Q3 Dynamics of smaller networks

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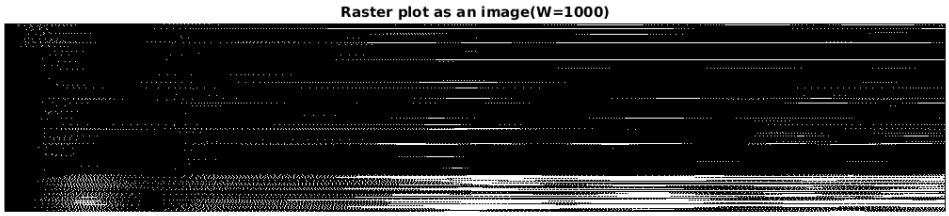
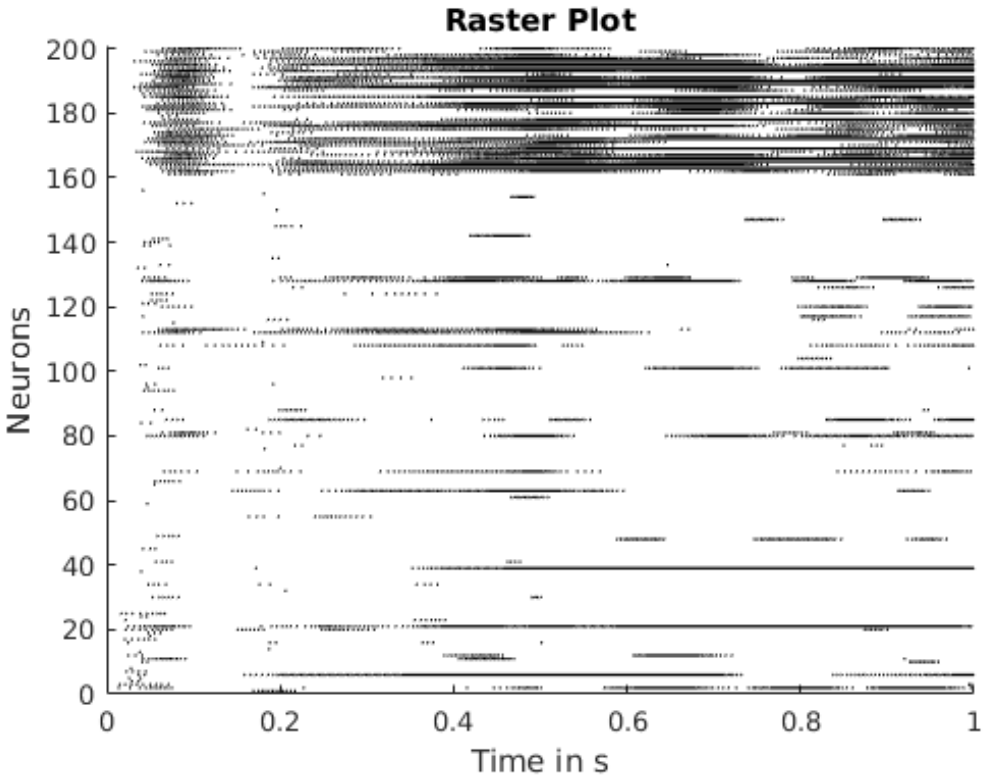
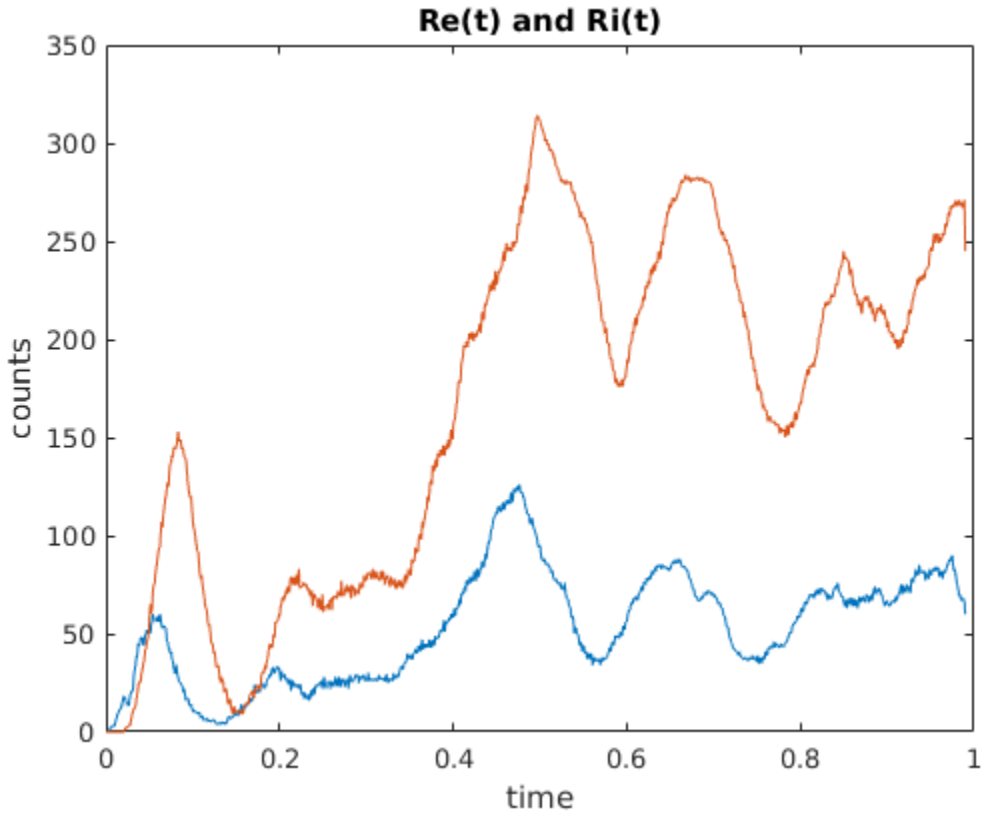
Part A

```
seed=200;
rng(seed,'twister');

ms=1E-3;
N=200;
fanout_ratio=N/10;
Ne=N*0.80;
Ni=N-Ne;
%  creating network
fanout_matrix=zeros(N,fanout_ratio);
for i=1:Ne
    fanout_matrix(i,:)=randperm(N,fanout_ratio);
end
for i=Ne+1:N
    fanout_matrix(i,:)=randperm(Ne,fanout_ratio);
end
gamma=1;
wi=-3000;
we=-gamma*wi;
Weights_matrix=we*ones(N,fanout_ratio);
Weights_matrix(Ne+1:end,:)=wi;

delay_matrix=randi([1,20],[N,fanout_ratio])*ms;
delay_matrix(round(N*0.8)+1:end,:)=1*ms;

% constants
delta_t=1*ms;
T=1000*ms;
t=linspace(0,T,T/delta_t);
Io=1E-12;
tau=15*ms;
tau_s=tau/4;
EL=-70*1E-3;
gL=30*1E-9;
Vt=20*1E-3;
C=300*1E-12;
```

```
Rp=2*ms;
ws=3000;

% % forming Iext matrix

lambda=100;
myPoissonSpikeTrain = rand(25, T/delta_t) < lambda*delta_t;
Iext_t= @(ts,t) Io*ws*(exp(-(t-ts)/tau)-exp(-(t-ts)/tau_s)).*(t>ts);
Iext=zeros(25,T/delta_t);
for i=1:25
    ts=find(myPoissonSpikeTrain(i,:)==1)*delta_t;
    for k=1:size(ts,2)
        Iext(i,:)=Iext(i,:)+Iext_t(ts(k),t);
    end

end


[V,t,spikes,none]=LIF_dynamic( delta_t,T,N,fanout_matrix,Weights_matrix,delay_matr

imshow(255*spikes);
title('Raster plot as an image(W=1000)');
plotRaster(spikes,t);
Re_temp=sum(spikes(1:round(N*0.8),:),1);
Ri_temp=sum(spikes(round(N*0.8)+1:end,:),1);
Re=zeros(1,T/delta_t-10*ms/delta_t);
Ri=zeros(1,T/delta_t-10*ms/delta_t);
for i=1:T/delta_t-10*ms/delta_t
    Re(i)=sum(Re_temp(i:i+10*ms/delta_t));
    Ri(i)=sum(Ri_temp(i:i+10*ms/delta_t));
end

figure();
plot(t(1:T/delta_t-10*ms/delta_t),Re,t(1:T/delta_t-10*ms/delta_t),Ri);
title('Re(t) and Ri(t)')
xlabel('time');ylabel('counts');
```

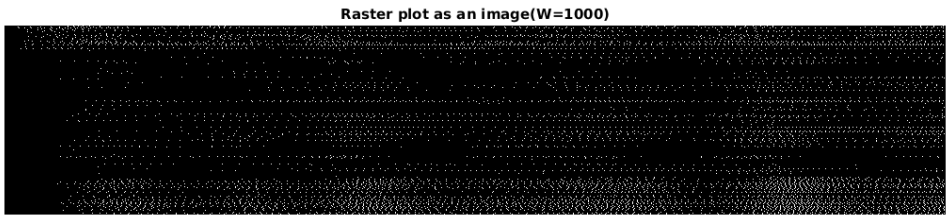


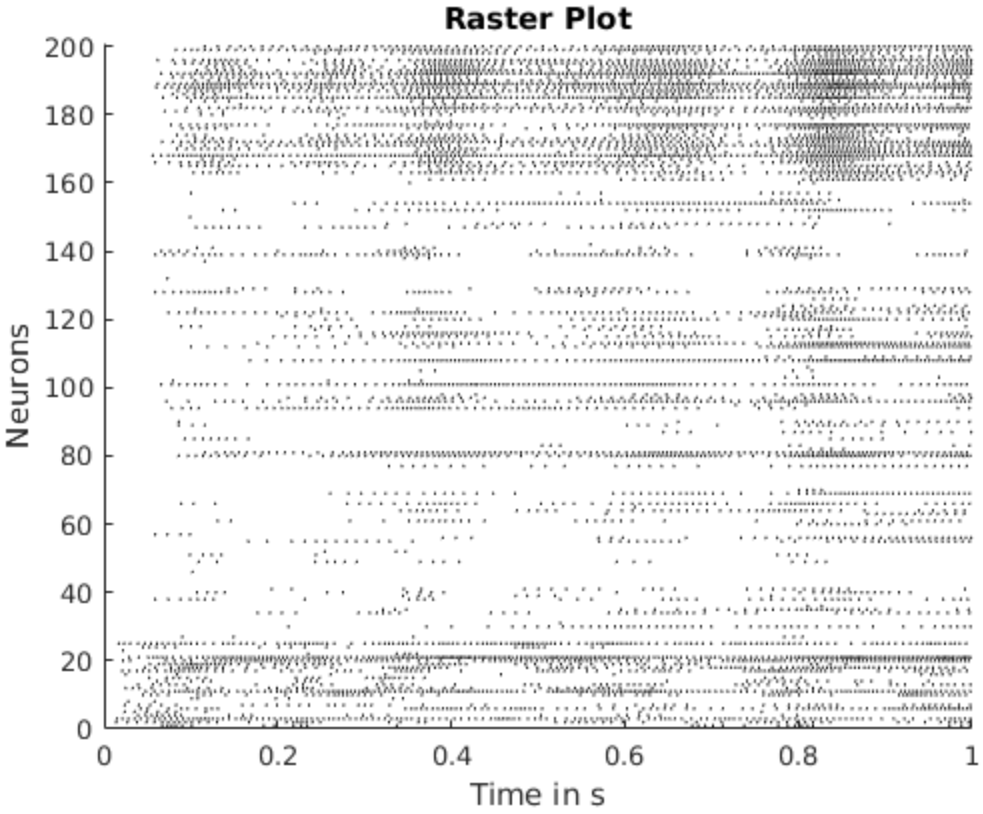

Raster Plot
Neurons
Time in s
0
20
40
60
80
100
120
140
160
180
200
0
0.2
0.4
0.6
0.8
1

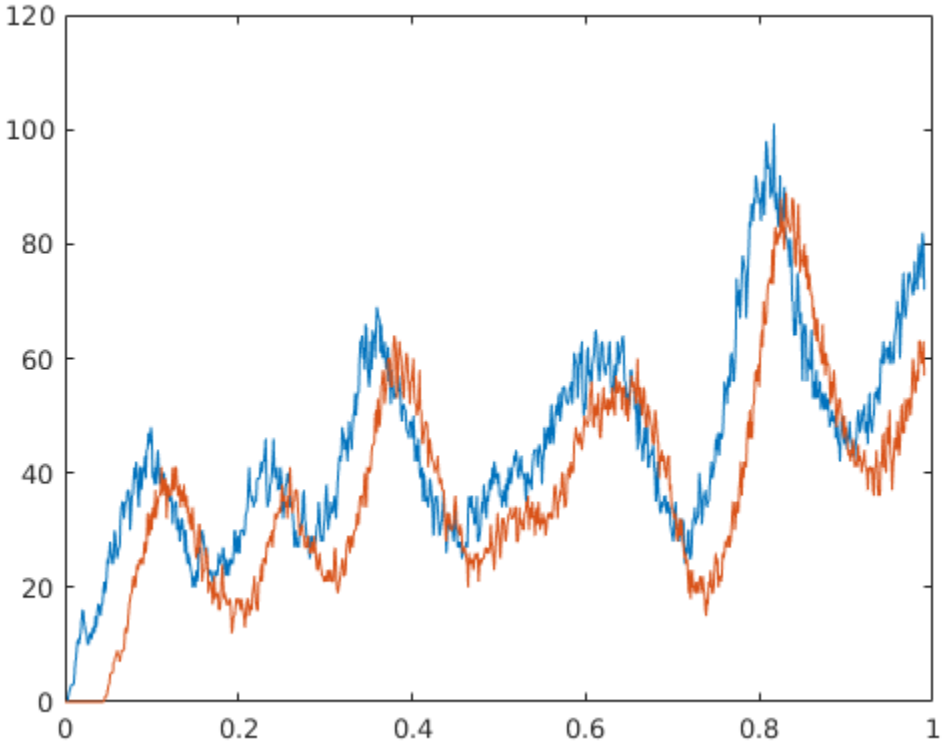

Re(t) and Ri(t)
counts
time
0
50
100
150
200
250
300
350
0
0.2
0.4
0.6
0.8
1

Part B we=1000

```
gamma=1;
wi=-1000;
we=-gamma*wi;
Weights_matrix=we*ones(N,fanout_ratio);
Weights_matrix(Ne+1:end,:)=wi;

delay_matrix=randi([1,20],[N,fanout_ratio])*ms;
delay_matrix(round(N*0.8)+1:end,:)=1*ms;

[V,t,spikes,none]=LIF_dynamic( delta_t,T,N,fanout_matrix,Weights_matrix,delay_matr


imshow(spikes*255);
title('Raster plot as an image(W=1000)');
plotRaster(spikes,t);

Re_temp=sum(spikes(1:round(N*0.8),:),1);
Ri_temp=sum(spikes(round(N*0.8)+1:end,:),1);
Re=zeros(1,T/delta_t-10*ms/delta_t);
Ri=zeros(1,T/delta_t-10*ms/delta_t);
for i=1:T/delta_t-10*ms/delta_t
    Re(i)=sum(Re_temp(i:i+10*ms/delta_t));
    Ri(i)=sum(Ri_temp(i:i+10*ms/delta_t));
end

figure();
plot(t(1:T/delta_t-10*ms/delta_t),Re,t(1:T/delta_t-10*ms/delta_t),Ri);
```

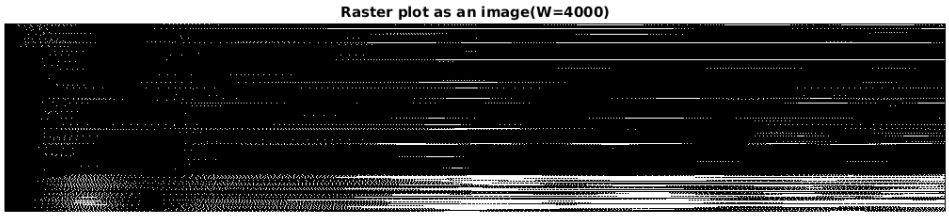


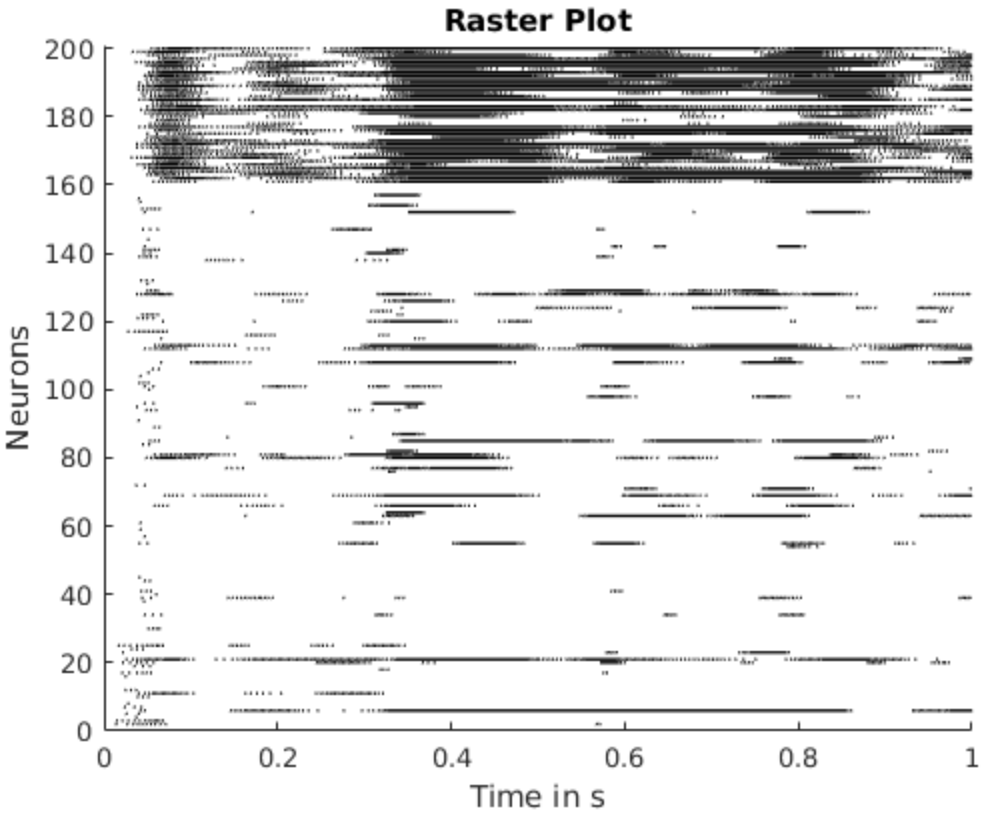

Raster Plot
Neurons
Time in s
0
20
40
60
80
100
120
140
160
180
200
0
0.2
0.4
0.6
0.8
1

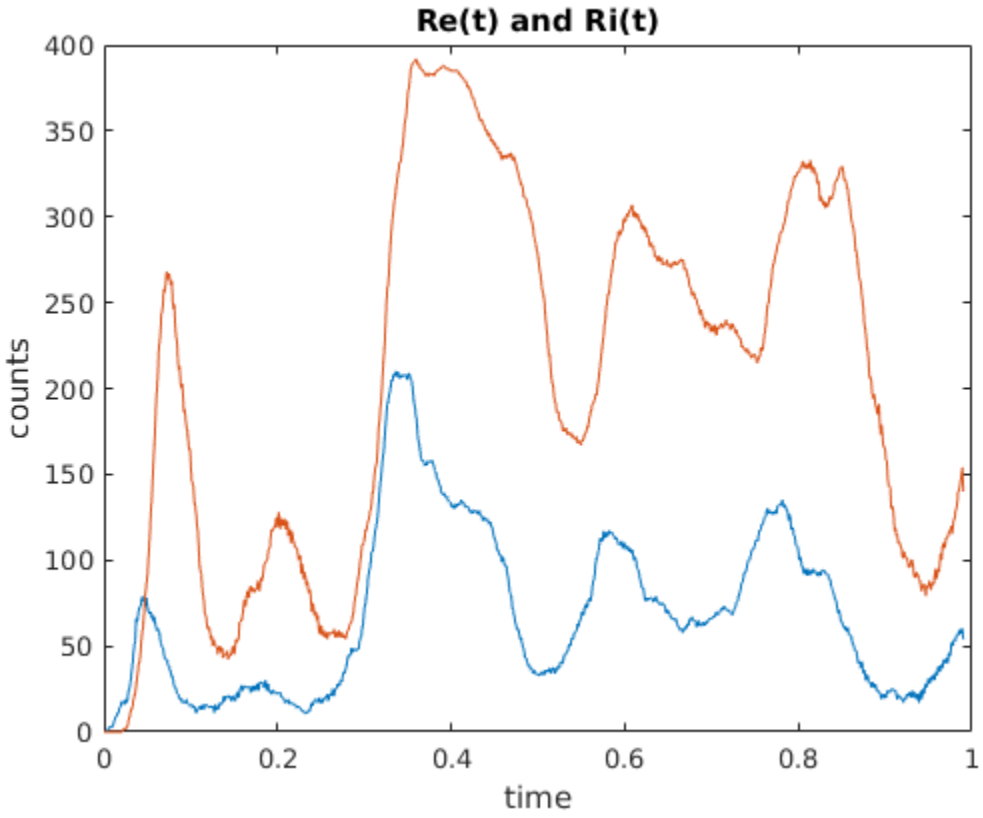

0
20
40
60
80
100
120
0
0.2
0.4
0.6
0.8
1

Part B we=4000

```
gamma=1;
wi=-4000;
we=-gamma*wi;
Weights_matrix=we*ones(N,fanout_ratio);
Weights_matrix(Ne+1:end,:)=wi;

delay_matrix=randi([1,20],[N,fanout_ratio])*ms;
delay_matrix(round(N*0.8)+1:end,:)=1*ms;

[V,t,spikes,none]=LIF_dynamic( delta_t,T,N,fanout_matrix,Weights_matrix,delay_matr


imshow(spikes*255);
title('Raster plot as an image(W=4000)');
plotRaster(spikes,t);

Re_temp=sum(spikes(1:round(N*0.8),:),1);
Ri_temp=sum(spikes(round(N*0.8)+1:end,:),1);
Re=zeros(1,T/delta_t-10*ms/delta_t);
Ri=zeros(1,T/delta_t-10*ms/delta_t);
for i=1:T/delta_t-10*ms/delta_t
    Re(i)=sum(Re_temp(i:i+10*ms/delta_t));
    Ri(i)=sum(Ri_temp(i:i+10*ms/delta_t));
end

figure();
plot(t(1:T/delta_t-10*ms/delta_t),Re,t(1:T/delta_t-10*ms/delta_t),Ri);
title('Re(t) and Ri(t)')
xlabel('time');ylabel('counts');
```




Raster Plot
Neurons
Time in s
0
20
40
60
80
100
120
140
160
180
200
0
0.2
0.4
0.6
0.8
1

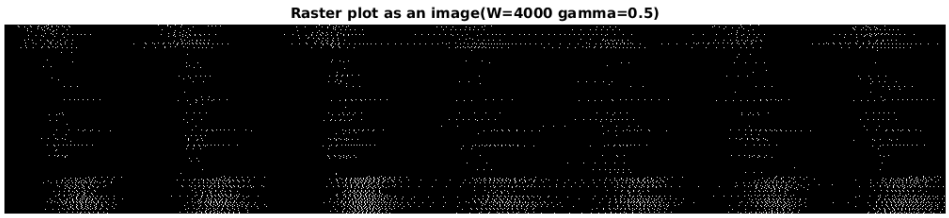

Re(t) and Ri(t)
counts
time
0
50
100
150
200
250
300
350
400
0
0.2
0.4
0.6
0.8
1

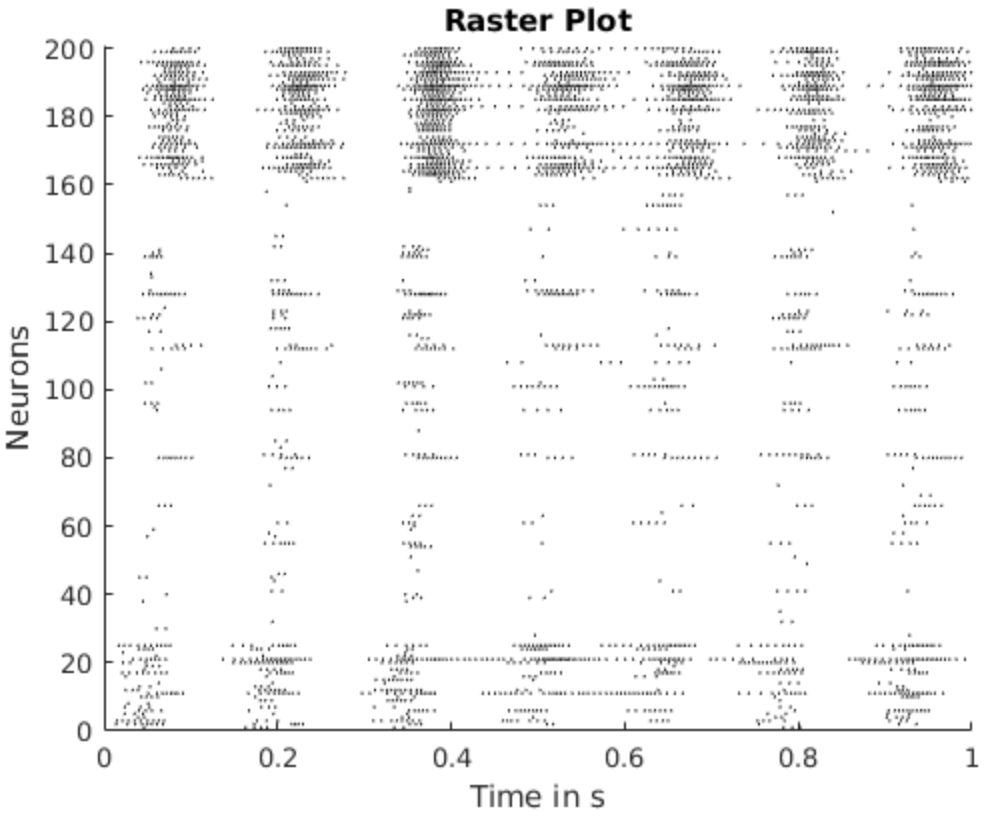
Part C

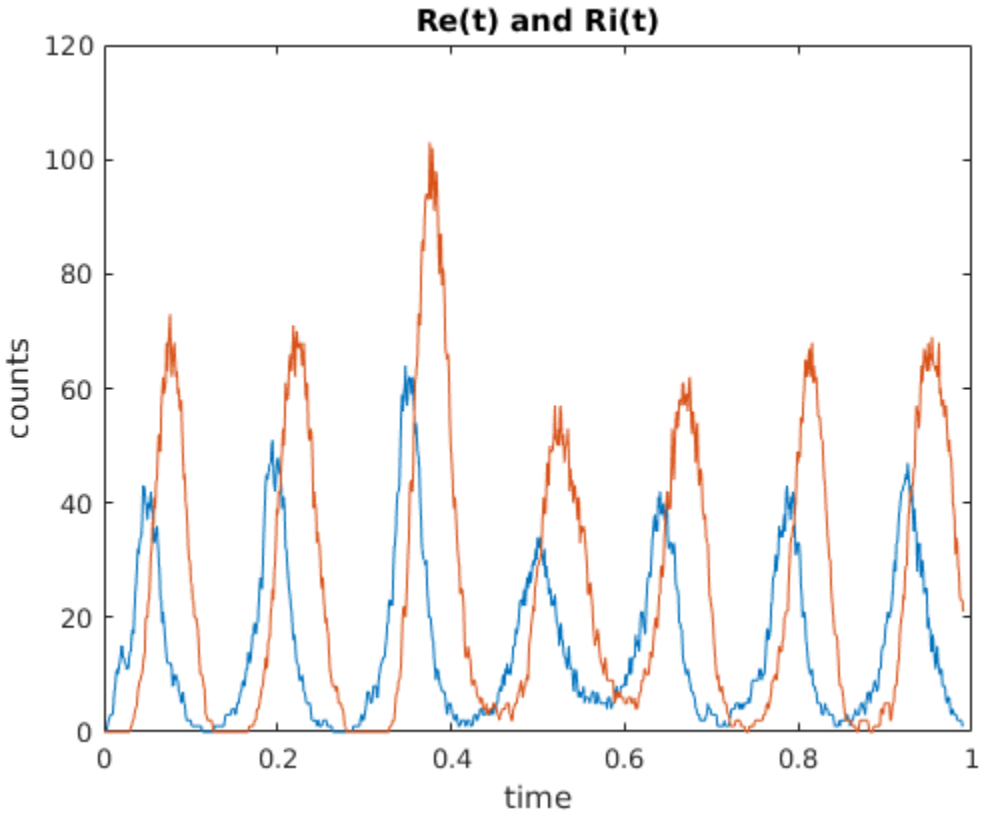
The net excitation in the network should be decreased in order to observe the network behavior observed in problem 2 And The net inhibition in the network should be increased in order to observe the network behavior observed in problem 2

Part D

```
% we=4000 gamma=0.5
gamma=0.5;
wi=-4000;
we=-gamma*wi;
Weights_matrix=we*ones(N,fanout_ratio);
Weights_matrix(Ne+1:end,:)=wi;

delay_matrix=randi([1,20],[N,fanout_ratio])*ms;
delay_matrix(round(N*0.8)+1:end,:)=1*ms;

[V,t,spikes,none]=LIF_dynamic( delta_t,T,N,fanout_matrix,Weights_matrix,delay_matr


imshow(spikes*255);
title('Raster plot as an image(W=4000 gamma=0.5)');
plotRaster(spikes,t);

Re_temp=sum(spikes(1:round(N*0.8),:),1);
Ri_temp=sum(spikes(round(N*0.8)+1:end,:),1);
Re=zeros(1,T/delta_t-10*ms/delta_t);
Ri=zeros(1,T/delta_t-10*ms/delta_t);
for i=1:T/delta_t-10*ms/delta_t
    Re(i)=sum(Re_temp(i:i+10*ms/delta_t));
    Ri(i)=sum(Ri_temp(i:i+10*ms/delta_t));
end

figure();
plot(t(1:T/delta_t-10*ms/delta_t),Re,t(1:T/delta_t-10*ms/delta_t),Ri);
title('Re(t) and Ri(t)')
xlabel('time');ylabel('counts');
```




Raster Plot
Neurons
Time in s
0
20
40
60
80
100
120
140
160
180
200
0
0.2
0.4
0.6
0.8
1


Re(t) and Ri(t)
counts
time
0
20
40
60
80
100
120
0
0.2
0.4
0.6
0.8
1

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