

Sample Input Files

TecML File

```
<tecml>
<!--          FTCS_Diffusion_2D.tecml: forward-time center-space FDM scheme  -->
<!--          Single-step Replacement Scheme 2D array                      -->
<!--          Last edit:    20140108                                       -->
<!--          Variables: v = differential variables, y = arithmetic variables,-->
<!--          z = constants, c = distributed parameters                      -->

<variable name="v" type="recurvar" />
<variable name="y" type="arithvar" />
<variable name="z" type="constvar" />
<variable name="c" type="constvar" />

<variable name="t" type="timevar"/>
<variable name="x1" type="spatialvar"/>
<variable name="x2" type="spatialvar"/>

<variable name="deltat" type="constvar" />
<variable name="deltax1" type="constvar" />
<variable name="deltax2" type="constvar" />

<variable name="n" type="stepvar" />
<variable name="i" type="stepvar" />
<variable name="j" type="stepvar" />
<!--          <variable name="k" type="stepvar" />  -->

<math xmlns="http://www.w3.org/1998/Math/MathML">

  <apply><eq/>
    <ci> t </ci>
    <apply><selector/>
      <ci> t </ci>
      <ci> n </ci>
    </apply>
  </apply>

  <apply><eq/>
    <ci> v </ci>
    <apply><selector/>
      <ci> v </ci>
      <ci> n </ci>
      <ci> i </ci>
      <ci> j </ci>
    </apply>
  </apply>
</math>
```

```

        </apply>
</apply>

<apply><eq/>
    <ci> y </ci>
    <apply><selector/>
        <ci> y </ci>
        <ci> n </ci>
        <ci> i </ci>
        <ci> j </ci>
    </apply>
</apply>

<apply type="parameter-cond" parameter-id="0"><eq/>
    <ci> c </ci>
    <apply><selector/>
        <ci> c </ci>
        <ci> n </ci>
        <ci> i </ci>
        <ci> j </ci>
    </apply>
</apply>

<!-- Neumann boundary conditions at time n -->

<apply type="boundary-cond" boundary-id="1" location="left"><eq/>
    <apply><partialdiff/>
        <bvar><ci> x1 </ci></bvar>
        <ci> v </ci>
    </apply>
    <apply><minus/>
        <apply><selector/>
            <ci> v </ci>
            <ci> n </ci>
            <ci> i </ci>
            <ci> j </ci>
        </apply>
        <apply><selector/>
            <ci> v </ci>
            <ci> n </ci>
            <apply><plus/>
                <ci> i </ci>
                <cn> 1 </cn>
            </apply>
            <ci> j </ci>
        </apply>
    </apply>
</apply>

```

```

    </apply>
</apply>

<apply type="boundary-cond" boundary-id="2" location="right"><eq/>
  <apply><partialdiff/>
    <bvar><ci> x1 </ci></bvar>
    <ci> v </ci>
  </apply>
  <apply><minus/>
    <apply><selector/>
      <ci> v </ci>
      <ci> n </ci>
      <ci> i </ci>
      <ci> j </ci>
    </apply>
    <apply><selector/>
      <ci> v </ci>
      <ci> n </ci>
      <apply><minus/>
        <ci> i </ci>
        <cn> 1 </cn>
      </apply>
      <ci> j </ci>
    </apply>
  </apply>
</apply>

</apply>

<apply type="boundary-cond" boundary-id="4" location="top"><eq/>
  <apply><partialdiff/>
    <bvar><ci> x2 </ci></bvar>
    <ci> v </ci>
  </apply>
  <apply><minus/>
    <apply><selector/>
      <ci> v </ci>
      <ci> n </ci>
      <ci> i </ci>
      <ci> j </ci>
    </apply>
    <apply><selector/>
      <ci> v </ci>
      <ci> n </ci>
      <ci> i </ci>
      <apply><plus/>
        <ci> j </ci>
        <cn> 1 </cn>
      </apply>
    </apply>
  </apply>
</apply>

```

```

        </apply>
    </apply>
</apply>
</apply>
</apply>
<apply type="boundary-cond" boundary-id="8" location="bottom"><eq/>
    <apply><partialdiff/>
        <bvar><ci> x2 </ci></bvar>
        <ci> v </ci>
    </apply>
    <apply><minus/>
        <apply><selector/>
            <ci> v </ci>
            <ci> n </ci>
            <ci> i </ci>
            <ci> j </ci>
        </apply>
        <apply><selector/>
            <ci> v </ci>
            <ci> n </ci>
            <ci> i </ci>
            <apply><minus/>
                <ci> j </ci>
                <cn> 1 </cn>
            </apply>
        </apply>
    </apply>
</apply>
</apply>
</apply>
<!-- The following boundary conditions are for Dirichlet condition -->
<apply type="boundary-cond" boundary-id="64"><eq/>
    <ci> v </ci>
    <apply><selector/>
        <ci> v </ci>
        <ci> n </ci>
        <ci> i </ci>
        <ci> j </ci>
    </apply>
</apply>
<apply><eq/>
    <apply><partialdiff/>
        <bvar><ci> x1 </ci><degree><cn> 2 </cn></degree></bvar>
        <degree><cn> 2 </cn></degree>
    </apply>

```

```

        <ci> v </ci>
    </apply>
</apply>
<apply><divide/>
    <apply><plus/>
        <apply><selector/>
            <ci> v </ci>
            <ci> n </ci>
            <apply><plus/>
                <ci> i </ci>
                <cn> 1 </cn>
            </apply>
            <ci> j </ci>
        </apply>
        <apply><minus/>
            <apply><times/>
                <cn> 2 </cn>
                <apply><selector/>
                    <ci> v </ci>
                    <ci> n </ci>
                    <ci> i </ci>
                    <ci> j </ci>
                </apply>
            </apply>
        </apply>
        <apply><selector/>
            <ci> v </ci>
            <ci> n </ci>
            <apply><minus/>
                <ci> i </ci>
                <cn> 1 </cn>
            </apply>
            <ci> j </ci>
        </apply>
    </apply>
    <apply><times/>
        <ci> deltax1 </ci>
        <ci> deltax1 </ci>
    </apply>
</apply>
</apply>
<apply><eq/>
    <apply><partialdiff/>
        <bvar><ci> x2 </ci><degree><cn> 2 </cn></degree></bvar>
        <degree><cn> 2 </cn></degree>

```

```

    <apply>
      <ci> v </ci>
    </apply>
  </apply>
</apply><divide/>
  <apply><plus/>
    <apply><selector/>
      <ci> v </ci>
      <ci> n </ci>
      <ci> i </ci>
      <apply><plus/>
        <ci> j </ci>
        <cn> 1 </cn>
      </apply>
    </apply>
  </apply>
  <apply><minus/>
    <apply><times/>
      <cn> 2 </cn>
      <apply><selector/>
        <ci> v </ci>
        <ci> n </ci>
        <ci> i </ci>
        <ci> j </ci>
      </apply>
    </apply>
  </apply>
  <apply><selector/>
    <ci> v </ci>
    <ci> n </ci>
    <ci> i </ci>
    <apply><minus/>
      <ci> j </ci>
      <cn> 1 </cn>
    </apply>
  </apply>
</apply>
<apply><times/>
  <ci> deltax2 </ci>
  <ci> deltax2 </ci>
</apply>
</apply>
</apply>
<apply><eq/>
  <apply><partialdiff/>
    <bvar><ci> t </ci></bvar>

```

```

        <apply>
            <ci> v </ci>
        </apply>
    </apply>
    <apply><divide/>
        <apply><minus/>
            <apply><selector/>
                <ci> v </ci>
                <apply><plus/>
                    <ci> n </ci>
                    <cn> 1 </cn>
                </apply>
                <ci> i </ci>
                <ci> j </ci>
            </apply>
            <apply><selector/>
                <ci> v </ci>
                <ci> n </ci>
                <ci> i </ci>
                <ci> j </ci>
            </apply>
        </apply>
        <ci> deltat </ci>
    </apply>
</apply>
</math>
</tecml>

```

CellML File

```

<?xml version="1.0" encoding="utf-8"?>
<model name="fhn_diffusion_2D" cmeta:id="fhn" xmlns="http://www.cellml.org/cellml/1.0#"
  xmlns:cellml="http://www.cellml.org/cellml/1.0#"
  xmlns:cmeta="http://www.cellml.org/metadata/1.0#">
  <documentation xmlns="http://cellml.org/tmp-documentation">
  <article>
    <articleinfo>
      <title>The FitzHugh-Nagumo Simplified Cardiac Myocyte Model</title>
    </articleinfo>
  </article>
</documentation>
<units name="millisecond">
  <unit units="second" prefix="milli"/>
</units>

```

```

<component name="Main">
<variable name="time" units="millisecond" initial_value="0"/>
<variable name="r" units="dimensionless" initial_value="0"/>
<variable name="v" units="dimensionless" initial_value="0"/>
<variable name="w" units="dimensionless" initial_value="0"/>
<variable name="zz" units="dimensionless" initial_value="0"/>
<variable name="beta" units="dimensionless" initial_value="1.2"/>
<variable name="gamma" units="dimensionless" initial_value="0.3"/>
<variable name="epsilon" units="dimensionless" initial_value="0.03"/>
<variable units="micrometer" name="x1" initial_value="1"/>
<variable units="micrometer" name="x2" initial_value="1"/>
<variable units="micrometer" name="D" initial_value="0.001"/>
<math xmlns="http://www.w3.org/1998/Math/MathML">
  <apply>
    <eq/>
    <ci>r</ci>
    <apply>
      <times/>
      <ci>v</ci>
      <ci>v</ci>
      <ci>v</ci>
    </apply>
  </apply>
  <apply>
    <eq/>
    <apply>
      <diff/>
      <bvar>
        <ci>time</ci>
      </bvar>
      <ci>v</ci>
    </apply>
    <apply>
      <plus/>
      <apply>
        <minus/>
        <apply>
          <minus/>
          <ci>v</ci>
          <apply>
            <divide/>
            <ci>r</ci>
            <cn cellml:units="dimensionless">3</cn>
          </apply>
        </apply>
      </apply>
      <ci>w</ci>
    </apply>
  </math>

```



```

        </apply>
        <ci>zz</ci>
<apply><times/>
<ci> D </ci>
<apply>
  <partialdiff/>
  <bvar><ci> x1 </ci><degree><cn> 2 </cn></degree></bvar>
  <degree><cn> 2 </cn></degree>
  <apply>
    <ci> v </ci>
  </apply>
</apply>
</apply>
<apply><times/>
  <ci> D </ci>
  <apply>
    <partialdiff/>
    <bvar><ci> x2 </ci><degree><cn> 2 </cn></degree></bvar>
    <degree><cn> 2 </cn></degree>
    <apply>
      <ci> v </ci>
    </apply>
  </apply>
</apply>
</apply>
  </apply>
</apply>
  <apply>
    <eq/>
    <apply>
      <diff/>
      <bvar>
        <ci>time</ci>
      </bvar>
      <ci>w</ci>
    </apply>
    <apply>
      <times/>
      <ci>epsilon</ci>
      <apply>
        <minus/>
        <apply>
          <plus/>
          <ci>v</ci>
          <ci>beta</ci>
        </apply>
      </apply>
    </apply>
  </apply>

```

```

                                <times/>
                                <ci>gamma</ci>
                                <ci>w</ci>
                            </apply>
                        </apply>
                    </apply>
                </apply>
            </math>
        </component>
    </model>

```

RelML File

```

<!--          FHN_FTCS_Diffusion_2D.relml          -->
<!-- Finite Difference solution in 2D for the FitzHugh-Nagumo model          -->
<!-- with diffusion PDE and Forward-Time Central Space Scheme (FTCS)          -->

<relml>

<tecml filename="model/TecMLPDE/FTCS_Diffusion_2D.tecml" />
<cellml filename="model/CellML/fhn_diffusion_2D.cellml"/>

<variable name="Main.time" tecmlname="t" init="0"/>
<variable name="Main.x1" tecmlname="x1" />
<variable name="Main.x2" tecmlname="x2" />

<variable name="deltat" tecmlname="deltat" init="0.01" />
<variable name="deltax1" tecmlname="deltax1" init="1" />
<variable name="deltax2" tecmlname="deltax2" init="1" />

<variable name="Main.v" tecmlname="v" init="-1.501250563778375"/>
<variable name="Main.w" tecmlname="v" init="-0.37621367749846896"/>
<variable name="Main.r" tecmlname="y" />
<variable name="Main.z" tecmlname="z" />
<variable name="Main.epsilon" tecmlname="z" init="0.03" />
<variable name="Main.beta" tecmlname="z" init="1.2" />
<variable name="Main.gamma" tecmlname="z" init="0.3"/>
<variable name="Main.D" tecmlname="z" init="1"/>

<morphology name="2D LV wall model" filename="csv/morphology_square_100x100.csv" >
    <geometry geometry-id="1" tecmlname="solid" dimension="2">
        <mesh tecmlname="RECTILINEAR_GRID" sizex="100" sizey="100" sizez="1" spac
    </geometry>
</morphology>

```

```

<boundary-cond variablename="Main.v" filename="csv/boundary_square_100x100.csv" />
<!-- <parameter-cond variablename="Main.epsilon" filename="csv/dpEpsilon_square_100x100cs
<!-- <parameter-cond variablename="Main.zz" parameter-id="1" /> -->

```

```

<math>

```

```

  <apply type="boundary-cond" boundary-id="1" location="left"><eq/>
    <apply><partialdiff/>
      <bvar><ci> Main.x1 </ci></bvar>
      <ci> Main.v </ci>
    </apply>
    <cn> 0 </cn>
  </apply>

```

```

  <apply type="boundary-cond" boundary-id="2" location="right"><eq/>
    <apply><partialdiff/>
      <bvar><ci> Main.x1 </ci></bvar>
      <ci> Main.v </ci>
    </apply>
    <cn> 0 </cn>
  </apply>

```

```

  <apply type="boundary-cond" boundary-id="4" location="top"><eq/>
    <apply><partialdiff/>
      <bvar><ci> Main.x2 </ci></bvar>
      <ci> Main.v </ci>
    </apply>
    <cn> 0 </cn>
  </apply>

```

```

  <apply type="boundary-cond" boundary-id="8" location="bottom"><eq/>
    <apply><partialdiff/>
      <bvar><ci> Main.x2 </ci></bvar>
      <ci> Main.v </ci>
    </apply>
    <cn> 0 </cn>
  </apply>

```

```

</math>

```

```

</relml>

```