Simulation and Visualization of Optimal Geometry

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For any topological object, we can ask for its optimal geometric shape, minimizing some geometric energy. A classic example is a soap bubble that is round because it minimizes surface area while enclosing a fixed volume. Other examples -- topicas of current mathematical research – include knots tied tight in thick rope, which minimize their length, and surfaces minimizing elastic bending energy. The resulting shapes are not only mathematically elegant, but often exhibit striking visual beauty.

We will watch several short computer-graphics videos, illustrating tight knots and a mathematical way to turn a sphere inside out (guided by surface bending energy). We will see other examples of mathematical visualizations arising from optimal geometry, including computer-generated sculpture.

Most of my computer simulations in this area have been performed in Brakke's "evolver". The second presentation will give an introduction to using the evolver for sculpture design, and will also touch on some of the other software I have used for visualizations.