

Advanced Graphics and Visualisation

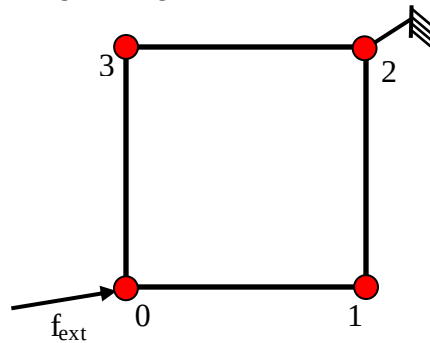
Tutorial 5

Physics-Based modelling

The goal of this tutorial is to simulate a mass spring model similar to the one we saw during the theoretical part of this tutorial

The object:

Let S be a 2D solid represented as a mass spring model. S is a square with particles of mass m at each corner and a length l_0 between each particle. An external force f_{ext} is applied to a node of the square at time $t_0 = 0$. Another node is fixed while the others are free. We assume there is no gravity and no damping at first. For now, no diagonal springs are present. The stiffness k of the springs is strong enough to assure a small displacement at each step.



For this practical tutorial, we set the parameters to the following values:

$$l_0 = 10$$

$$f_{\text{ext}} = (0.2; 0.1)$$

$$k = 1.5$$

Exercise 1

Using Newton's law and the Euler method (and the equation from the theoretical tutorial), complete the following code to simulate the mass spring model behaviour over the time (the time step could be 1 and the length of the simulation could be 10 or 20 for now).

Exercise 2

Add gravity g and damping c to the simulation, and complete the code.

$$g = 9.8$$

c is between 0 and 1 for attenuation of the displacement.

Exercise 3

Add diagonal springs to the Euler behaviour and see if the simulation is more stable. For visualization simplicity, don't take the gravity into account.

Exercise 4

Create a 3D cube (without the diagonal springs), apply the Euler method to it, and render it.

Don't forget to change the force on the z direction.
To create the cube in 3D either add more vtkLines or use another vtk structure.

Exercise 5

Try to add a texture image to the cube surface.

You will find example skeleton code here:

<http://www.doc.ic.ac.uk/~eedwards/teaching/AGV/Tutorial5practical/>