What parameters are available?

Parameters are specified as a hierarchy of components and properties

- **Components (Facilities)** are the object building blocks
  - Appendix B of the PyLith manual lists all of the components
    - Problem `TimeDependent`
    - Boundary conditions `DirichletBC`
    - Faults `FaultCohesiveKin`
    - Materials `MaxwellViscoelastic3D`
    - Output managers `OutputSolnSubset`
    - Readers `MeshIOCubit`

- **Properties** are the basic types
  - String `mat_viscoelastic.spatialdb`
  - Integer `4`
  - Float `2.3`
  - Dimensioned quantity `2.5*year`
  - Array of Strings, Integers, or Floats `[0, 0, 1]`
How do I show the values of the current parameters?
Case study: examples/3d/hex8/step01

- All current parameters and their values
  
  `pylithinfo [--verbose] [-o pylith.parameters.txt] [-h] [PyLith args]

  `pylithinfo --verbose step01.cfg`

- Components and properties for given component --help
  
  `step01.cfg [pylithapp.timedependent.bc.z_neg]

  `shell pylith step01.cfg --timedependent.bc.z_neg.help`

- Current components of a given component --help-components
  
  `step01.cfg [pylithapp.timedependent.bc.z_neg]

  `shell pylith step01.cfg --timedependent.bc.z_neg.help-components`

- Current properties of a given component --help-properties
  
  `step01.cfg [pylithapp.timedependent.bc.z_neg]

  `shell pylith step01.cfg --timedependent.bc.z_neg.help-properties`
What about a GUI?

Browser-based GUI under development

- Use web browser as GUI to parameters
  - See all parameters with descriptions
  - See possible choices for components and properties
- Basic validation of parameters
- Export parameters to single file
  Facilitate archiving parameters used in given simulation

Started in Oct 2013 but v2.0 release had higher priority
Step01 Simple shear using Dirichlet BC in static simulation
Step02 Prescribed fault slip with Dirichlet BC
  ● Static simulation
  ● Fault is embedded within the domain
Step03 Spontaneous rupture with Dirichlet BC
  ● Static simulation
  ● Static friction ($\mu_f = 0.6$)
  ● Slip driven by simple shear

Correct files are provided for reference (posted later today)
Step01: Error 1
Error found while doing very basic validation of parameters

$ pylith step01.cfg

Python stacktrace

Traceback (most recent call last):
  File "/Volumes/Tools/unix/pylith-dev/gcc-4.7.3/bin/pylith", line 27, in <module>
    start(applicationClass=PyLithApp)
  File "/Volumes/Tools/unix/cig/gcc-4.7.3/lib/python2.7/site-packages/pythia-0.8.1.15-py2.7.egg/shell.run(**kwds)
  File "/Volumes/Tools/unix/cig/gcc-4.7.3/lib/python2.7/site-packages/pythia-0.8.1.15-py2.7.egg/app.applyConfiguration(context)
  File "/Volumes/Tools/unix/cig/gcc-4.7.3/lib/python2.7/site-packages/pythia-0.8.1.15-py2.7.egg/r
raise ValueError("%s\nBacktrace — Component %s % (err.message, aliases))

Error message

ValueError: Error while configuring Dirichlet boundary condition (dirichletbc, x_pos):
Error while configuring boundary condition (dirichletbc, x_pos):
Label for group/nodeset/pset in mesh not specified.

Component hierarchy

Backtrace — Component dirichletbc, x_pos
Backtrace — Component bc
Backtrace — Component timedependent, problem
Backtrace — Component pylithapp
Step01: Error 1 Resolution
Error found while doing very basic validation of parameters

Error message

ValueError: Error while configuring Dirichlet boundary condition (dirichletbc, x.pos):
Error while configuring boundary condition (dirichletbc, x.pos):
Label for group/nodeset/pset in mesh not specified.

Component hierarchy

Backtrace — Component dirichletbc, x.pos
Backtrace — Component bc
Backtrace — Component timedependent, problem
Backtrace — Component pylithapp
Step01: Error 1 Resolution
Error found while doing very basic validation of parameters

Error message

```
ValueError: Error while configuring Dirichlet boundary condition (dirichletbc, x_pos):
Error while configuring boundary condition (dirichletbc, x_pos):
Label for group/nodeset/pset in mesh not specified.
```

Component hierarchy

Backtrace – Component dirichletbc, x_pos
Backtrace – Component bc
Backtrace – Component timedependent, problem
Backtrace – Component pylithapp

Debug: Examine parameters for pylithapp.problem.bc.x_pos
Step01: Error 1 Resolution
Error found while doing very basic validation of parameters

Error message

```
ValueError: Error while configuring Dirichlet boundary condition (dirichletbc, x.pos):
Error while configuring boundary condition (dirichletbc, x.pos):
Label for group/nodeset/pset in mesh not specified.
```

Component hierarchy

- Backtrace — Component dirichletbc, x.pos
- Backtrace — Component bc
- Backtrace — Component timedependent, problem
- Backtrace — Component pylithapp

Debug: Examine parameters for pylithapp.problem.bc.x_pos

Resolution

```
[pylithapp.timedependent.bc.x_pos]
```
Step01: Error 2
Error found in parsing .cfg file

$ pylith step01.cfg

.cfg file with line number

>> step01.cfg:100:

Error message

−− pyre.inventory(error)
−− pylithapp.timedependent.implicit.output.outputsoIn.write.filename ← 'output/step01.vtk'
−− unknown component
'pylithapp.timedependent.implicit.output.outputsoIn.write'

Usage information

usage: pylith [−−<property>=<value>] [−−<facility>,<property>=<value>] [FILE.cfg] ...
component 'pylithapp'
  properties: help, help−components, help−persistence, help−properties, initialize_only, job,
  facilities: job, launcher, mesh_generator, perf_logger, petsc, problem, scheduler, weaver
For more information:
  −−help−properties: prints details about user settable properties
  −−help−components: prints details about user settable facilities and components
pylithapp: configuration error(s)
Step01: Error 2 Resolution
Error found in parsing .cfg file

Error message

| — pyre.inventory(error) |
| — pylithapp.timedependent.implicit.output.outputsoIn.write.filename ← 'output/step01.vtk' |
| — unknown component |
| 'pylithapp.timedependent.implicit.output.outputsoIn.write' |
Step01: Error 2 Resolution
Error found in parsing .cfg file

Error message

<table>
<thead>
<tr>
<th>pyre.inventory(error)</th>
</tr>
</thead>
<tbody>
<tr>
<td>pylithapp.timedependent.implicit.output.outputsoln.write.filename '&lt;output/step01.vtk'</td>
</tr>
<tr>
<td>unknown component</td>
</tr>
<tr>
<td>'pylithapp.timedependent.implicit.output.outputsoln.write'</td>
</tr>
</tbody>
</table>

Debug: Look up the properties of the OutputSoln object
Error message

— pyre.inventory(error)
— pylithapp.timedependent.implicit.output.outputsoIn.write.filename ← 'output/step01.vtk'
— unknown component
'pylithapp.timedependent.implicit.output.outputsoIn.write'

Debug: Look up the properties of the OutputSoln object

Resolution

[pylithapp.problem.formulation.output.domain]
writer.filename = output/step01.vtk
Step01: Error 3
Error found when initializing integrators

$ pylith step01.cfg

Error message

terminate called after throwing an instance of 'std::runtime_error'
  what():  Error occurred while reading spatial database file 'mat_elastic.spatialdb'. I/O error while reading SimpleDB data.

Abort message

[0]0: Return code = 0, signaled with Abort trap: 6
Error message

terminate called after throwing an instance of 'std::runtime_error'
  what(): Error occurred while reading spatial database file 'mat_elastic.spatialdb'.
I/O error while reading SimpleDB data.
Step01: Error 3 Resolution
Error found when initializing integrators

Error message

```
terminate called after throwing an instance of 'std::runtime_error'
  what(): Error occurred while reading spatial database file 'mat_elastic.spatialdb'.
I/O error while reading SimpleDB data.
```

Debug: Look at mat_elastic.spatialdb for errors in data
Error message

terminate called after throwing an instance of 'std::runtime_error'
    what(): Error occurred while reading spatial database file 'mat_elastic.spatialdb'.
I/O error while reading SimpleDB data.

Debug: Look at mat_elastic.spatialdb for errors in data
Resolution

num_locs = 1 // number of locations
$ pylith step01.cfg

Error message

terminate called after throwing an instance of 'std::runtime_error'

  what(): Error occurred while reading spatial database file 'mat_elastic.spatialdb'.
  Number of dimensions in coordinates of spatial distribution (2) does not match number of dimensions

Abort message

[0]0: Return code = 0, signaled with Abort trap: 6
Step01: Error 4 Resolution
Error found when initializing integrators

Error message

terminate called after throwing an instance of 'std::runtime_error'
  what():  Error occurred while reading spatial database file 'mat_elastic.spatialdb'.
Number of dimensions in coordinates of spatial distribution (2) does not match number of dimensions
Step01: Error 4 Resolution
Error found when initializing integrators

Error message

```
terminate called after throwing an instance of 'std::runtime_error'
  what(): Error occurred while reading spatial database file 'mat_elastic.spatialdb'.
Number of dimensions in coordinates of spatial distribution (2) does not match number of dimensions
```

Debug: Look at coordinate system in `mat_elastic.spatialdb` header
Step01: Error 4 Resolution
Error found when initializing integrators

Error message

terminate called after throwing an instance of 'std::runtime_error'
    what(): Error occurred while reading spatial database file 'mat_elastic.spatialdb'.
Number of dimensions in coordinates of spatial distribution (2) does not match number of dimensions.

Debug: Look at coordinate system in mat_elastic.spatialdb header

Resolution
space—dim = 3
Step01: Error 5
Error found when setting up solution field

$ pylith step01.cfg

Python stacktrace

Fatal error: Calling MPI.Abort() to abort PyLith application.
Traceback (most recent call last):
  File "/Volumes/Tools/unix/pylith-dev/gcc-4.7.3/lib/python2.7/site-packages/pylith/apps/PetscApplication.py", line 64, in onComputeNodes
    self.main(*args, **kwds)
  File "/Volumes/Tools/unix/pylith-dev/gcc-4.7.3/lib/python2.7/site-packages/pylith/apps/PyLithApp.py", line 125, in main
    self.problem.initialize()
  File "/Volumes/Tools/unix/pylith-dev/gcc-4.7.3/lib/python2.7/site-packages/pylith/problems/TimeDependent.py", line 119, in initialize
    self.formulation.initialize(self.dimension, self.normalizer)
  File "/Volumes/Tools/unix/pylith-dev/gcc-4.7.3/lib/python2.7/site-packages/pylith/problems/Implicit.py", line 122, in initialize
    self.initialize(dimension, normalizer)
  File "/Volumes/Tools/unix/pylith-dev/gcc-4.7.3/lib/python2.7/site-packages/pylith/bc/bc.py", line 218, in setConstraintSizes
    def setConstraintSizes(self, *args):
        return _bc.DirichletBC_setConstraintSizes(self, *args)

Error message

RuntimeError: Found overly constrained point while setting up constraints for DirichletBC boundary condition 'face_zneg'. Number of DOF at point 503 is 3 and number of attempted constraints is 4.

Abort information

application called MPI.Abort(MPI.COMM_WORLD, -1) — process 0
/Volumes/Tools/unix/cig/gcc-4.7.3/bin/nemesis: mpirun: exit 255
Step01: Error 5 Resolution
Error found when setting up solution field

Error message

```
RuntimeError: Found overly constrained point while setting up constraints for DirichletBC boundary condition 'face_zneg'. Number of DOF at point 503 is 3 and number of attempted constraints is 4.
```
Step01: Error 5 Resolution
Error found when setting up solution field

Error message

```
RuntimeError: Found overly constrained point while setting up constraints for DirichletBC boundary condition 'face_zneg'. Number of DOF at point 503 is 3 and number of attempted constraints is 4.
```

Debug: Look at overlap of constraints in Dirichlet BC
Step01: Error 5 Resolution
Error found when setting up solution field

Error message

```
RuntimeError: Found overly constrained point while setting up constraints for DirichletBC boundary condition 'face_zneg'. Number of DOF at point 503 is 3 and number of attempted constraints is 4.
```

Debug: Look at overlap of constraints in Dirichlet BC Resolution

```python
[pylithapp.timedependent.bc.y_pos]
bc_dof = [0]
...
[pylithapp.timedependent.bc.y_neg]
bc_dof = [0]
```
Step02: Error 1
Error found in parsing .cfg file

$ pylith step02.cfg

Configuration error

>>> step02.cfg:30:
   — pyre.inventory(error)
   — timedependent.nondimensionalquasistatic.relaxation_time < '2.0*years'
   — name 'years' is not defined
pylithapp: configuration error(s)
Step02: Error 1 Resolution
Error found in parsing .cfg file

Error message

```
>>> step02.cfg:30:
   — pyre.inventory(error)
   — timedependent.nondimelasticquasistatic.relaxation_time ← '2.0*years'
   — name 'years' is not defined
pylithapp: configuration error(s)
```
Step02: Error 1 Resolution

Error found in parsing .cfg file

Error message

```python
>>> step02.cfg:30:
     −− pyre.inventory(error)
     −− timedependent.nondimelasticquasistatic.relaxation_time ← '2.0*years'
     −− name 'years' is not defined
pylithapp: configuration error(s)
```

Debug: Pyre is poorly documented. Look for example. :(

Error Messages
Step02: Error 1 Resolution
Error found in parsing .cfg file

Error message

```
>>> step02.cfg:30:
    — pyre.inventory(error)
    — timedependent.nondimelasticquasistatic.relaxation_time <- '2.0*years'
    — name 'years' is not defined
pylithapp: configuration error(s)
```

Debug: Pyre is poorly documented. Look for example. :(

```
$ python

>>> from pyre.units.time import *

>>> dir()

['__builtins__', '__doc__', '__name__', '__package__', 'day', 'hour', 'micro', 'microsecond', 'milli', 'millisecond', 'minute', 'ms', 'nano', 'nanosecond', 'ns', 'pico', 'picosecond', 'ps', 's', 'second', 'us', 'year']
```

Resolution

```
relaxation_time = 2.0*year
```
$ pylith step02.cfg

Python stacktrace

Fatal error. Calling MPI_Abort() to abort PyLith application.
Traceback (most recent call last):
  File "/Volumes/Tools/unix/pylith-dev/gcc-4.7.3/lib/python2.7/site-packages/pylith/apps/PetscApplication
      self.main(*args, **kwds)
  File "/Volumes/Tools/unix/pylith-dev/gcc-4.7.3/lib/python2.7/site-packages/pylith/apps/PyLithApp
      self.problem.verifyConfiguration()
  File "/Volumes/Tools/unix/pylith-dev/gcc-4.7.3/lib/python2.7/site-packages/pylith/problems/TimeDependent
      self.formulation.verifyConfiguration()
  File "/Volumes/Tools/unix/pylith-dev/gcc-4.7.3/lib/python2.7/site-packages/pylith/problems/Formulation
      integrator.verifyConfiguration()
  File "/Volumes/Tools/unix/pylith-dev/gcc-4.7.3/lib/python2.7/site-packages/pylith/faults/FaultCohesiveKin
      ModuleFaultCohesiveKin.verifyConfiguration(self, self.mesh())
  File "/Volumes/Tools/unix/pylith-dev/gcc-4.7.3/lib/python2.7/site-packages/pylith/faults/faults.py
      def verifyConfiguration(self, *args): return
      _faults.FaultCohesiveLagrange_verifyConfiguration(self, *args)

Error message

RuntimeError: Number of dofs in reference cell (3) is not compatible with number of edges (4) in cohesive cell 256 for fault 'fault_ext'.

Abort info

application called MPI_Abort(MPI_COMM_WORLD, -1) — process 0
/Volumes/Tools/unix/cig/gcc-4.7.3/bin/nemesis: mpirun: exit 255

Error message

```
RuntimeError: Number of dofs in reference cell (3) is not compatible with number of edges (4) in cohesive cell 256 for fault 'fault_ext'.
```
Step02: Error 2 Resolution
Error doing some basic validation of input

Error message

```
RuntimeError: Number of dofs in reference cell (3) is not compatible with number of edges (4) in cohesive cell 256 for fault 'fault_ext'.
```

Debug: Turn on journal for quadrature

```
$ pylith step02.cfg --problem.interfaces.fault.quadrature.help-components
```

Facilities of 'quadrature':
```
cell=<component name>: Reference cell with basis fns and quadrature rules.
    current value: 'fiatsimplex', from {default}
    configurable as: fiatsimplex, cell
```
Error message

RuntimeError: Number of dofs in reference cell (3) is not compatible with number of edges (4) in cohesive cell 256 for fault 'fault_ext'.

Debug: Turn on journal for quadrature

$ pylith step02.cfg --problem.interfaces.fault.quadrature.help-components

facilities of 'quadrature':
    cell=<<component name>>: Reference cell with basis fns and quadrature rules.
    current value: 'fiatsimplex', from {default}
    configurable as: fiatsimplex, cell

[pylithapp.journal.info]
fiatlagrange = 1
fiatsimplex = 1

Resolution

[pylithapp.timedependent.interfaces.fault]
quadrature.cell = pylith.feassemble.FIATLagrange
$ pylith step02.cfg

Python stacktrace

Fatal error. Calling MPI_Abort() to abort PyLith application.
Traceback (most recent call last):
  File "/Volumes/Tools/unix/pylith-dev/gcc-4.7.3/lib/python2.7/site-packages/pylith/apps/PetscApplication.py", line 64, in onComputeNodes
    self.main(*args, **kwds)
  File "/Volumes/Tools/unix/pylith-dev/gcc-4.7.3/lib/python2.7/site-packages/pylith/apps/PyLithApp.py", line 125, in main
    self.problem.initialize()
  File "/Volumes/Tools/unix/pylith-dev/gcc-4.7.3/lib/python2.7/site-packages/pylith/problems/TimeDependent.py", line 119, in initialize
    self.formulation.initialize(self.dimension, self.normalizer)
  File "/Volumes/Tools/unix/pylith-dev/gcc-4.7.3/lib/python2.7/site-packages/pylith/problems/Implicit.py", line 122, in initialize
    self._initialize(dimensions, normalizer)
  File "/Volumes/Tools/unix/pylith-dev/gcc-4.7.3/lib/python2.7/site-packages/pylith/problems/Formulation.py", line 470, in initialize
    integrator.initialize(totalTime, numTimeSteps, normalizer)
  File "/Volumes/Tools/unix/pylith-dev/gcc-4.7.3/lib/python2.7/site-packages/pylith/feassemble/ElasticityImplicit.py", line 56, in initialize
    ModuleElasticityImplicit.initialize(self, self.mesh())

Error message

RuntimeError: Determinant of Jacobian (1.25e-07) for cell 0 is smaller than minimum permissible value (1e-06)! The two most likely causes of this are highly distorted cells and nondimensionalization with a length scale that is much larger than the dimensions of the cells.

Abort info

a p p l i c a t i o n c a l l e d MPI
Abort (MPI COMM WORLD, -1) – process 0

/Volumes/Tools/unix/cig/gcc-4.7.3/bin/nemesis: exit 255
/Volumes/Tools/unix/pylith-dev/gcc-4.7.3/bin/pylith:
  /Volumes/Tools/unix/cig/gcc-4.7.3/bin/nemesis: exit 1

Error Messages
Step02: Error 3 Resolution

Error found when initializing integrators

Error message

RuntimeError: Determinant of Jacobian (1.25e−07) for cell 0 is smaller than minimum permissible value (1e−06)! The two most likely causes of this are highly distorted cells and nondimensionalization with a length scale that is much larger than the dimensions of the cells.
Step02: Error 3 Resolution
Error found when initializing integrators

Error message

```
RuntimeError: Determinant of Jacobian (1.25e−07) for cell 0 is smaller than minimum permissible value (1e−06)! The two most likely causes of this are highly distorted cells and nondimensionalization with a length scale that is much larger than the dimensions of the cells.
```

Debug: Look at nondimensional scales relative to the parameters

```
$ pylith step02.cfg --problem.normalizer.help-properties

properties of 'nondimensionalquasistatic':
length_scale=<dimensional>: Value to nondimensionalize length scale.
  default value: 1000*m
  current value: 1e+06*m, from { file = 'step02.cfg', line = 28, column = -1 }
  validator: ( greater than 0*m )
relaxation_time=<dimensional>: Relaxation time to nondimensionalize time.
  default value: 3.15576e+07*s
  current value: 6.31152e+07*s, from { file = 'step02.cfg', line = 30, column = -1 }
  validator: ( greater than 0*s )
shear_modulus=<dimensional>: Shear modulus to nondimensionalize pressure.
  default value: 3e+10*m**−1*kg*s**−2
  current value: 3e+10*m**−1*kg*s**−2, from { file = 'step02.cfg', line = 29, column = -1 }
  validator: ( greater than 0*m**−1*kg*s**−2 )
```
Step02: Error 3 Resolution

Error found when initializing integrators

Error message

RuntimeError: Determinant of Jacobian (1.25e−07) for cell 0 is smaller than minimum permissible value (1e−06)! The two most likely causes of this are highly distorted cells and nondimensionalization with a length scale that is much larger than the dimensions of the cells.

Debug: Look at nondimensional scales relative to the parameters

$ pylith step02.cfg --problem.normalizer.help-properties

properties of 'nondimensionalquasistatic':
  length_scale=<dimensional>: Value to nondimensionalize length scale.
    default value: 1000*m
    current value: 1e+06*m, from {file='step02.cfg', line=28, column=-1}
    validator: (greater than 0*m)
  relaxation_time=<dimensional>: Relaxation time to nondimensionalize time.
    default value: 3.15576e+07*s
    current value: 6.31152e+07*s, from {file='step02.cfg', line=30, column=-1}
    validator: (greater than 0*s)
  shear_modulus=<dimensional>: Shear modulus to nondimensionalize pressure.
    default value: 3e+10*m**−1*kg*s**−2
    current value: 3e+10*m**−1*kg*s**−2, from {file='step02.cfg', line=29, column=-1}
    validator: (greater than 0*m**−1*kg*s**−2)

Resolution

[pylithapp.problem.normalizer]
length_scale = 1.0*km
Step02: Error 4
Error found when initializing fault

$ pylith step02.cfg

Error message

terminate called after throwing an instance of 'std::runtime_error'
what(): Could not find value left-lateral-slip in spatial database
Final slip. Available values are:
lateral-slip
reverse-slip
fault-opening

Abort message

[0]0:Return code = 0, signaled with Abort trap: 6
Step01: Error 4 Resolution

Error found when initializing fault

Error message

terminate called after throwing an instance of 'std::runtime_error'
  what():  Could not find value left-lateral-slip in spatial database

Final slip. Available values are:
  lateral-slip
  reverse-slip
  fault-opening
Step01: Error 4 Resolution

Error found when initializing fault

Error message

terminate called after throwing an instance of 'std::runtime_error'
what(): Could not find value left-lateral-slip in spatial database
Final slip. Available values are:
  lateral-slip
  reverse-slip
  fault-opening

Resolution

slip.values = [left-lateral-slip, reverse-slip, fault-opening]
Step02: Error 5
Error found when setting up solution field

$ pylith step02.cfg

Python stacktrace

Fatal error. Calling MPI_Abort() to abort PyLith application.
Traceback (most recent call last):
  File "/Volumes/Tools/unix/pylith-dev/gcc-4.7.3/lib/python2.7/site-packages/pylith/apps/PetscApplication.py", line 64, in onComputeNodes
    self.main(*args, **kwds)
  File "/Volumes/Tools/unix/pylith-dev/gcc-4.7.3/lib/python2.7/site-packages/pylith/apps/PyLithApp.py", line 125, in main
    self.problem.initialize()
  File "/Volumes/Tools/unix/pylith-dev/gcc-4.7.3/lib/python2.7/site-packages/pylith/problems/TimeDependent.py", line 119, in initialize
    self.formulation.initialize(self.dimension, self.normalizer)
  File "/Volumes/Tools/unix/pylith-dev/gcc-4.7.3/lib/python2.7/site-packages/pylith/problems/Implicit.py", line 122, in initialize
    self._initialize(dimension, normalizer)
  File "/Volumes/Tools/unix/pylith-dev/gcc-4.7.3/lib/python2.7/site-packages/pylith/problems/Formulation.py", line 522, in _initialize
    integrator.checkConstraints(solution)
  File "/Volumes/Tools/unix/pylith-dev/gcc-4.7.3/lib/python2.7/site-packages/pylith/faults/faults.py", line 366, in checkConstraints
    def checkConstraints(self, *args):
      return faults.FaultCohesiveLagrange.checkConstraints(self, *args)

Error message

RuntimeError: Vertex with label '396' on negative side of fault 'fault_ext' is constrained.
Fault vertices cannot be constrained.

Abort info

application called MPI_Abort(MPI_COMM_WORLD, -1) — process 0
/Volumes/Tools/unix/cig/gcc-4.7.3/bin/nemesis: mpirun: exit 255
/Volumes/Tools/unix/pylith-dev/gcc-4.7.3/bin/pylith: /Volumes/Tools/unix/cig/gcc-4.7.3/bin/nemesis
Error message

```
RuntimeError: Vertex with label '396' on negative side of fault 'fault_ext' is constrained. Fault vertices cannot be constrained.
```
Step02: Error 5 Resolution
Error found when setting up solution field

Error message

```
RuntimeError: Vertex with label '396' on negative side of fault 'fault_ext' is constrained. Fault vertices cannot be constrained.
```

Debug: Oops. Didn’t mean to use through-going fault!
Step02: Error 5 Resolution
Error found when setting up solution field

Error message

RuntimeError: Vertex with label '396' on negative side of fault 'fault_ext' is constrained. Fault vertices cannot be constrained.

Debug: Oops. Didn’t mean to use through-going fault!
Resolution

[pylithapp.timedependent.interfaces.fault]
label = fault
$ pylith step02.cfg

Python stacktrace

Fatal error. Calling MPI_Abort() to abort PyLith application.
Traceback (most recent call last):
  File "/Volumes/Tools/unix/pylith-dev/gcc-4.7.3/lib/python2.7/site-packages/pylith/apps/PetscApplication.py", line 64, in onComputeNodes
    self.main(*args, **kwds)
  File "/Volumes/Tools/unix/pylith-dev/gcc-4.7.3/lib/python2.7/site-packages/pylith/apps/PyLithApp.py", line 125, in main
    self.problem.initialize()
  File "/Volumes/Tools/unix/pylith-dev/gcc-4.7.3/lib/python2.7/site-packages/pylith/problems/TimeDependent.py", line 119, in initialize
    self.formulation.initialize(self.dimension, self.normalizer)
  File "/Volumes/Tools/unix/pylith-dev/gcc-4.7.3/lib/python2.7/site-packages/pylith/problems/Implicit.py", line 122, in initialize
    self._initialize(dimension, normalizer)
  File "/Volumes/Tools/unix/pylith-dev/gcc-4.7.3/lib/python2.7/site-packages/pylith/problems/Formulation.py", line 470, in initialize
    integrator.initialize(totalTime, numTimeSteps, normalizer)
  File "/Volumes/Tools/unix/pylith-dev/gcc-4.7.3/lib/python2.7/site-packages/pylith/problems/faults/FaultCohesive.py", line 166, in initialize
    FaultCohesive.initialize(self, totalTime, numTimeSteps, normalizer)
  File "/Volumes/Tools/unix/pylith-dev/gcc-4.7.3/lib/python2.7/site-packages/pylith/problems/faults/faults.py", line 321, in initialize

Error message

RuntimeError: Error computing orientation of cell face.
Up direction (0, 0, 1) cannot be parallel to the face normal (0, 0, 1).
If the face is horizontal, adjust the up_dir parameter.

Abort info
Error message

RuntimeError: Error computing orientation of cell face.
Up direction (0, 0, 1) cannot be parallel to the face normal (0, 0, 1).
If the face is horizontal, adjust the up_dir parameter.
Step02: Error 6 Resolution
Error found when initializing fault

Error message

```
RuntimeError: Error computing orientation of cell face.
Up direction (0, 0, 1) cannot be parallel to the face normal (0, 0, 1).
If the face is horizontal, adjust the up_dir parameter.
```

Debug: Change up-dir

```
up_dir = [1, 0, 1]
```
Step02: Error 6 Resolution
Error found when initializing fault

Error message

```
RuntimeError: Error computing orientation of cell face.
Up direction (0, 0, 1) cannot be parallel to the face normal (0, 0, 1).
If the face is horizontal, adjust the up_dir parameter.
```

Debug: Change up-dir

```
up_dir = [1, 0, 1]
```

Debug: Look at fault surface
Step02: Error 6 Resolution
Error found when initializing fault

Error message

```
RuntimeError: Error computing orientation of cell face.
Up direction (0, 0, 1) cannot be parallel to the face normal (0, 0, 1).
If the face is horizontal, adjust the up_dir parameter.
```

Debug: Change up-dir
```
up_dir = [1,0,1]
```

Debug: Look at fault surface

Resolution: Mark buried edges
```
[pylithapp.timedependentinterfaces.fault]
label = fault
edge = fault.edge
up_dir = [0,0,1]
```
Insertion of Cohesive Cells

(a) Original mesh

(b) Add colocated vertices

Original fault vertex

Add Lagrange multiplier edge

Add vertex on positive side

(c) Update cells with fault faces

Cell on negative side

Cell on positive side

(d) Classify cells and update remaining cells

Error Messages

Fault Edges
Forgetting to Mark Buried Edges

PyLith will extend the fault one cell in an arbitrary fashion

Purple region shows intended fault surface.
Step03: Error 1
Error doing basic validation on parameters

$ pylith step02.cfg

Python stacktrace

Fatal error. Calling MPI_Abort() to abort PyLith application.
Traceback (most recent call last):
  File "/Volumes/Tools/unix/pylith-dev/gcc−4.7.3/lib/python2.7/site−packages/pylith/apps/PetscApplication.py", line 64, in onComputeNodes
    self.main(*args, **kwds)

File "/Volumes/Tools/unix/pylith−dev/gcc−4.7.3/lib/python2.7/site−packages/pylith/faults/FaultCohesive.verifyConfiguration(self)
File "/Volumes/Tools/unix/pylith−dev/gcc−4.7.3/lib/python2.7/site−packages/pylith/faults/FaultCohesive.verifyConfiguration(self)
File "/Volumes/Tools/unix/pylith−dev/gcc−4.7.3/lib/python2.7/site−packages/pylith/meshio/OutputManager.verifyConfiguration(self.mesh())
File "/Volumes/Tools/unix/pylith−dev/gcc−4.7.3/lib/python2.7/site−packages/pylith/meshio/OutputManager._verifyFields(self.dataProvider().availableFields)
raise ValueError(msg)

Error message

ValueError: Requested fields not available for output.
Data provider: 'faultcohesivedyn'
Field type: 'vertex'
Data type: 'data'
Available fields: 'slip' 'slip_rate' 'traction'
Fields not available: 'initial_traction'

Abort info

application called MPI_Abort(MPI_COMM_WORLD, −1) − process 0
Error Messages: mpirun: exit 255
Step03: Error 1 Resolution
Error doing basic validation on parameters

Error message

ValueError: Requested fields not available for output.
Data provider: 'faultcohesivedyn'
Field type: 'vertex'
Data type: 'data'
Available fields: 'slip' 'slip_rate' 'traction'
Fields not available: 'initial_traction'
Step03: Error 1 Resolution

Error doing basic validation on parameters

Error message

ValueError: Requested fields not available for output.
Data provider: 'faultcohesivedyn'
Field type: 'vertex'
Data type: 'data'
Available fields: 'slip' 'slip_rate' 'traction'
Fields not available: 'initial_traction'

Resolution

vertex_data_fields = [slip, slip_rate, traction]
Step03: Error 2
Error creating solution field

$ pylith step03.cfg

Python stacktrace

Fatal error. Calling MPI_Abort() to abort PyLith application.
Traceback (most recent call last):
  File "/Volumes/Tools/unix/pylith-dev/gcc-4.7.3/lib/python2.7/site-packages/pylith/apps/PetscApplication.py", line 64, in onComputeNodes
    self.main(*args, **kwds)
  File "/Volumes/Tools/unix/pylith-dev/gcc-4.7.3/lib/python2.7/site-packages/pylith/apps/PyLithApp.py", line 125, in main
    self.problem.initialize()
  File "/Volumes/Tools/unix/pylith-dev/gcc-4.7.3/lib/python2.7/site-packages/pylith/problems/TimeDependent.py", line 119, in initialize
    self.formulation.initialize(dimension, normalizer)
  File "/Volumes/Tools/unix/pylith-dev/gcc-4.7.3/lib/python2.7/site-packages/pylith/problems/Implicit.py", line 122, in initialize
    ...initialize(dimension, normalizer)
  File "/Volumes/Tools/unix/pylith-dev/gcc-4.7.3/lib/python2.7/site-packages/pylith/problems/Formulation.py", line 516, in initialize
    constraint.setConstraintSizes(solution)
  File "/Volumes/Tools/unix/pylith-dev/gcc-4.7.3/lib/python2.7/site-packages/pylith/bc/bc.py", line 218, in setConstraintSizes
    def setConstraintSizes(self, *args):
      bc.DirichletBC.setConstraintSizes(self, *args)

Error message

RuntimeError: Found overly constrained point while setting up constraints for DirichletBC boundary condition 'face_zneg'. Number of DOF at point 535 is 3 and number of attempted constraints is 4.

Abort info

application called MPI_Abort(MPI.COMM_WORLD, -1) -- process 0
/Volumes/Tools/unix/cig/gcc-4.7.3/bin/nemesis: mpirun: exit 255
/Volumes/Tools/unix/pylith-dev/gcc-4.7.3/bin/pylith: exit 1
Error message

RuntimeError: Found overly constrained point while setting up constraints for DirichletBC boundary condition 'face_zneg'. Number of DOF at point 535 is 3 and number of attempted constraints is 4.
Step03: Error 2 Resolution

Error creating solution field

Error message

```
RuntimeError: Found overly constrained point while setting up constraints for DirichletBC boundary condition 'face_zneg'. Number of DOF at point 535 is 3 and number of attempted constraints is 4.
```

Debug: Look for overlap of constraints in Dirichlet BC
Step03: Error 2 Resolution

Error creating solution field

Error message

```
RuntimeError: Found overly constrained point while setting up constraints for DirichletBC boundary condition 'face_zneg'. Number of DOF at point 535 is 3 and number of attempted constraints is 4.
```

Debug: Look for overlap of constraints in Dirichlet BC

Resolution

```
[pylithapp.timedependent.bc.x_pos]
bc_dof = [0, 1]
...
[pylithapp.timedependent.bc.x_neg]
bc_dof = [0, 1]
```
Step03: Error 3
Error creating solution field

$ pylith step03.cfg

Python stacktrace

Fatal error. Calling MPI_Abort() to abort PyLith application.
Traceback (most recent call last):
  File "/Volumes/Tools/unix/pylith-dev/gcc-4.7.3/lib/python2.7/site-packages/pylith/apps/PetscApplication.py", line 64, in onComputeNodes
    self.main(*args, **kwds)
  File "/Volumes/Tools/unix/pylith-dev/gcc-4.7.3/lib/python2.7/site-packages/pylith/apps/PyLithApp.py", line 125, in main
    self.problem.initialize()
  File "/Volumes/Tools/unix/pylith-dev/gcc-4.7.3/lib/python2.7/site-packages/pylith/problems/TimeDependent.py", line 119, in initialize
    self.formulation.initialize(self.dimension, self.normalizer)
  File "/Volumes/Tools/unix/pylith-dev/gcc-4.7.3/lib/python2.7/site-packages/pylith/problems/Implicit.py", line 122, in initialize
    self._initialize(dimension, normalizer)
  File "/Volumes/Tools/unix/pylith-dev/gcc-4.7.3/lib/python2.7/site-packages/pylith/problems/Formulation.py", line 522, in initialize
    integrator.checkConstraints(solution)
  File "/Volumes/Tools/unix/pylith-dev/gcc-4.7.3/lib/python2.7/site-packages/pylith/problems/Faults.py", line 366, in checkConstraints
    def checkConstraints(self, *args):
      return _faults.FaultCohesiveLagrange.checkConstraints(solution)

Error message

RuntimeError: Vertex with label '605' on negative side of fault 'fault_ext' is constrained. Fault vertices cannot be constrained.

Abort info

application called MPI_Abort(MPI_COMM_WORLD, -1) — process 0
/Volumes/Tools/unix/cig/gcc-4.7.3/bin/nemesis: mpirun: exit 255
/Volumes/Tools/unix/pylith-dev/gcc-4.7.3/bin/pylith:
/Volumes/Tools/unix/cig/gcc-4.7.3/bin/nemesis: exit 1
Step03: Error 3 Resolution
Error creating solution field

Error message

```
RuntimeError: Vertex with label '605' on negative side of fault 'fault_ext' is constrained. Fault vertices cannot be constrained.
```
Error message

```
RuntimeError: Vertex with label '605' on negative side of fault 'fault_ext' is constrained. Fault vertices cannot be constrained.
```

Debug: Look for overlap in fault and BC nodesets
Step03: Error 3 Resolution

Error creating solution field

Error message

```
RuntimeError: Vertex with label '605' on negative side of fault 'fault_ext' is constrained. Fault vertices cannot be constrained.
```

Debug: Look for overlap in fault and BC nodesets

Resolution

```python
[pyleithapp.timedependent.bc.z_neg]
...
lable = face_zneg_nofault
```
Step03: Error 4
No error but funky results
Step03: Error 4 Resolution

No error but funky results

Debug: Did the solver converge?
Step03: Error 4 Resolution
No error but funky results

Debug: Did the solver converge?
Resolution

[pylithapp.petsc]
ksp_monitor = true
ksp.converged_reason = true
ksp.error_if_not_converged = true

snes.converged_reason = true
snes.error_if_not_converged = true
snes.monitor = true
Step03: Error 5
Nonlinear solver diverges

PETSc error message

```plaintext
[0]PETSC ERROR: __________________________ Error Message __________________________
[0]PETSC ERROR: SNES Solve has not converged
[0]PETSC ERROR: Petsc Development GIT revision: v3.4.4—g852d360  GIT Date: 2014-05-19 15:04:32

...PETSC ERROR: #1 SNES Solve() line 3765 in /Volumes/Tools/unix/petsc-dev/src/snes/interface/snes.c
[0]PETSC ERROR: #2 SNES Log Convergence History() line 150 in /Users/baagaard/src/cig/pylith/libsrc/problems/SolverNonlinear.cc
```

Debugging

Examine KSP and SNES residuals

Fatal error. Calling MPI_Abort() to abort PyLith application.
Traceback (most recent call last):
  File "/Volumes/Tools/unix/pylith-dev/gcc-4.7.3/lib/python2.7/site-packages/pylith/apps/PetscApplication.py", line 64, in onComputeNodes
    self.main(*args, **kwds)
  File "/Volumes/Tools/unix/pylith-dev/gcc-4.7.3/lib/python2.7/site-packages/pylith/apps/PyLithApp.py", line 135, in main
    self.problem.run(self)
  File "/Volumes/Tools/unix/pylith-dev/gcc-4.7.3/lib/python2.7/site-packages/pylith/problems/TimeDependent.py", line 154, in run
    self.formulation.step(t, dt)
    self.solver.solve(dispIncr, self.jacobian, residual)
  File "/Volumes/Tools/unix/pylith-dev/gcc-4.7.3/lib/python2.7/site-packages/pylith/problems/problems.py", line 179, in solve
    def solve(self, *args):
      return problems.SolverNonlinear_solve(self, *args)
```

Abort info

RuntimeError: Error detected while in PETSc function.
   application called MPI_Abort(MPI_COMM_WORLD, -1) – process 0
   mpiexec: mpirun: exit 255
   mpiexec: /Volumes/Tools/unix/cig/gcc-4.7.3/bin/nemesis: exit 1

Error Messages
Step03: Error 5 Resolution
Nonlinear solver diverges

PETSc error message

0]PETSC ERROR: ---------------- Error Message ----------------
0]PETSC ERROR: SNESsolve has not converged
0]PETSC ERROR: Petsc Development GIT revision: v3.4.4-4559-g852d360 GIT Date: 2014-05-19 15:04:32
.
0]PETSC ERROR: #1 SNESsolve() line 3765 in /Volumes/Tools/unix/petsc-dev/src/snes/interface/snes.c
0]PETSC ERROR: #2 SNESLogConvergenceHistory() line 150 in /Users/baagaard/src/cig/pylith/libsrc
Step03: Error 5 Resolution
Nonlinear solver diverges

PETSc error message

[0]PETSC ERROR: --------------- Error Message -------------------------------
[0]PETSC ERROR: SNESolve has not converged
[0]PETSC ERROR: Petsc Development GIT revision: v3.4.4–4559–g852d360  GIT Date: 2014–05–19 15:04:32.0500...
[0]PETSC ERROR: #1 SNESolve() line 3765 in /Volumes/Tools/unix/petsc-dev/src/snes/interface/snes.c
[0]PETSC ERROR: #2 SNESLogConvergenceHistory() line 150 in /Users/baagaard/src/cig/pylith/libsrc

Debug: Examine KSP and SNES residuals using log file

$ pylith step03.cfg >& step03.log

$ grep "norm" step03.log
Step03: Error 5 Resolution
Nonlinear solver diverges

PETSc error message

[0]PETSC ERROR: ------------------------------- Error Message -------------------------------
[0]PETSC ERROR: SNESolve has not converged
[0]PETSC ERROR: Petsc Development GIT revision: v3.4.4-4559-g852d360 GIT Date: 2014–05–19 15:04:32

...[0]PETSC ERROR: #1 SNESolve() line 3765 in /Volumes/Tools/unix/petsc-dev/src/snes/interface/snes.c
[0]PETSC ERROR: #2 SNESLogConvergenceHistory() line 150 in /Users/baagaard/src/cig/pylith/libsrep

Debug: Examine KSP and SNES residuals using log file

$ pylith step03.cfg &gt;&amp; step03.log

$ grep "norm" step03.log

Resolution

[pylithapp.timedependent.interfaces.fault]
zero_tolerance = 1.0e-10

[pylithapp.petsc]
ksp_rtol = 1.0e-20
ksp_atol = 1.0e-12
snes_rtol = 1.0e-20
snes_atol = 1.0e-8
Step03: Error 6
Intended shear to drive fault slip

Debug: Check fault tractions
Step03: Error 6
Intended shear to drive fault slip

Debug: Check fault tractions
Compare $T_{\text{shear}} / T_{\text{normal}}$ against $\mu_f$
Step03: Error 6
Intended shear to drive fault slip

Debug: Check fault tractions
Compare $T_{\text{shear}} / T_{\text{normal}}$ against $\mu_f$

Resolution

```python
[pylithapp.timedependent.bc.x_pos]
...
db_initial.data = [−1.0*m,3.0*m,0.0*m]

[pylithapp.timedependent.bc.x_neg]
...
db_initial.data = [1.0*m,−3.0*m,0.0*m]
```
Try to debug on your own first

Describe what you are trying to do
  - Overview of problem, BC
  - 2-D or 3-D
  - Cell type (tri, quad, hex, tet)
  - Prescribed slip or spontaneous rupture

Specify which version you are using AND your operating system (PyLith v2.0.1 binary on Linux)

Send the **entire** error message, not just what you think is important (entire log of output is best)