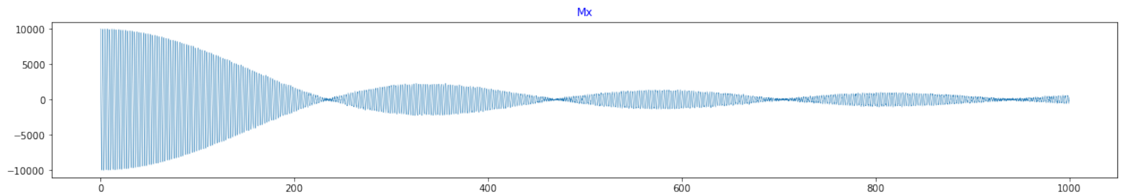
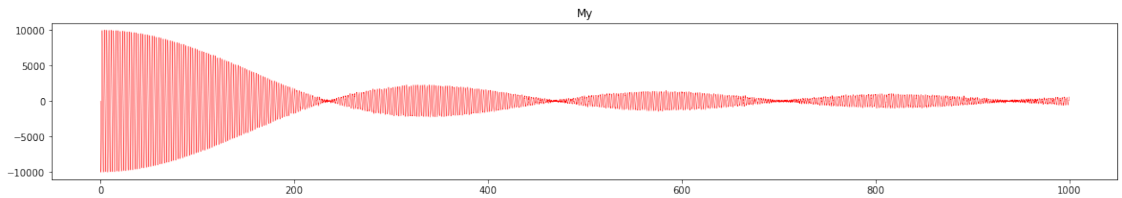
pnmr_prelab

November 3, 2022

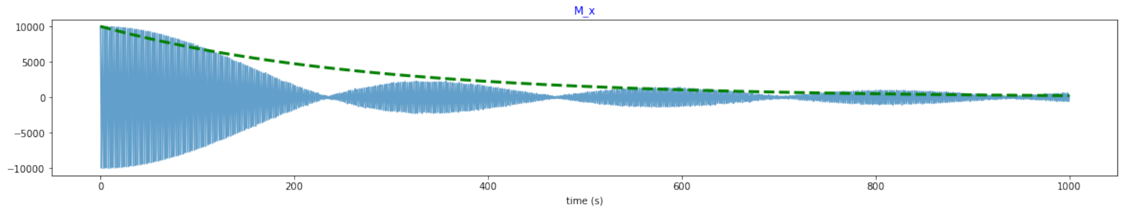
[56]:

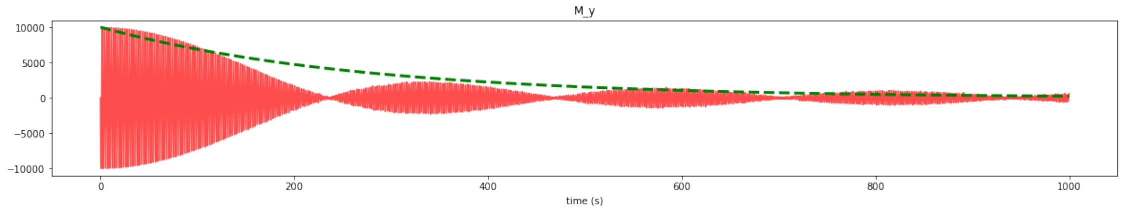
```
import numpy as np
import matplotlib.pyplot as plt

N = 10000

B0 = 1
gamma = 2.675

smallB = B0/100

mx = []
my = []
ts = []

for t in np.arange(0, 1000, 0.1):

    deltas = np.random.rand(N)
    sumx = np.sum(np.cos(gamma*(B0+deltas*smallB)*t))
    sumy = -np.sum(np.sin(gamma*(B0+deltas*smallB)*t))

    mx.append(sumx)
    my.append(sumy)
    ts.append(t)

plt.rcParams["figure.figsize"] = (20,3)

plt.plot(ts, mx, linewidth=0.4 )
plt.title("Mx", color='b')
plt.show()

plt.clf()
plt.title("My")
plt.plot(ts,my, color='r', linewidth=0.4)
plt.show()
```





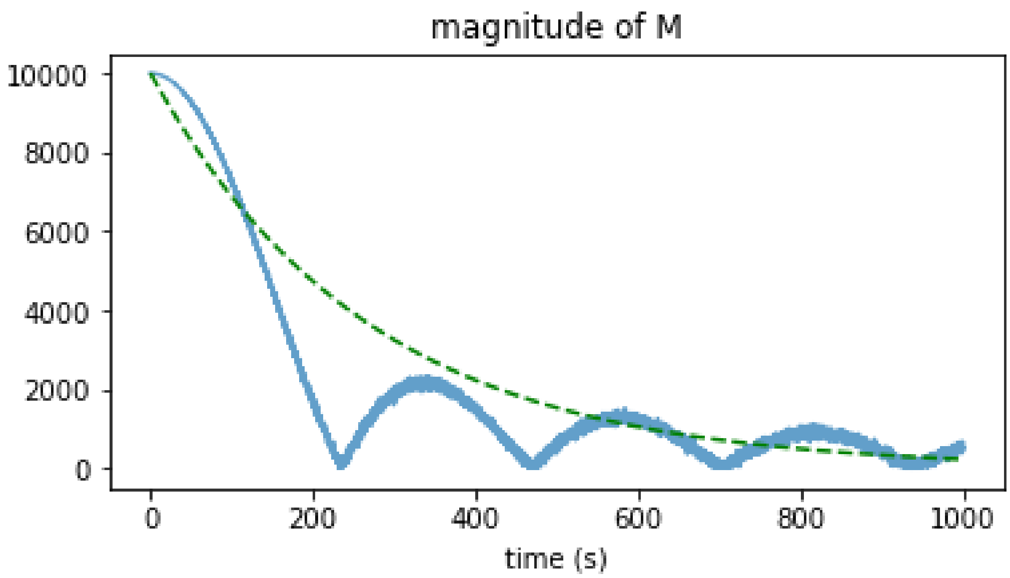
[58]:
```
plt.plot(ts, mx, alpha=0.7)
plt.plot(ts, N*np.exp(-np.array(ts)/(gamma/smallB)), linewidth=3,␣
 ↪linestyle='--', color='green')
plt.title("M_x", color='b')
plt.xlabel('time (s)')
plt.show()

plt.clf()
plt.title("M_y")
plt.plot(ts,my, color='r', alpha=0.7)
plt.plot(ts, N*np.exp(-np.array(ts)/(gamma/smallB)), linewidth=3,␣
 ↪linestyle='--', color='green')
plt.xlabel('time (s)')
plt.show()
```





[61]:

```
M = np.sqrt(np.array(mx)**2 + np.array(my)**2)
plt.plot(ts, M, alpha=0.7)
plt.plot(ts, N*np.exp(-np.array(ts)/(gamma/smallB)), linestyle='--',␣
 ↪color='green')
plt.rcParams["figure.figsize"] = (4,3)
plt.title("magnitude of M")
plt.xlabel('time (s)')
plt.show()
```



We see that the M_x and M_y precesses and and their magnitudes decay and "pulse". The system acts as though $\vec{M}$ decays as an exponential

$$e^{-t/\tau}$$

of time constant

$$\tau = \gamma \cdot B$$

Plots are made above, with the units chosen arbitrarily