Programming project

The jupyter notebook ProgrammingProject.ipynb contains the implementation of a Random Fuse Model problem in a square lattice, similar to that introduced in the CoMBiF course. The system is subject to a uniaxial load in the vertical direction, with constant voltages V=1 and V=0 applied to the top and bottom boundary respectively. Periodic boundary conditions are applied in the horizontal direction. This configuration mimics the geometry of an elastic/brittle material, which is subject to tension in the vertical direction.

In the current implementation, four contiguous vertical links are removed, in order to simulate a horizontal crack. The two figures in the notebook show i) the actual fuse network structure and ii) the currents flowing in the system as a consequence of the applied load and the crack, where we represent higher currents with thicker lines.

Because of the crack, some currents flow in the horizontal direction, mimicking load redistribution around the crack profile, in analogy with patterns of stress redistribution in fracture mechanics.

Project tasks:

1. Familiarize yourself with the code. Keep in mind that the N nodes are labelled from 0 to N-1, from bottom left to top right. For example, in a small 3 x 3 system they would be:
6 7 8
3 4 5
0 1 2
For this project, a size of at least 20 x 20 is recommended (as in the provided notebook)

2. The global current I carried by the system (in simulation units) is the current carried by all vertical links in any horizontal cross-section of the network. Study the dependence of I on the length of the crack a.

3. Currents in horizontal links are higher near the crack and decrease with the distance from the crack (for instance, in the direction normal to the crack line). Fix a crack size and study the dependence of these currents on the distance from the crack.