) 	OpenSeesSP (V 3.0) 	Simcenter Dakota S	

Jobs Status

- Comparison_stampede2 4 kB
- Fixed_base 4 kB
- flexi_base_Uwall_param 4 kB

OpenSeesEXPRESS analysis: *Run the analysis*

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File name	Size
.ipynb_checkpoints	4 kB
.Trash	16 kB
.Trash-458981	4 kB
archive	4 kB
Comparison_stampede2	4 kB
Examples	4 kB
Fixed_base	4 kB
flexi_base_Uwall_param	4 kB
FreefieldAnalysisEffective	4 kB

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TCL Script

The filename only of the OpenSees TCL script to execute. This file should reside in the Input Directory specified. To try this out copy and paste in 'freeFieldEffective.tcl'.

Job details

Maximum job runtime

02:00:00

In HH:MM:SS format. The maximum time you expect this job to run for. After this amount of time your job will be killed by the job scheduler. Shorter run times result in shorter queue wait times. Maximum possible time is 48:00:00 (48 hours).

Job name

A recognizable name for this job.

Job output archive location (optional)

Select

Specify a location where the job output should be archived. By default, job output will be archived at:

`<username>/archive/jobs/${YYYY-MM-DD}/${JOB_NAME}-${JOB_ID}`.

Jobs Status

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



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OpenSeesEXPRESS

File name	Size
 accel_disp_Plot.m	2 kB
 freeFieldEffective.tcl	17 kB
 plotAcc.py	2 kB
 plotPorepressure.py	596 bytes
 plotProfile.py	2 kB
 plotStressStrain.py	354 bytes
 porePressurePlot.m	572 bytes
 PostProcessing_matlab.m	128 bytes
 profile_pp_Plot.m	4 kB
 OpenSees.m	1 kB

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Select

Specify a location where the job output should be archived. By default, job output will be archived at:
<username>/archive/jobs/\${YYYY-MM-DD}/\${JOB_NAME}-\${JOB_ID}.

OpenSeesEXPRESS analysis: *Check job status*



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Job Submitted Successfully

Your job OpenSeesEXPRESS has been submitted. Monitor its status on the right.

RUN OPENSEES-EXPRESS ver. 2.5.0.6248

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JOBS STATUS

OpenSeesEXPRESS

PENDING

More info

JOBS STATUS

OpenSeesEXPRESS

RUNNING

More info

JOBS STATUS

OpenSeesEXPRESS

FINISHED

More info

OpenSeesEXPRESS

Application

opensees-docker-2.5.0.6248u14

Status

FINISHED

Submitted

Oct 24, 2018 6:22:59 PM

Finished

Oct 24, 2018 6:24:22 PM

Output

View

Actions

Delete

Close

OpenSees-Express provides users with a sequential OpenSees interpreter (version 2.5).



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OpenSeesEXPRESS analysis: *Check job result*

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File Preview: openseesexpress.err

File name	openseesexpress.err
File path	/margod/archive/jobs/2018-10-25/openseesexpress-4974937107357503976-242ac11b-0001-007/openseesexpress.err
File size	2.6 kB
Last modified	10/24/18 6:24 PM

Rename Move Copy Download

```
+++ dirname ./openseesexpress.ipcexe
++ cd .
++ pwd
+ WRAPPERDIR=/home/tg458981/agave/home/margod/job-4974937107357503976-242ac11b-0001-007-openseesexpress
+ echo 'inputScript is freeFieldEffective.tcl'
+ INPUTSCRIPT=freeFieldEffective.tcl
+ echo 'INPUTSCRIPT is freeFieldEffective.tcl'
+ TCLSCRIPT=freeFieldEffective.tcl
+ echo 'TCLSCRIPT is freeFieldEffective.tcl'
++ pwd
+ docker run -i --sig-proxy=true --rm -m 1G --name opensees_margod_4974937107357503976-242ac11b-0001-007
-v /home/tg458981/agave/home/margod/job-4974937107357503976-242ac11b-0001-007-openseesexpress/OpenSeesE
XPRESS:/data/ stevemock/designsafe-opensees-express /bin/sh -c 'cd /data ; OpenSees < /data/freeFieldEff
ective.tcl'
```

Usage of loopback devices is strongly discouraged for production use. Either use '--storage-opt dm.thinpooldev' or use '--storage-opt dm.no_warn_on_loop_devices=true' to suppress this warning.

OpenSees -- Open System For Earthquake Engineering Simulation
Pacific Earthquake Engineering Research Center
Version 2.5.0 (rev 6248) 32-Bit

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(Copyright and Disclaimer @ <http://www.berkeley.edu/OpenSees/copyright.html>)

```
size: 0.5
size: 0.5
size: 0.5
number of nodes in layer 1: 80
number of nodes in layer 2: 32
number of nodes in layer 3: 10
total number of nodes: 122
Finished creating all -ndf 3 boundary conditions...
Finished creating equalDOF for pore pressure nodes...
```

Close

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Dropbox.com

Google Drive

Published

Community Data

Name

Size

Last modified

.agave.log

406.0 bytes

10/24/18 6:24 PM

OpenSeesEXPRESS

--

10/24/18 6:24 PM

openseesexpress.err

2.6 kB

10/24/18 6:24 PM

openseesexpress.out

342.0 bytes

10/24/18 6:24 PM

openseesexpress.pid

5.0 bytes


10/24/18 6:24 PM



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Name	Size	Last modified
 accel_disp_Plot.m	2.3 kB	10/24/18 6:24 PM
 acceleration.out	1.9 MB	10/24/18 6:24 PM
 displacement.out	2.0 MB	10/24/18 6:24 PM
 elementInfo.dat	1.0 kB	10/24/18 6:24 PM
 freeFieldEffective.flavia.msh	3.3 kB	10/24/18 6:24 PM
 freeFieldEffective.tcl	17.3 kB	10/24/18 6:24 PM
 Gacceleration.out	591.1 kB	10/24/18 6:24 PM
 Gdisplacement.out	560.9 kB	10/24/18 6:24 PM
 GporePressure.out	180.4 kB	10/24/18 6:24 PM
 Gstrain.out	397.9 kB	10/24/18 6:24 PM
 Gstress.out	502.8 kB	10/24/18 6:24 PM
 nodesInfo.dat	2.2 kB	10/24/18 6:24 PM


Post-processing alternatives

- Work on the Cloud using the tools available on DesignSafe (Data Processing Tab):
 - Jupyter Notebook;
 - Matlab.
- Download all the output and post-process data locally.

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 - Jupyter Notebook;
 - Matlab.
- Download all the output and post-process data locally.

Post-processing alternatives: *Jupyter Notebook*

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




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File name	Size
 .ipynb_checkpoints	4 kB
 .Trash	16 kB
 .Trash-458981	4 kB
 archive	4 kB
 Comparison_stampede2	4 kB
 Examples	4 kB
 Fixed_base	4 kB
 flexi_base_Uwall_param	4 kB
 FreefieldAnalysisEffective	4 kB
 Freq_dep	4 kB

DESIGNSAFE - CI JUPYTER NOTEBOOK

The Jupyter Notebook is a web application that allows you to create and share documents that contain live code, equations, visualizations and explanatory text. Uses include: data cleaning and transformation, numerical simulation, statistical modeling, machine learning and [much more](#).

Launch

NOTE: This Jupyter instance will terminate after being idle for 3 days.

Post-processing alternatives: *Jupyter Notebook* – *OpenSeesEXPRESS* (Community Data/Workspace Applications Examples / OpenSees/ freeFieldEffectiveJupyter_postprocessing.ipynb)

jupyter Logout Control Panel

Files Running Clusters

Select items to perform actions on them. Upload New ↻

0 / CommunityData / Workspace Applications Examples / OpenSees

Name	Last Modified
..	seconds ago
OpenSeesEXPRESS	an hour ago
OpenSeesMP	an hour ago
freeFieldEffectiveJupyter_postprocessing.ipynb	36 minutes ago
freeFieldEffectiveJupyter_postprocessing_parallel.ipynb	34 minutes ago
model.png	2 hours ago

Post-processing alternatives: Jupyter Notebook – OpenSeesEXPRESS

(Community Data/Workspace Applications Examples / OpenSees/ freeFieldEffectiveJupyter_postprocessing.ipynb)

The screenshot shows a Jupyter Notebook interface with the following content:

Free Field Analysis Example

This example shows how to postprocess the output results of OpenSeesEXPRESS analysis using python scripts.

The site response analysis discussed in this article is for a soil profile consisting of a 10 m thick layer of loose sand ($D_r = 40\%$) above a 20 m thick layer of more dense sand ($D_r = 75\%$). A schematic representation of the analyzed soil profile is shown in the figure below. The entire soil profile is underlain by an elastic half-space which represents the finite rigidity of an underlying medium such as bedrock. The groundwater table is located at a depth of 2 m, therefore, saturated unit weights are used for the soil below this point and effective stress analysis is considered through the use of nine-node quadrilateral elements which are able to simulate fluid-solid coupling.

The results are presented in terms of:

- Acceleration time series at base and the surface and corresponding response spectra;
- Profiles of maximum displacement, PGA, maximum shear strain, and stress ratio;
- Stress strain plot and evolution of pore water pressure for the point that experienced the maximum shear strain.

Postprocess Results

```
Out[1]: The raw code for this IPython notebook is by default hidden for easier reading. To toggle on/off the raw code, click here.
```

Import python libraries

```
/home/jupyter/CommunityData/Workspace Applications Examples/OpenSees
```

Change directory

```
/home/jupyter/CommunityData/Workspace Applications Examples/OpenSees/OpenSeesEXPRESS
```

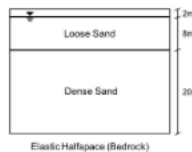
Post-processing alternatives: *Jupyter Notebook* – *OpenSeesEXPRESS* (Community Data/Workspace Applications Examples / OpenSees/ freeFieldEffectiveJupyter_postprocessing.ipynb)

Free Field Analysis Example

This example shows how to postprocess the output results of OpenSeesEXPRESS analysis using python script. The site response analysis discussed in this article is for a soil profile consisting of a 10 m thick layer of loose sand (40%) above a 20 m thick layer of more dense sand ($D_r = 75\%$). A schematic representation of the analyzed soil shown in the figure below. The entire soil profile is underlain by an elastic half-space which represents the finite of an underlying medium such as bedrock. The groundwater table is located at a depth of 2 m, therefore, saturation weights are used for the soil below this point and effective stress analysis is considered through the use of nine quadrilateral elements which are able to simulate fluid-solid coupling.

The results are presented in terms of:

- Acceleration time series at base and the surface and corresponding response spectra;
- Profiles of maximum displacement, PGA, maximum shear strain, and stress ratio;
- Stress strain plot and evolution of pore water pressure for the point that experienced the maximum shear strain.



Postprocess Results

`Out[1]:` The raw code for this IPython notebook is by default hidden for easier reading. To toggle on/off the raw code, click [here](#).

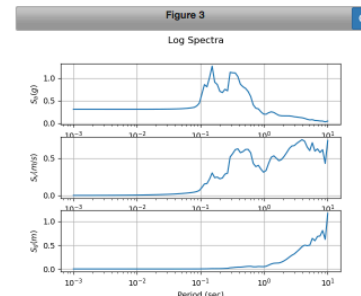
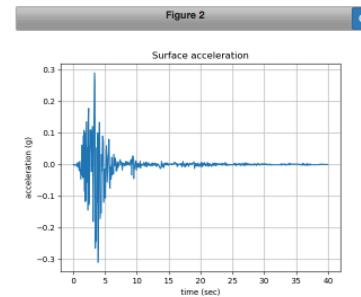
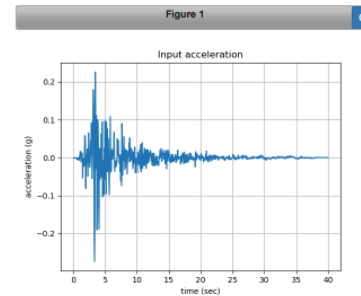
Import python libraries

```
/home/jupyter/CommunityData/Workspace Applications Examples/OpenSees
```

Change directory

```
/home/jupyter/CommunityData/Workspace Applications Examples/OpenSees/OpenSeesEXPRESS
```

a) Acceleration time series at base and the surface and corresponding response spectra:



Post-processing alternatives: *Jupyter Notebook* – *OpenSeesEXPRESS* *(Community Data/Workspace Applications Examples / OpenSees/ freeFieldEffectiveJupyter_postprocessing.ipynb)*

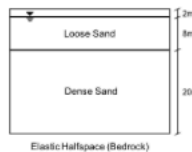
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Postprocess Results

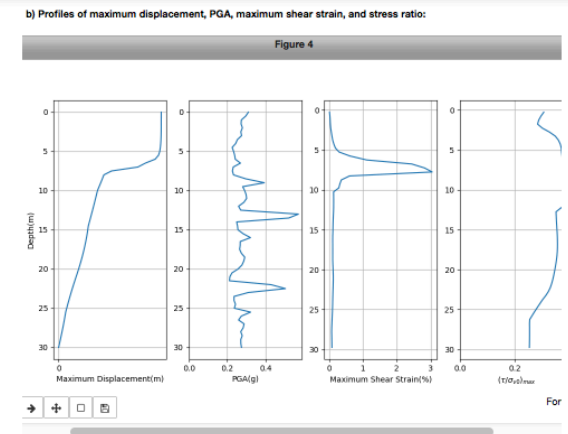
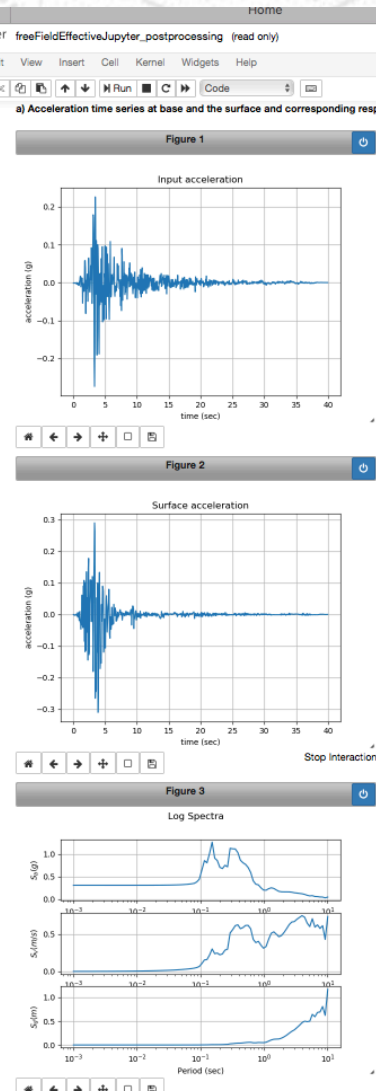
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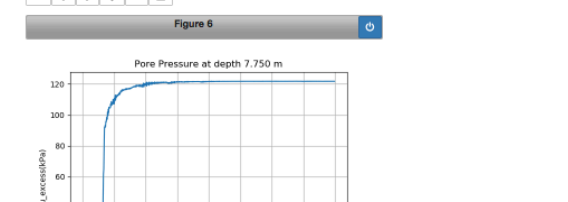
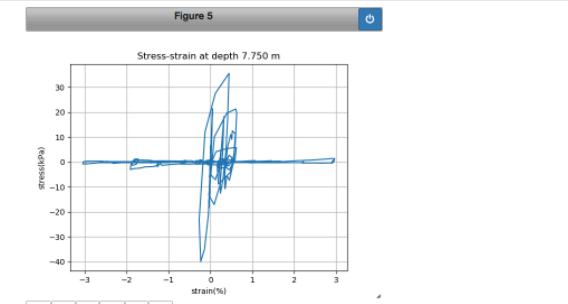
```
/home/jupyter/CommunityData/Workspace Applications Examples/OpenSees
```

Change directory

```
/home/jupyter/CommunityData/Workspace Applications Examples/OpenSees/OpenSeesEXPRESS
```



c) Stress strain plot and evolution of pore water pressure for the point that experienced the maximum shear strain:



Post-processing alternatives

- Work on the Cloud using the tools available on DesignSafe (Data Processing Tab):
 - Jupyter Notebook;
 - Matlab.
- Download all the output and post-process data locally.

Post-processing alternatives: *Matlab*

You have to submit a ticket to activate your license on DesignSafe

The screenshot shows the DesignSafe-CI workspace interface. At the top, the logo for DESIGNSAFE-CI is displayed, along with the text "NHERI: A NATURAL HAZARDS ENGINEERING RESEARCH INFRASTRUCTURE". A navigation bar includes links for "Research Workbench", "Learning Center", "NHERI Facilities", "NHERI Community", "About", and "Help". A search bar is also present. The main content area is titled "WORKSPACE" and features a "Learn About the Workspace" link. Below this, there are several application categories: "Simulation [17]", "Visualization [7]", "Data Processing [3]", "Partner Data Apps [4]", "Utilities [2]", and "My Apps [5]". Under the "Data Processing [3]" category, three application icons are visible: "Jupyter", "MATLAB R2017b", and "MATLAB". The "MATLAB R2017b" and "MATLAB" icons are circled in red. Below the application tray, there is a "Browsing:" section for the user "margod", which lists a table of files and folders. The main workspace area contains instructions to "Select an application from the tray above" and a description of the workspace's capabilities.

File name	Size
ipynb_checkpoints	4 kB
.Trash	16 kB
.Trash-458981	4 kB
archive	4 kB
Comparison_stampede2	4 kB
Examples	4 kB
Fixed_base	4 kB
flexi_base_Uwall_param	4 kB
FreefieldAnalysisEffective	4 kB
Freq_dep	4 kB

Post-processing alternatives: *Matlab*

MATLAB



Run an interactive Matlab 2016a session on a virtual machine. Work directly on your files rather than needing to copy them to and from Stampede.

Recommended for standard post-processing analyses.

MATLAB R2017b



Run an interactive MATLAB 2017b session on Stampede2.

Post-processing alternatives: *Matlab*

WORKSPACE

[Learn About the Workspace.](#)

Simulation [17]

Visualization [7]

Data Processing [3]

Partner Data Apps [4]

Utilities [2]

My Apps [5]

DATA DEPOT BROWSER

Select data source

My Data

Select file for Working Directory.

[More info](#)

Browsing:

margod / Examples

File name

Size

Select  OpenSeesEXPRESS 4 kB

Select  OpenSeesMP 4 kB

RUN MATLAB ver. 0.1

Run an interactive Matlab 2016a session on a virtual machine. Work directly on your files rather than needing to copy them to and from Stampede.

[MATLAB Documentation](#)

Inputs

Desktop Resolution

1280x800

Set the desktop screen size for your visualization session.

Job details

Maximum job runtime

01:00:00 ✓

In HH:MM:SS format. The maximum time you expect this job to run for. After this amount of time your job will be killed by the job scheduler. Shorter run times result in shorter queue wait times. Maximum possible time is 48:00:00 (48 hours).

Job name

Matlab ✓

A recognizable name for this job.

Job output archive location (optional)

Select <username>/archive/jobs/\${YYYY-MM-DD}/\${JOB_NAME}-\${JOB_ID}

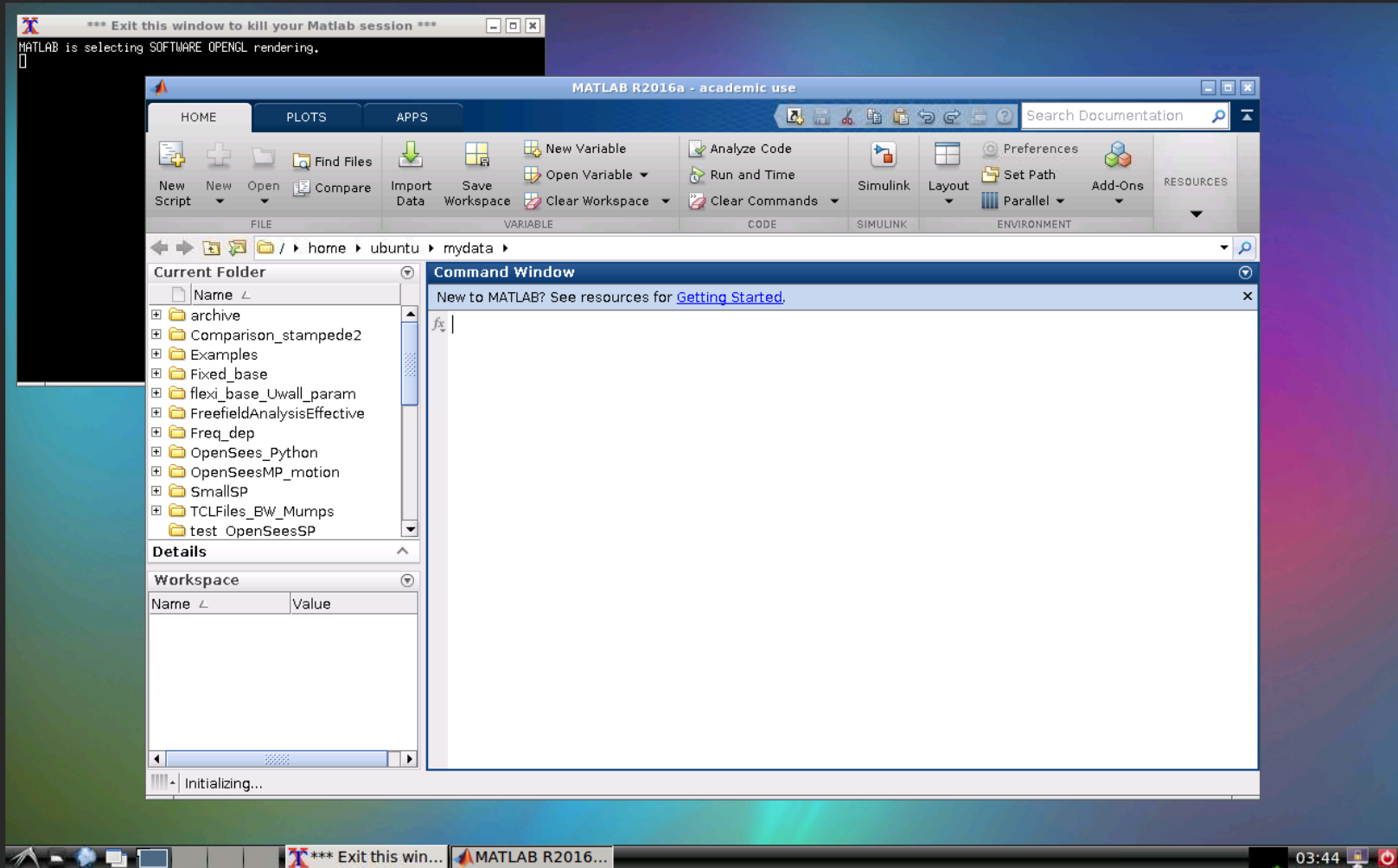
Specify a location where the job output should be archived. By default, job output will be archived at:

<username>/archive/jobs/\${YYYY-MM-DD}/\${JOB_NAME}-\${JOB_ID}.

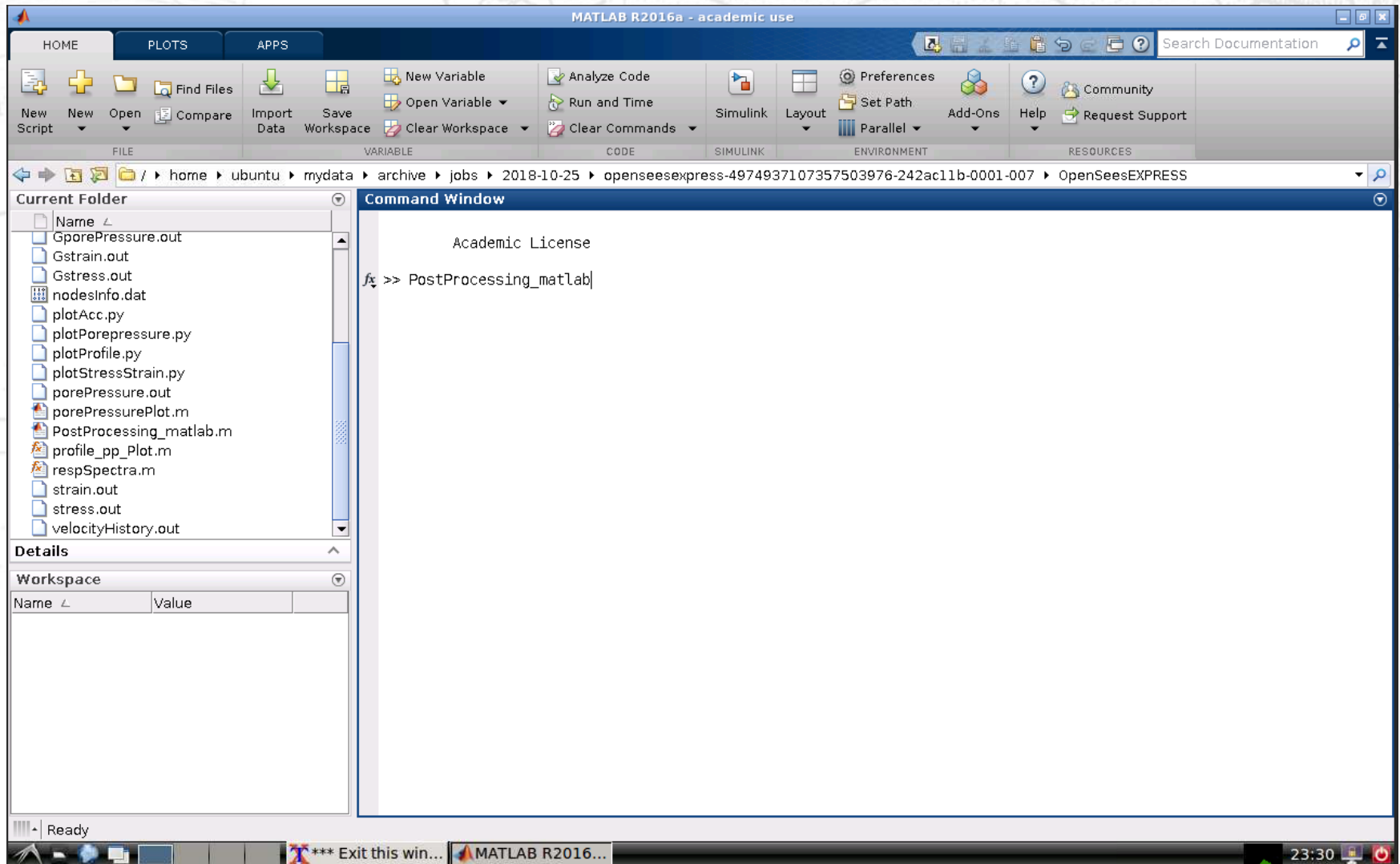
Run Close

d for
analyses.

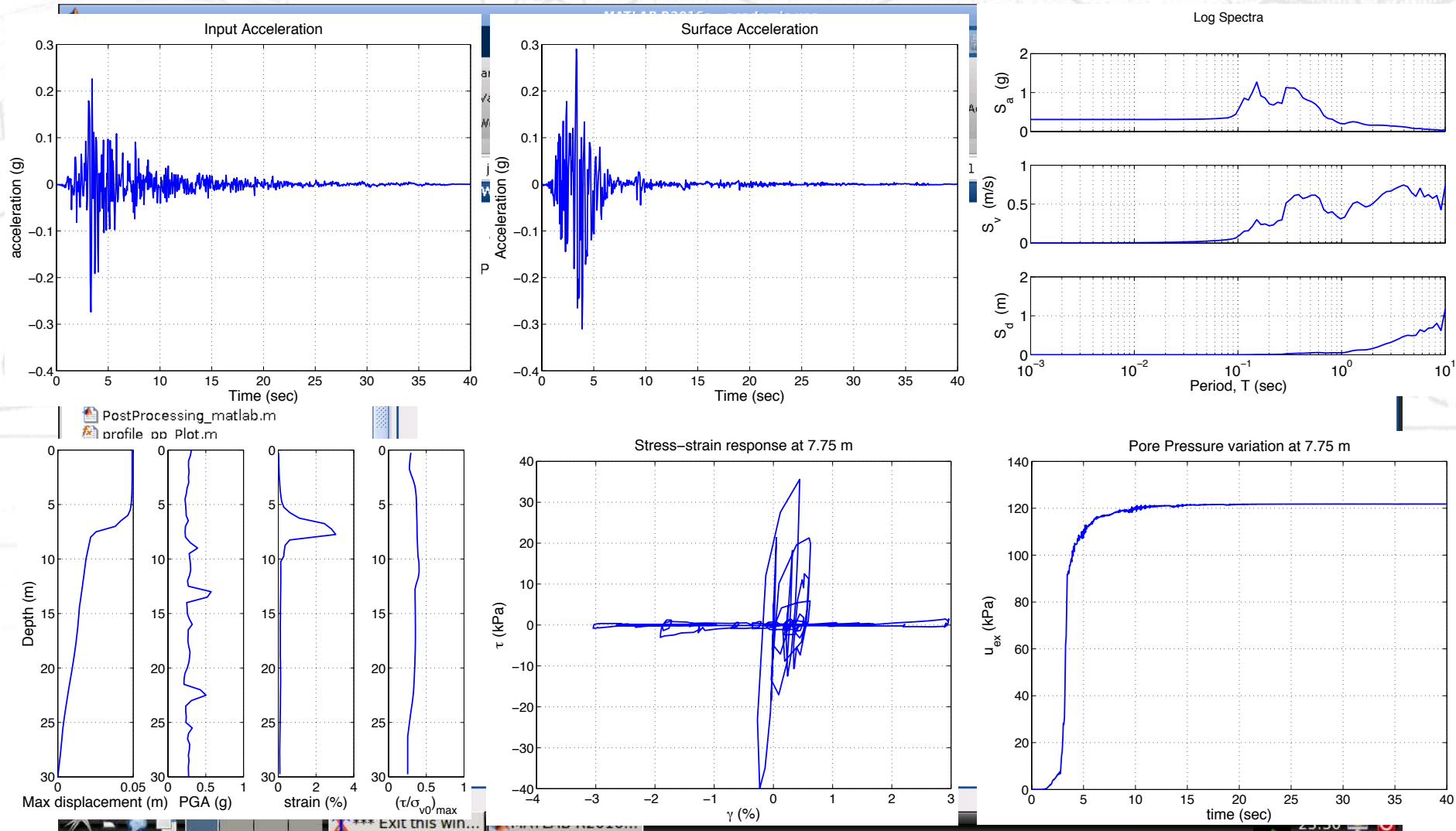
Post-processing alternatives: *Matlab*



Post-processing alternatives: *Matlab* – *OpenSeesEXPRESS* (Community Data/Workspace Applications Examples / OpenSees/ OpenSeesEXPRESS /PostProcessing_matlab.m)



Post-processing alternatives: Matlab – OpenSeesEXPRESS *(Community Data/Workspace Applications Examples / OpenSees/ OpenSeesEXPRESS /PostProcessing_matlab.m)*



OpenSees & DesignSafe: OpenSeesEXPRESS

...Questions?

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