OpenSees, VEES, and XML: Visualization and Model Archiving

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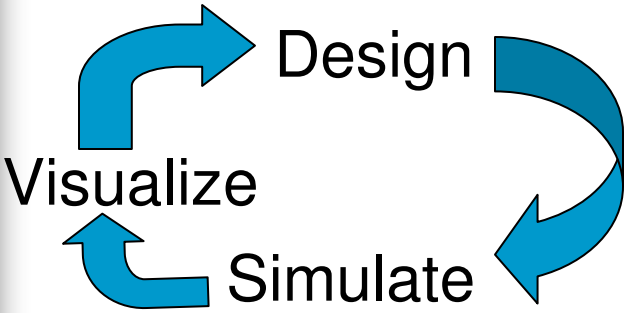
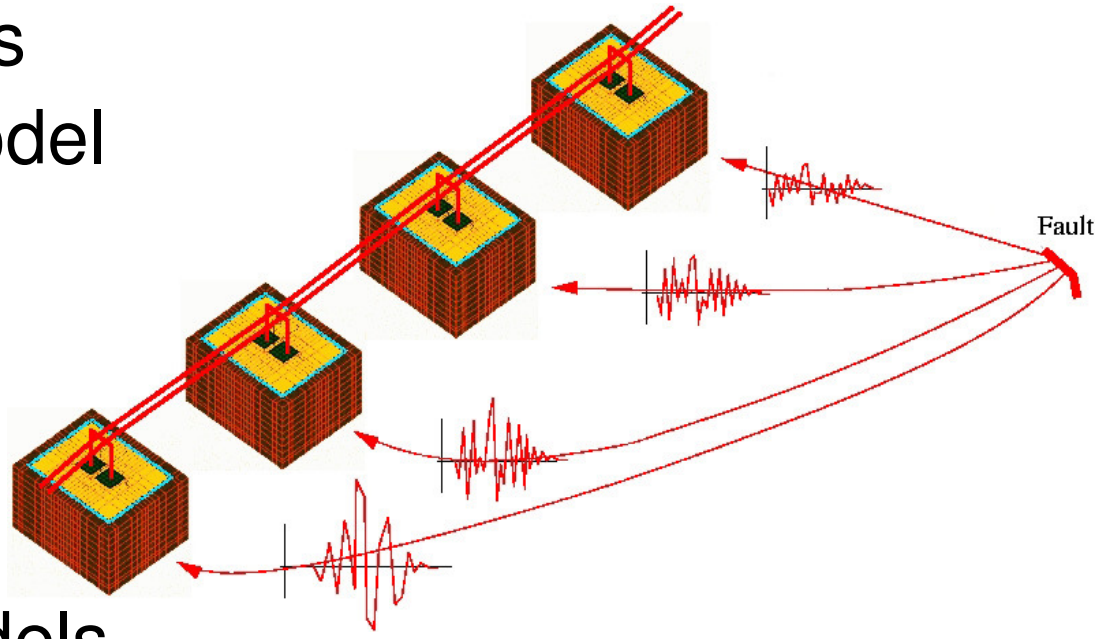
What Does Geomechanics Need?

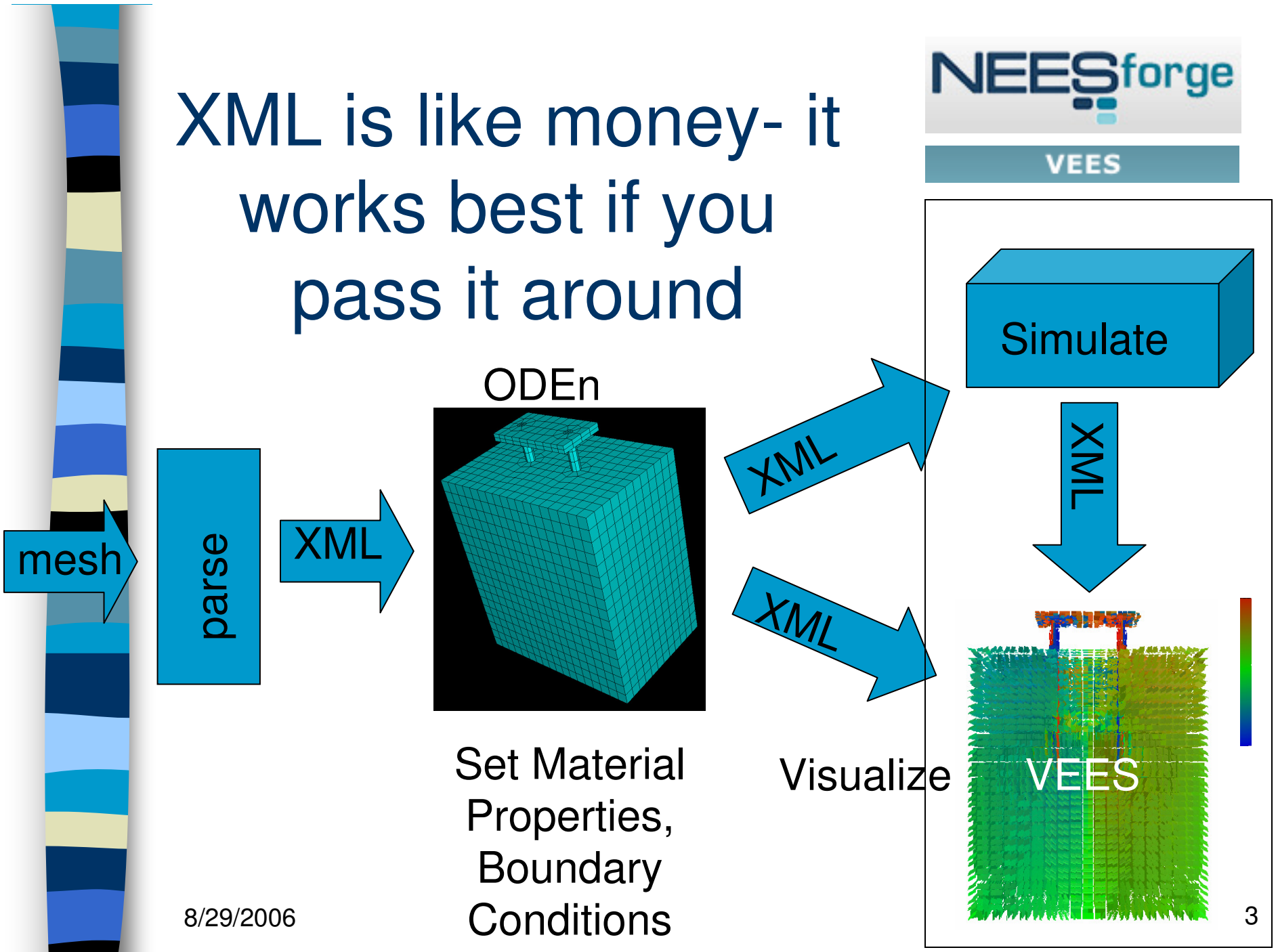
- **Run-time** visualization
- **New** techniques
- **Iterate** on a model





- **Archive** of models
  - **XML**

XML is like money- it works best if you pass it around



We're Not Starting from Zero:

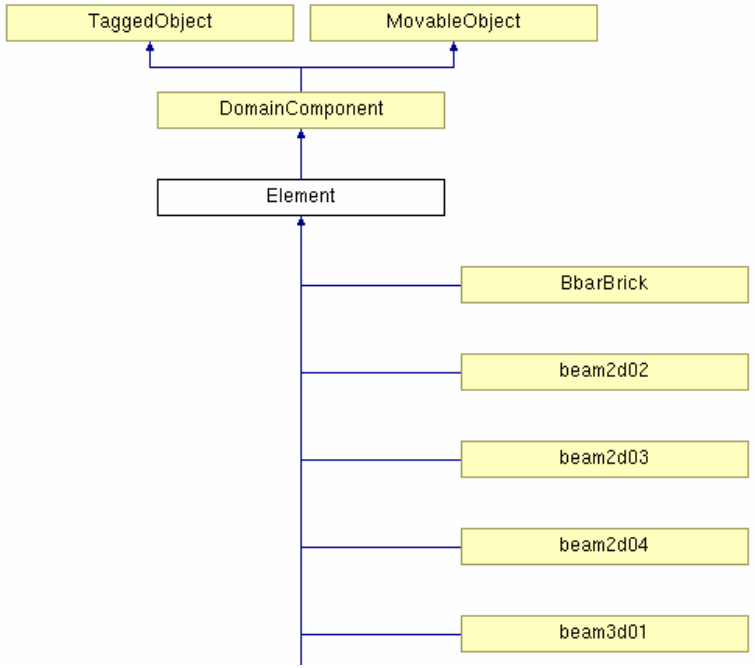
NEESforge

VEES

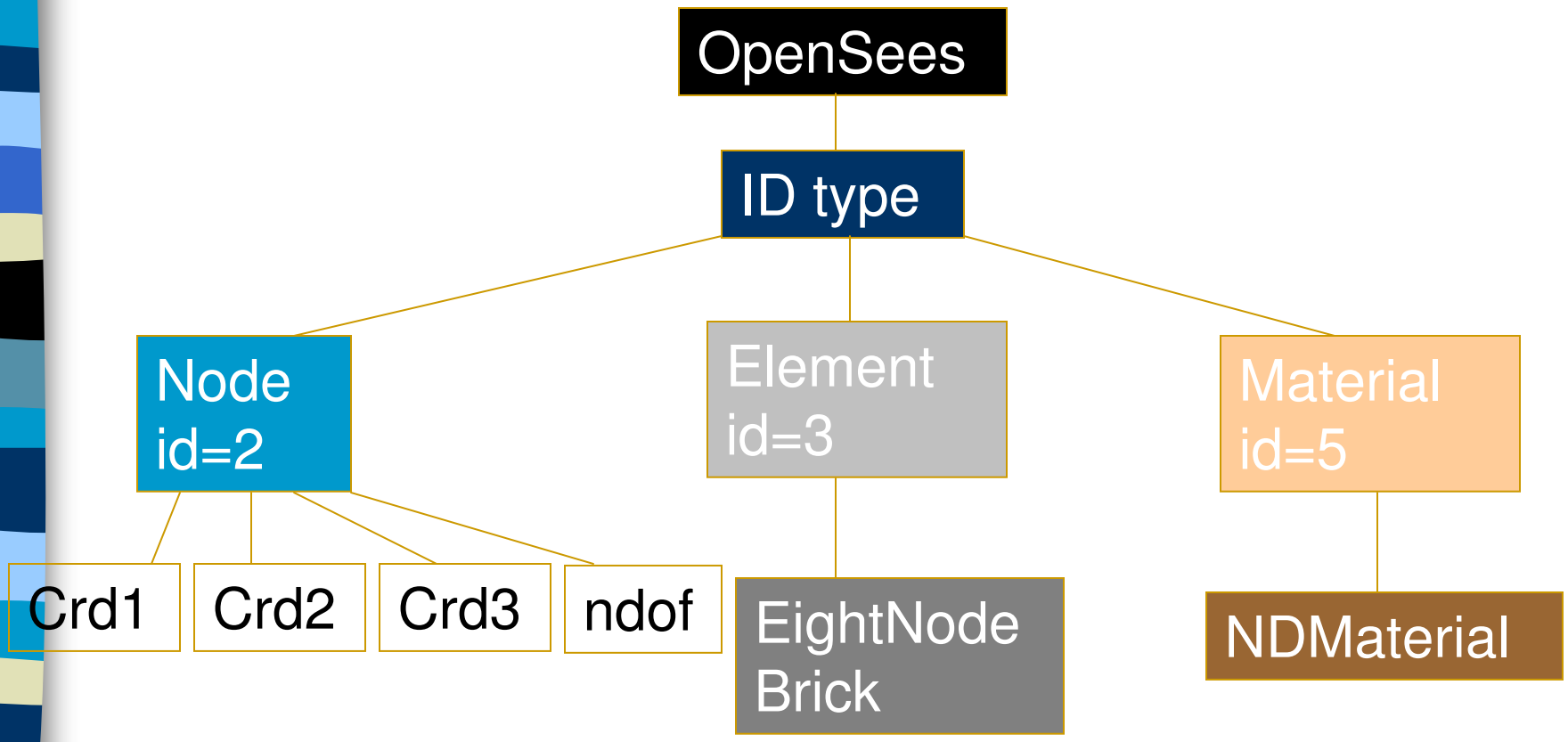
OpenSees — Open System for Earthquake Engineering Simulation

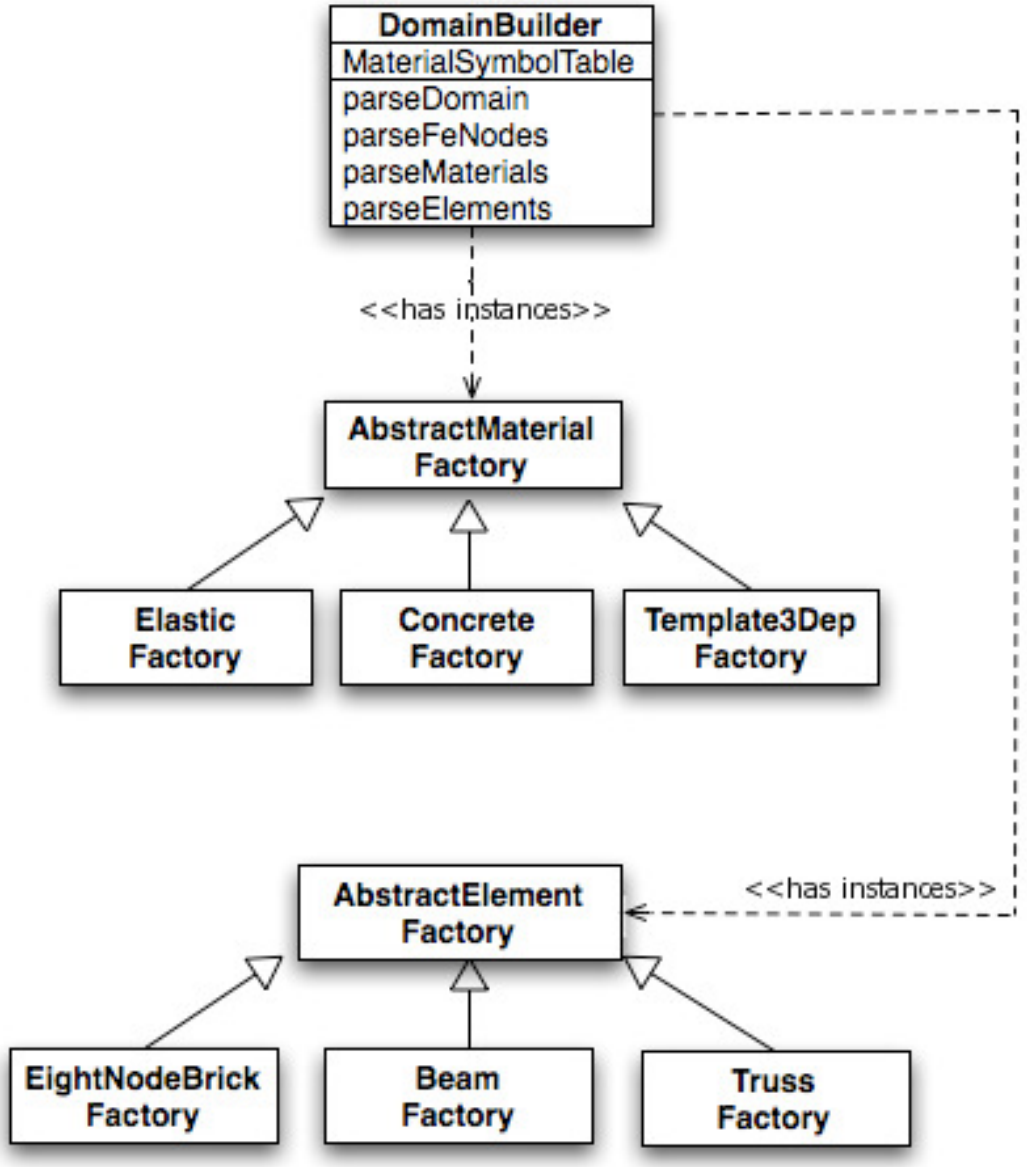
Pacific Earthquake Engineering Research Center

- Object-Oriented C++/Tcl FEM simulator
  - Data types organized in **natural hierarchy**
  - Runs on Linux and Windows
- All the data we might want to visualize:
  - Stress, strain, displacement, acceleration, elements, materials



XML Schema follows OpenSees Hierarchy





XML parsing code creates a running OpenSees simulation

How about the 687 other OpenSees classes???

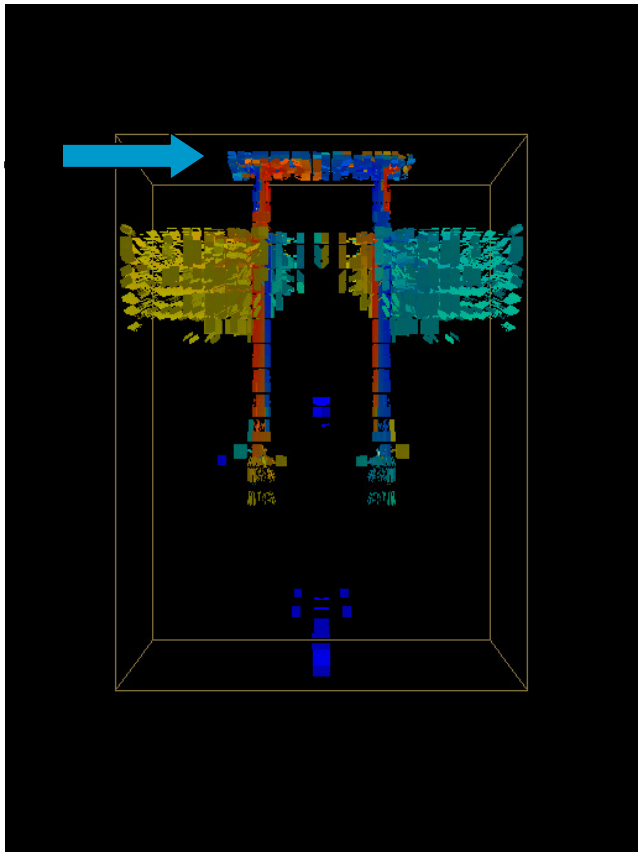
Code that writes code!!

- Java code (XMLFactoryBuilder.java) parses a C++ constructor and creates:
  - XML schema entry
  - C++ factory class
  - OpenSees printXMLModel function

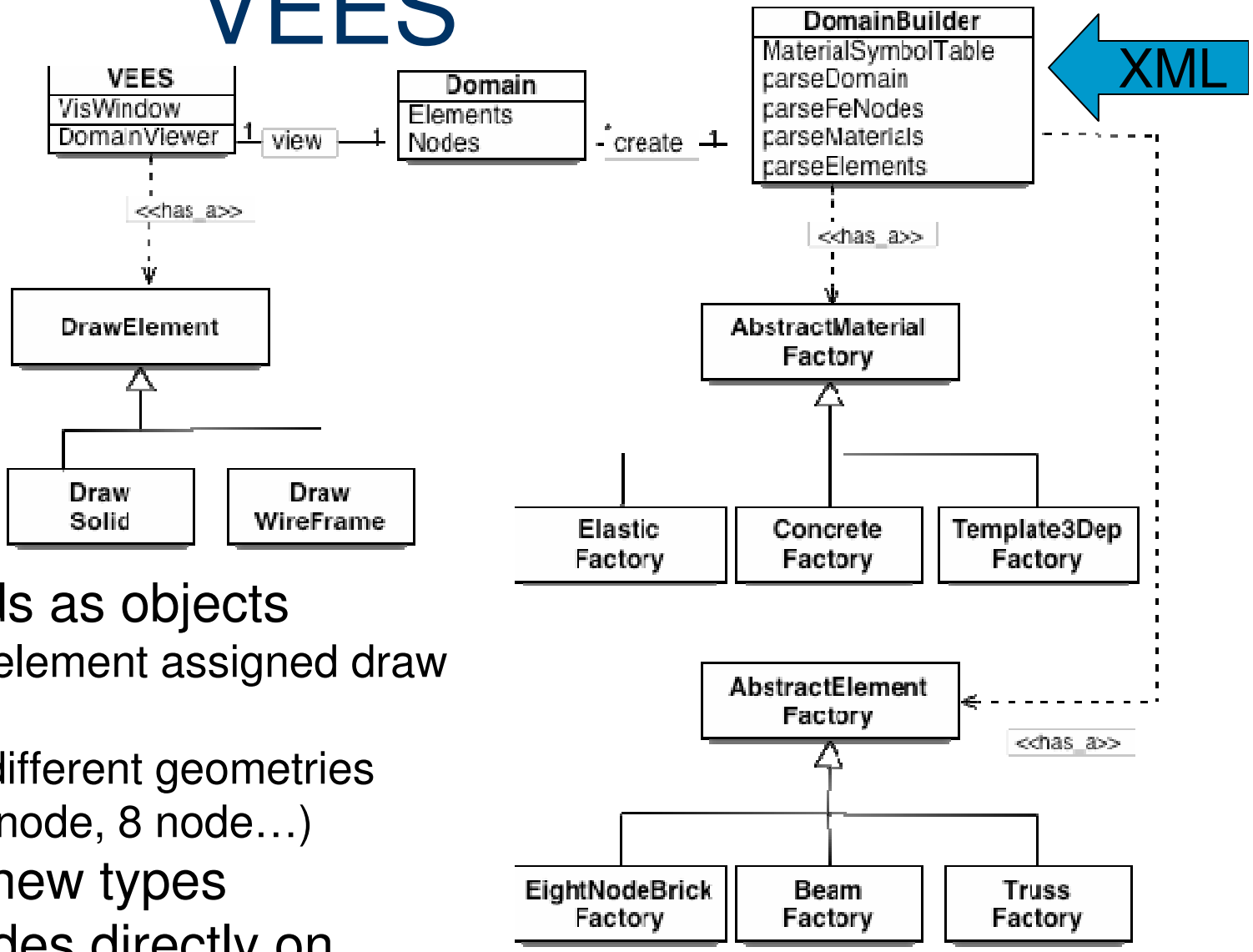
That's all good, but what about the visualization?

Software Reuse aids visualization

- OpenSees **full** of helpful data structures:
  - Graph, elements, nodes, Iterator!
- Scalar, vector, tensor data **right at hand**
- Mix & Match: individual elements visualized using different techniques
  - Stress colored by volumetric or distortional change
  - Probabilistic damage measure glyphs
  - Thresholding to find interesting data, assess accuracy of simulation
  - Displaced mesh



VEES



Draw methods as objects

- Each finite element assigned draw object
- Just a few different geometries (2 node, 4 node, 8 node…)

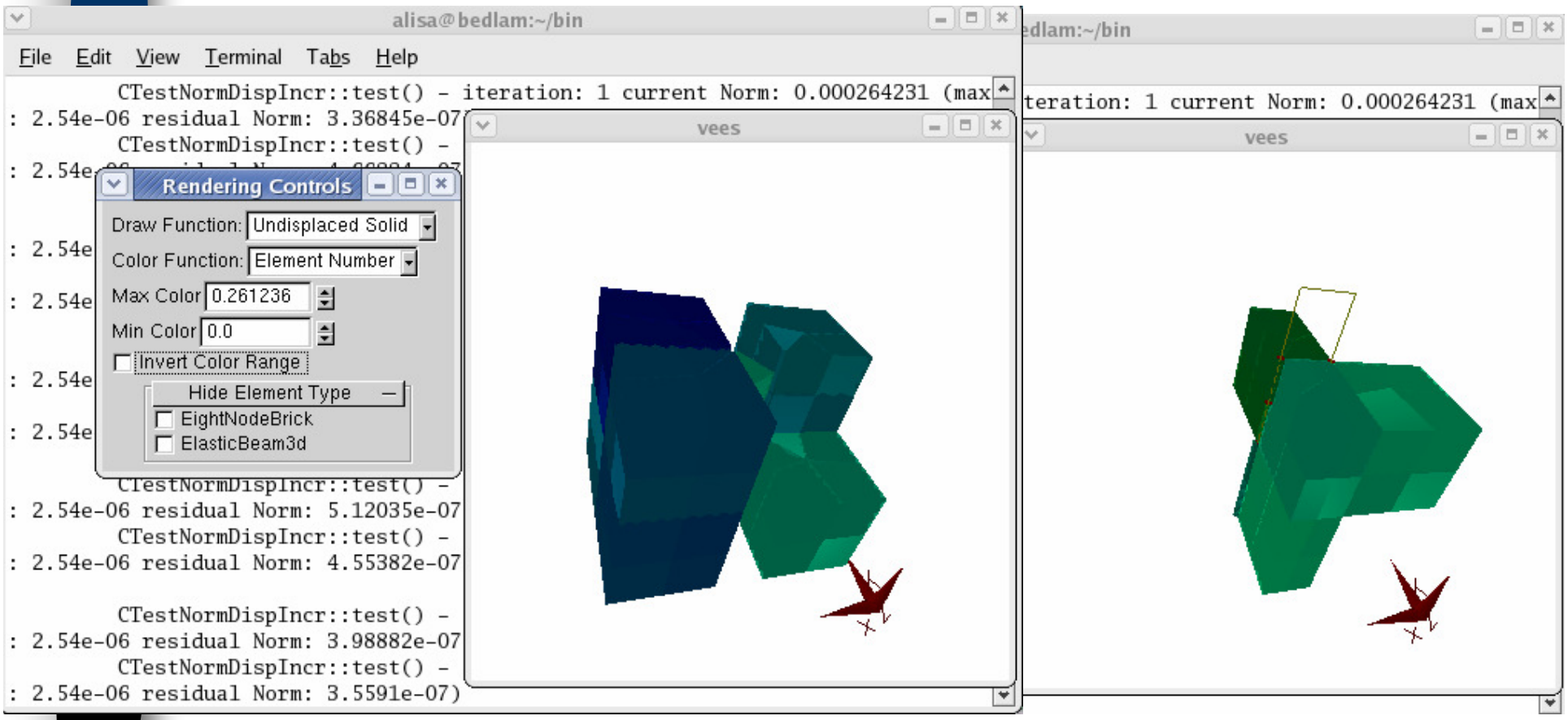
Easy to add new types

VEES also rides directly on OpenSees Tcl interpreter

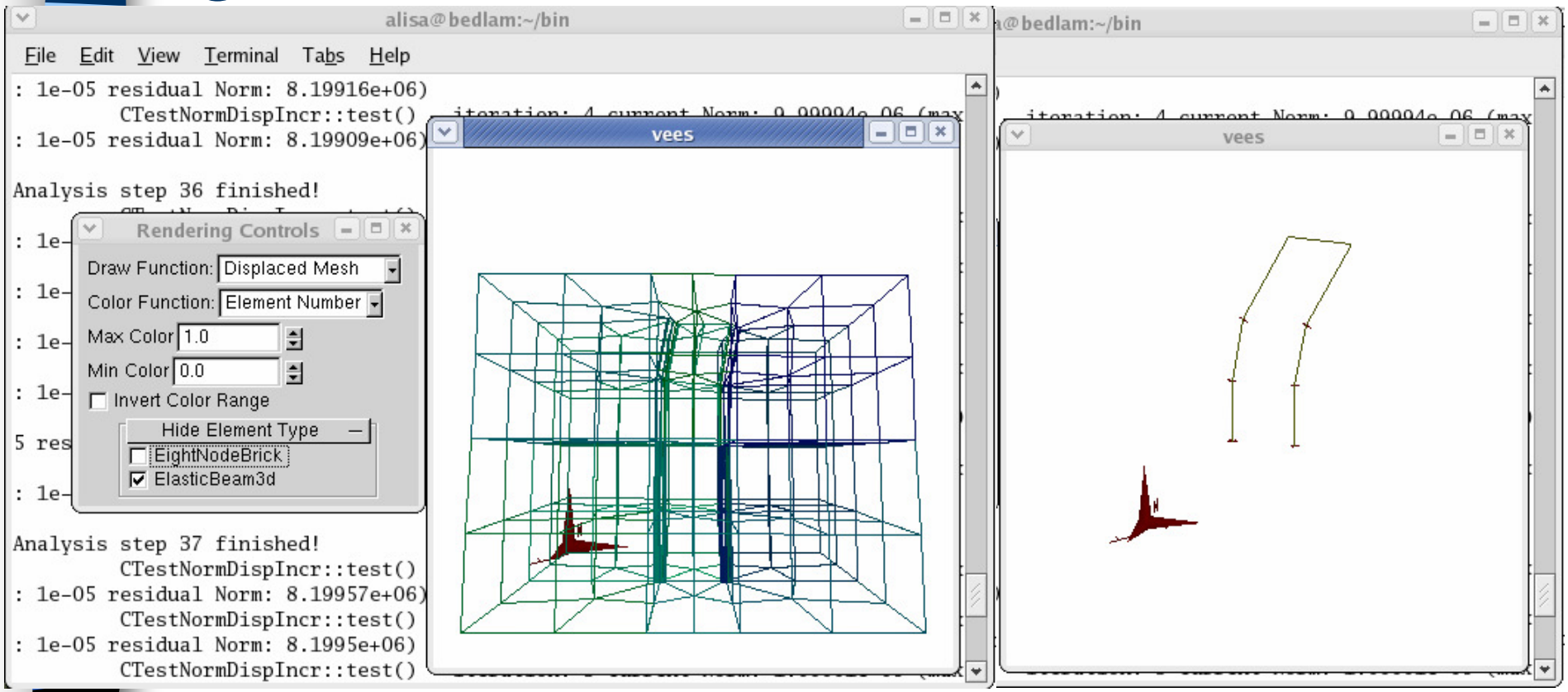
Info Viz approach

1. Overview (entire domain)
2. Zoom and Filter
3. Details on Demand

Filter by color/value and invert



Filter by element type - list automatically generated



Where we are today

NEESforge
VEES

XML

- Basic framework in place
- Lots of non-research manpower needed to complete XML but automation should help a lot

VEES

- Basic framework in place
- GUI coming along
- details-on-demand will be part of thesis research

Thanks!

Working pre-alpha release can be found at NEESforge: VEES project□□

Help us help you! The wish list is long and we need to prioritize.

http://neesforge.nees.org/projects/vees/

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