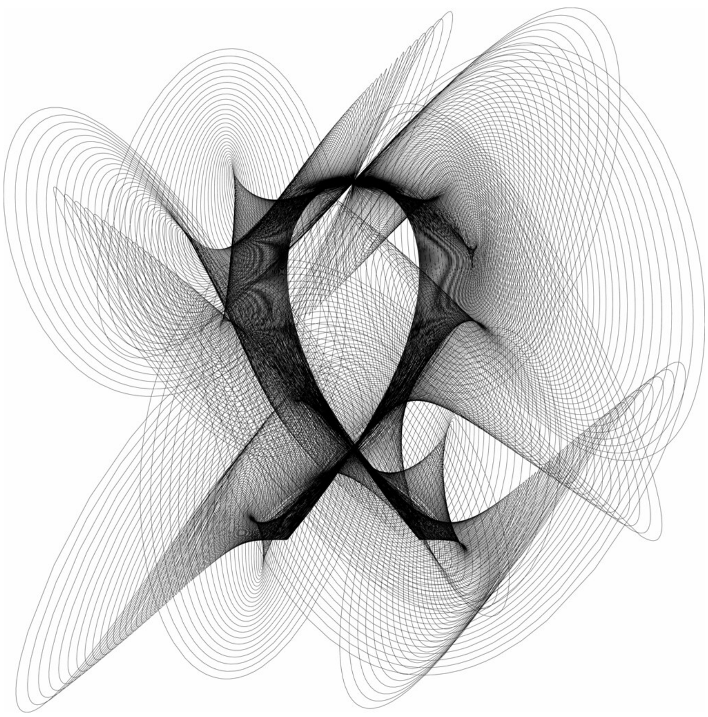
Preview: Harmonographs

Preview of harmonographs and how they work.

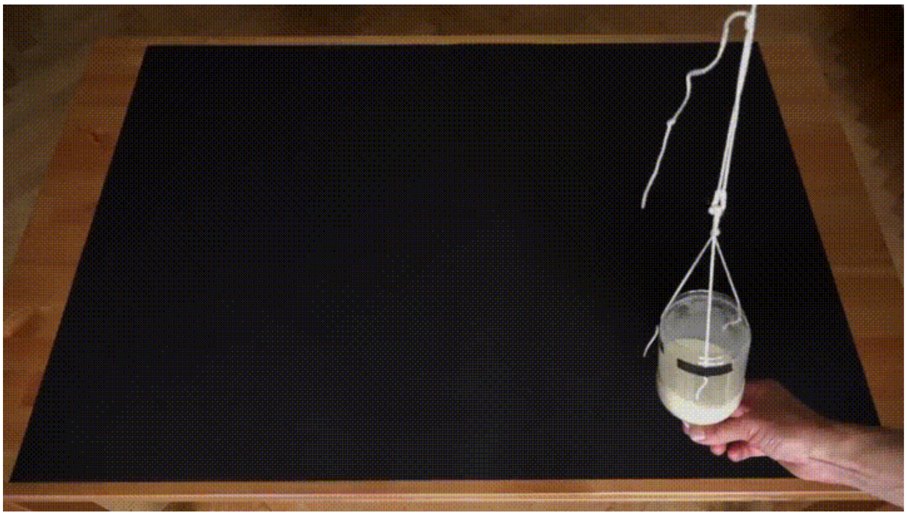
WE'LL COVER THE FOLLOWING

Harmonographs

A **harmonograph** is a mechanical apparatus that employs multiple coupled pendulums to create geometric images. As you can see below, the images are complex, yet beautiful.



These images can be created by attaching a pencil to the bottom of the pendulum. So, as the pendulum moves, these patterns are drawn.



A harmonograph on a single axis

A harmonograph creates its figures using the movements of damped pendulums. The movement of a damped pendulum along the $x-axis$ is described by the equation:

$$x(t) = Asin(2\pi ft + p)e^{dt}$$

where

- A is the amplitude,
- f is the frequency of the pendulum,
- t is the time,
- p is the phase,
- and d is the damping factor.

If we have two independent pendulums oscillating along the x-axis, the principle of superposition says that both contribute to the overall motion of our pencil. The total motion along the x-axis is given by:

$$x(t) = A_1 sin(2\pi f_1 t + p_1)e^{d_1 t} + A_2 sin(2\pi f_2 t + p_2)e^{d_2 t}$$

Harmonographs on two axes

If two pendulums are moving along two axes, the overall equations of motion of the pendulum is given by:

x-axis

$$x(t) = A_1 sin(2\pi f_1 t + p_1)e^{d_1 t} + A_2 sin(2\pi f_2 t + p_2)e^{d_2 t}$$

y-axis

$$y(t) = A_3 sin(2\pi f_3 t + p_3)e^{d_3 t} + A_4 sin(2\pi f_4 t + p_4)e^{d_4 t}$$

In the case above, we have 16 parameters to play with. We have infinite possibilities, as each distinct combination will produce a distinct result.

In the next lesson, you will solve exercises related to harmonographs.