

MiscProblems

March 2, 2019

1 Miscellaneous problems

1.1 Falling chain

A chain of mass m and length L is held vertically above a scale so that its lowest link is just touching the scale. The chain is then released. What is the reading on the scale as a function of time?

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In [1]: import numpy as np
import matplotlib.pyplot as plt
%matplotlib inline
#
g = 9.81
m = 0.5
L = 1.0
nLinks = 1000
mLink = m/nLinks
lLink = L/nLinks
zLink = np.linspace(0, L - lLink, nLinks)
vLink = 2*g*zLink
tLink = np.sqrt(2*zLink/g)
def nResting(t):
    w = 0.0
    logLinks = t > tLink
    tot = np.sum(logLinks)
    return tot
#
tBot = 0.0
tTop = 1.2*np.sqrt(2*L/g)
nTimes = 2000
dt = (tTop - tBot)/nTimes
tArr = np.linspace(tBot, tTop, nTimes)
totLinks = np.zeros(nTimes)
for i in range(0, nTimes):
    totLinks[i] = nResting(tArr[i])
#
wLink = mLink*g*totLinks
pLink = mLink*vLink
```

```

iLink = pLink
#
def fImpact(t):
    f = 0.0
    logLinks = np.logical_and(t > tLink, t < np.sqrt(2*L/g))
    tot = np.sum(iLink[logLinks])
    return tot
#
totImpulse = np.zeros(nTimes)
for i in range(0, nTimes):
    totImpulse[i] = fImpact(tArr[i])
#
plt.figure(figsize = (12, 6))
plt.subplot(1, 2, 1)
plt.title("Number of links on scale")
plt.xlabel("t (secs)")
plt.ylabel("Number of links")
plt.plot(tArr, totLinks)
plt.grid(color = 'g')
#
plt.subplot(1, 2, 2)
plt.title("Weight on scale")
plt.xlabel("t (secs)")
plt.ylabel("Scale reading")
plt.plot(tArr, wLink, linestyle = ':', color = 'b', label = "Weight")
plt.plot(tArr, totImpulse, linestyle = '--', color = 'c', label = "Impulse")
plt.plot(tArr, wLink + totImpulse, linestyle = '-', color = 'r', label = "Total")
plt.grid(color = 'g')
#
plt.show()

```



