

Part I

Mathematics

1 Resistor Network

Fractal Resistor Network Jul 2020

(1) Suppose an n -dimensional Sierpiński simplex (i.e., an analogue of triangle and tetrahedron) evolved k times. After replacing each line segment with unit resistors, find the effective resistance between the uttermost nodes. Note that 0-evolved Sierpiński simplexes are defined as normal simplexes.

Resistor Construction Jan 2021

Where a positive real number x is given, discuss if it is always possible to construct a unit resistor network such that its effective resistance between some two nodes of the network is equal to x .

Part II

Mechanics

Swinging Rope Feb 2023

(1) Suppose a uniform rope with length l is on the ground at rest. Hold one of the ends of the rope and turn it with a constant angular velocity ω . If an appropriate initial shape is made, the rope could maintain its shape thereafter. In the absence of friction or drag, find the area the rope sweeps over.

(2) At the free end of the rope, a small wooden block in mass with the identical mass as the rope was fixed. Find the area the rope sweeps over. The coefficient of kinetic friction between the block and the ground is μ_1 .

(3) Remove the block and now consider the presence of friction between the rope and the ground. Find the area the rope sweeps over. The coefficient of kinetic friction between the rope and the ground is μ_2 .
