



QuakeCoRE
NZ Centre for Earthquake Resilience

OpenSeesPy: Bringing OpenSees finite element analysis commands to Python 3

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OpenSees?

OpenSees is an open-source framework used for finite element analysis of structural and geotechnical earthquake engineering problems

- **Vision:** engineers would use the OpenSees framework to build new finite element analysis software
 - **Reality:** an actual application was needed to demonstrate this idea, so a TCL interpreter was extended to use OpenSees modeling commands
 - What has come to be known as OpenSees is an extended/expanded version of this first demonstration application
 - No other new applications were really developed
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OpenSeesPy?

OpenSeesPy brings the OpenSees finite element analysis commands to Python

- OpenSees commands can be imported into Python just like any other package
 - integrate commands directly into workflow
- Precompiled and available for download for Windows and Linux systems
 - Developed by Minjie Zhu at Oregon State University
 - <https://openseespydoc.readthedocs.io/en/latest/index.html>

Wait, what's the difference?

Standard workflow for OpenSees:

- **Pre-process:** Create model file by some means (model.tcl)
 - Could use scripting in tcl directly
 - Could create using Matlab, Python, something else
 - Could use a GUI tool like GiD
 - **Analysis:** Run analysis and record results to file(s)
 - **Post-process:** Read results file(s) into some tool for analysis and plotting
 - Matlab, Python, Excel, ...
 - GUI tool like GiD
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Wait, what's the difference?

Possible workflows for OpenSeesPy:

- **Pre-process, analysis, and post-process** all in one script
 - No longer need a model file
 - Can run OpenSees commands as part of a larger script/workflow that includes all pre- and post-processing steps
 - Opportunity for mid-analysis post-processing
 - Use OpenSees commands as computational tools
 - No longer need output files
 - Can use `eleResponse` and `nodeResponse` commands to directly populate arrays with results rather than writing to file and reading later
 - Enables the use of tools like Jupyter Notebook
 - Integrates directly with existing Python workflows
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I'm in. Where do I find out more?



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The OpenSeesPy developers maintain a documentation website at:

<https://openseespydoc.readthedocs.io/en/latest/index.html>

The precompiled downloads are also available on this site.

Conversion from existing tcl model files to the Python usage is pretty straightforward (at least for the OpenSees commands!)

e.g.

OpenSees Tcl:

```
element SSPbrick $tag 1 2 3 4 5 6 7 8 $matTag $bx $by $bz
```

OpenSeesPy:

```
element('SSPbrick', tag, 1, 2, 3, 4, 5, 6, 7, 8, matTag, bx, by, bz)
```

Note: OpenSeesPy is a research tool and just like with standard OpenSees, the expectations for support and operation should be adjusted accordingly
