Model fault-based PSHA
using SHERIFS and OpenQuake

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Global Earthquake Model

Downloading the lastest version

Without using git :

Go to :
https://github.com/tomchartier/SHERIFS

Click on "code" ➔ download zip

Unzip the code wherever you prefer, we will stay in this folder.

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Useful commands

Running SHERIFS :

python   0_build_ruptures.py   input/LMS_f/sherifs_in.toml

python   1_SHERIFS.py   input/LMS_f/sherifs_in.toml

Running OpenQuake :

oq engine --run job.ini

oq engine --export-outputs -1 ./out

Something missing in python :

pip install name_of_module

or

conda install name_of_module

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OpenQuake Engine

GEM Seismic Hazard Team

"Hands on fault-based PSHA: data and approaches to build models"

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Hazard Input Model

Anatomy of the hazard input (HI) model

Four essential components describe a PSHA input model for the OQ Engine

1. A **configuration file** containing all the information required to run an analysis (e.g. typology of analysis, investigated sites, typologies of results required)

2. An .xml file describing the initial seismic source model logic tree and the epistemic uncertainties affecting the seismic source characterization

3. (At least) One .xml file with the initial seismic source model (i.e. a list of seismic sources)

4. An .xml file describing the ground-motion models selected for computing hazard and the associated epistemic uncertainties

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Hazard input example in the Demos

Let's have a look at the files included in one of the demos provided with the OQ Engine. In particular let's look at the content of the `SimpleFaultSourceClassicalPSHA` folder in

https://github.com/gem/oq-engine/tree/master/demos/hazard

Defining a Simple Fault Source

GEM

```xml
<simpleFaultSource id="3" name="Simple Fault Source"
        tectonicRegion="Active Shallow Crust">
    <simpleFaultGeometry>
    <gml:LineString>
            <gml:posList> 1.0 -2.0 1.4 0.0 1.7 0.0 </gml:posList>
</gml:LineString>
    <dip> 30.0 </dip>
    <upperSeismoDepth> 5.0 </upperSeismoDepth>
    <lowerSeismoDepth> 15.0 </lowerSeismoDepth>
    </simpleFaultGeometry>
    <magScaleRel> WC1994 </magScaleRel>
    <ruptAspectRatio> 2.0 </ruptAspectRatio>
    <truncGutenbergRichterMFD aValue="4.2" bValue="0.9" maxMag="7.0" minMag="6.5"/>
    <rake> 90.0 </rake>
</simpleFaultSource>
```

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    <upperSeismoDepth> 5.0 </upperSeismoDepth>
    <lowerSeismoDepth> 15.0 </lowerSeismoDepth>
    </simpleFaultGeometry>
    <magScaleRel> WC1994 </magScaleRel>
    <ruptAspectRatio> 2.0 </ruptAspectRatio>
    <truncGutenbergRichterMFD aValue="4.2" bValue="0.9" maxMag="7.0" minMag="6.5"/>
    <rake> 90.0 </rake>
</simpleFaultSource>
```

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Multi Fault Source

Files required for its definition

Defined by two separate files:

1. One file containing the geometry of the sections (i.e. the description of the geometry of the elements composing the fault system) – For convenience let's call it the `sections` file

2. The Seismic Source Model file defining the ruptures. In case of a Multi Fault Source it contains a list of elements each one specifying the indexes of the sections composing a rupture and the probability of having 0, 1 … n occurrences in the investigation time

Let's use the files in the test case 65 for classical PSHA to illustrate an input model for the OQ Engine containing a Multi Fault Source (see https://github.com/gem/oq-engine/tree/master/openquake/qa_tests_data/classical/case_65)

Kite surface definition

The geometries described in the `sections` are Kite Surfaces. A set of `profiles` define a Kite Surface.

- Each profile is a sequence of points defining a multi-segment in 3D;

- Each Kite Surface requires at least 2 profiles, defined following the right hand rule;

- Using this information and a spacing distance, OQ builds a mesh made of quadrilaterals.

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Kite surface definition
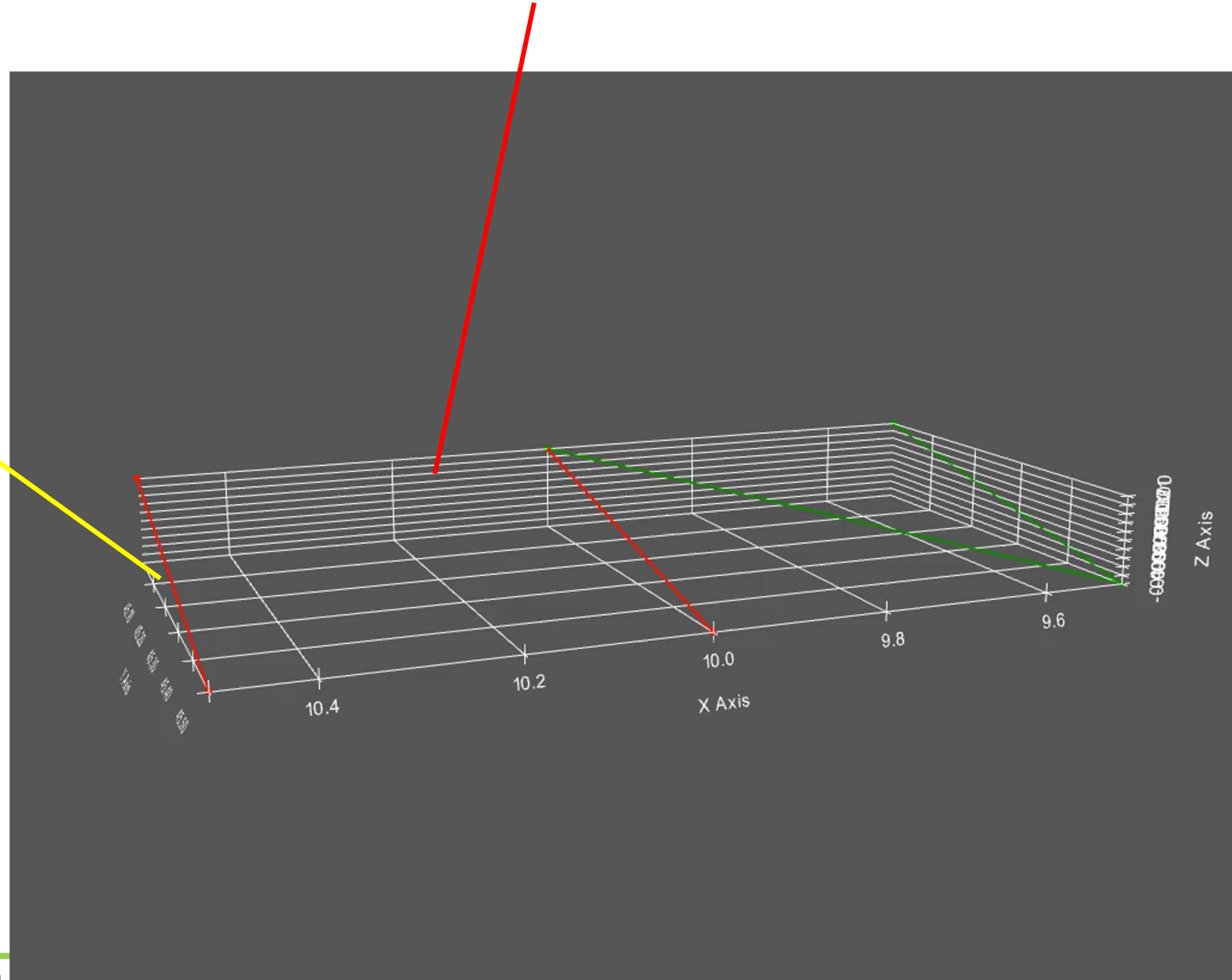
Multi Fault Source: intro

```xml
<geometryModel name="fault_sections">
  <section name="central" id="s1">
    <kiteSurface>
        <profile>
          <gml:LineString><gml:posList>
            10.5 45.0 0.0 10.5 45.5 10.0
          </gml:posList></gml:LineString>
        </profile>
        <profile>
          <gml:LineString><gml:posList>
            10.0 45.0 0.0 10.0 45.5 10.0
          </gml:posList></gml:LineString>
        </profile>
    </kiteSurface>
  </section>
```

This is defines section `s1`

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Multi Fault Source: intro

```
<multiFaultSource id="1" name="Test1">
    <multiPlanesRupture probs_occur="0.8 0.2">
        <magnitude>5.0</magnitude>
        <sectionIndexes indexes="s1"/>
        <rake>90</rake>
    </multiPlanesRupture>
    <multiPlanesRupture probs_occur="0.7 0.3">
        <magnitude>6.0</magnitude>
        <sectionIndexes indexes="s1,s2"/>
        <rake>90</rake>
    </multiPlanesRupture>
    …
</multiFaultSource>
```

Rupture 1 involves only section `s1`

Rupture 2 involves section `s1` and `s2`

Hands on fault-based PSHA: data and approaches to build models

Please attribute to the GEM Foundation with a link to

www.globalquakemodel.org

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