Magnetic Levitation Energy Harvester

(1) Calc the acceleration of the central magnet

$$a_z = \frac{1}{m}(-k_1 z - k_3 z^3 - cv - \alpha i) - g + \Omega^2 A sin(\Omega t)$$

(2) vertical velocity and displacement of the central magnet

$$\Delta v = a\Delta t$$
$$v = v + \Delta v$$
$$\Delta z = v\Delta t$$
$$z = z + \Delta z$$

These lines may appear a little strange. The first two will be coded as **velyZ += accelZ*dT;** and the last two will be coded as **dispZCentre += velyZ*dT;**

(3) Calculate the rate of change of current in the coil

$$\frac{di}{dt} = \frac{1}{L}\left(\alpha v - (R_C + R_L)\right)$$

and the current in the coil will be coded as **current += dCurrentDt*dT** where **dCurrentDt** is the above rate of change of current in the coil.

(4) Finally we code the power as current squared times load resistance **power = RL*current**2;**

Variables

Math	Code	Meaning	ICs
Δt	deltaT		0.01
t	time		0
z	dispZCentre	vertical displacement from equilibrium	
v	velyZ	vertical velocity	
a	accelZ	vertical acceleration	
i	current	current	
$\frac{di}{dt}$	dCurrentDt	rate of change of current	0

Parameters

Math	Code	Default	Meaning
m	mmass	0.09	mass of pendulum
g	gravity	9.8	gravity
k_1	k1	38.7	linear stiffness
k_3	k3	1.6×10^5	non-linear stiffness
c	c	0.054	damping
α	alpha	60	coupling constant
R_c	RC	1200	resistance of coil
R_L	RL	1100	load resistance
β	beta	10	time scaling for slow-down

Sinusoidal drive equation parameters

A	A	This is internally calculated from the **forcingAmplitude**	0.01 (metres)
Ω	omegaDrive	This is internally calculated from the **forcingFrequency**	11.1 (Hertz)

If you wish to calculate the peal power (rather than the instantaneous power) then you could perform a calculation like this, resetting to zero when the current changes direction

if(power > peakPower) peakPower = power;
if(current < 0) peakPower = 0.0;