

# Scientific Computing and Simulation

## Week 6 - Cellular Automata, Excitable Media and Cardiac Tissue

### - Lab Exercises

1. Download the SimpleThreeStateCA model code from Moodle. Study the code and execute the model to reproduce a plane wave and a spiral wave (by commenting / uncommenting the code that breaks the wave to initiate a spiral).
2. Modify the code so that the initial stimulation is (i) in the centre of the grid, (ii) in one corner.
3. Download the GerhardtSchusterTyson (GST) model code from Moodle. Study the code and execute the model to reproduce a plane wave and a spiral wave (by commenting / uncommenting the code that breaks the wave to initiate a spiral).
4. Modify the code so that the initial stimulation is in one corner.
5. Experiment with changing the parameters (one a time!) of the GST model to see the effects of each change.
6. Develop a FourStateCA from the SimpleThreeStateCA to better reproduce cardiac action action potentials. Each cell should have two variables:
  - **state** - to represent excitation & recovery - where 0 represents rest, 3 represents excited (wave front), 2 represents excited (plateau) and 1 represents recovering (wave back); a cell in state 0 becomes excited (moves to state 3) if one or more cells in its 8-cell neighbourhood is excited (i.e. is in state 3 or 2).
  - **timeToStateChange** - to represent the number of time-steps until the cell's state variable should be decremented to the next state (e.g. from 3 to 2, from 2 to 1 or from 1 to 0). This variable should be set to 2 when a cell first moves to state 3, to 3 on transition to state 2 and 3 on transition to state 1.

It should be decremented towards 0 if the cell remains in states 1-3 at the current time-step.