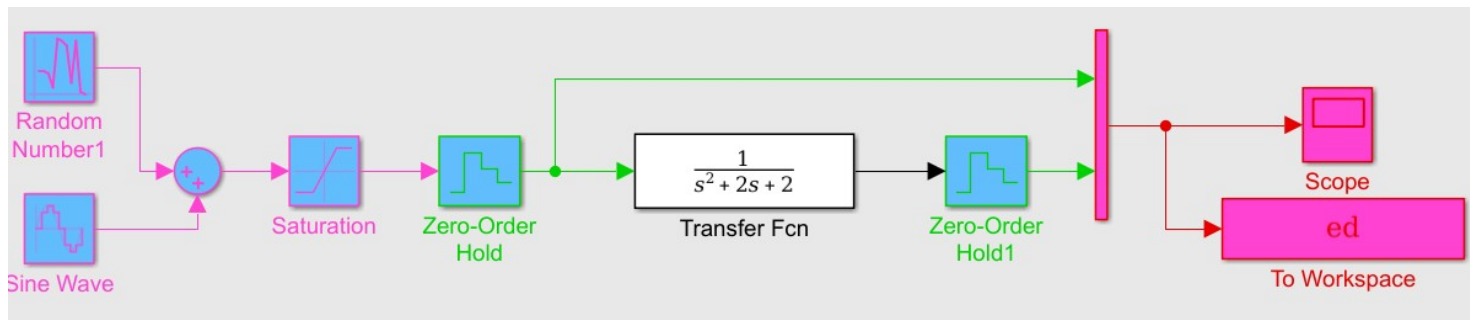


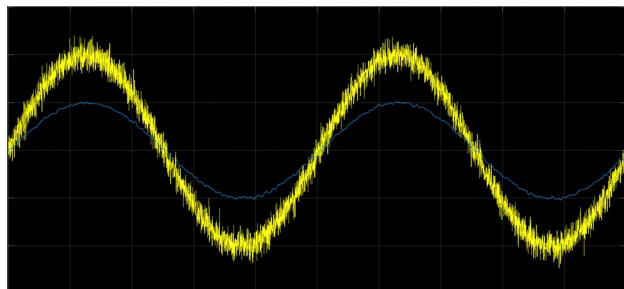
## INVERZNA DINAMIKA

### a) ulazni signal

vrijeme simulacije  $t=500$



Block Parameters: Random Number1	Block Parameters: Sine Wave
Random Number Output a normally (Gaussian) distributed random signal. C repeatable for a given seed.	parameters in the two types are related through: Samples per period = $2\pi / (\text{Frequency} * \text{Sample time})$ Number of offset samples = Phase * Samples per period Use the sample-based sine type if numerical problems di for large times (e.g. overflow in absolute time) occur.
Parameters	Parameters
Mean:	Sine type: Time based
0	Time (t): Use simulation time
Variance:	Amplitude:
0.1	4
Seed:	Bias:
0	0
Sample time:	Frequency (rad/sec):
0.1	0.025
	Phase (rad):
	0
	Sample time:
	0.1



### b) Matlab kod

```
N=4;  
% Priprema podataka za treniranje mreze  
fprintf('Priprema podataka za treniranje mreze...\n');  
P= ed(:, 1);  
T = ed(:, 2);  
minulaz = min(P);  
maxulaz = max(P); %opseg ulaznih vrijednosti  
minizlaz = min(T);  
maxizlaz = max(T); %opseg moguceg izlaza  
  
net = newff([zeros(2*N,1)-1 zeros(2*N,1)+1], ...  
[15 5 1], {'tansig', 'tansig', 'purelin'}, 'trainlm');  
  
net.trainParam.epochs = 2000;  
net.trainParam.goal = 2e-9;  
net.trainParam.show = 10;  
net.trainParam.time = Inf;  
  
fprintf('Opseg ulaza mreze je: [%g, %g].\n', minizlaz,  
maxizlaz);  
  
% normiranje ulaza i izlaza na opseg [-1, 1]
```

```

P= 2 * (P - minulaz) ./ (maxulaz - minulaz) - 1;
T = 2 * (T - minizlaz) ./ (maxizlaz - minizlaz) - 1;

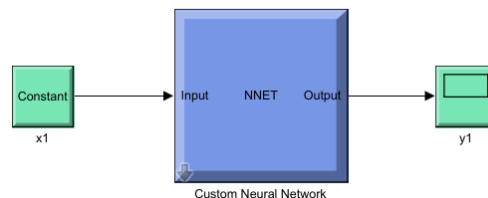
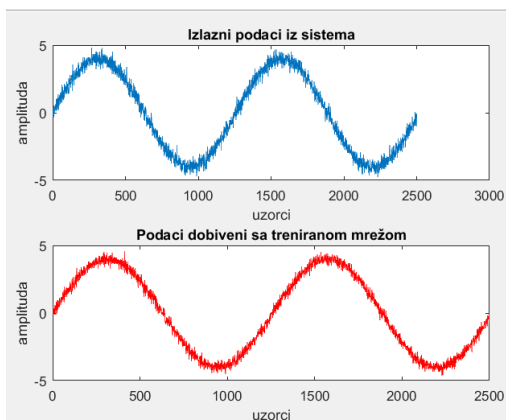
vel = length(T);
ulaz = zeros(2*N, vel-N);
izlaz = zeros(1, vel-N);

for k = N : vel-1
    t = flipud( T(k-N+1:k+1) );
    p = flipud( P(k-N+1:k-1) );
    ulaz(:,k) = [t; p];
    izlaz(k) = P(k);
end;
% Treniranje...
fprintf('Po?etak treniranja\n');
tic
net = train(net, ulaz, izlaz);
toc

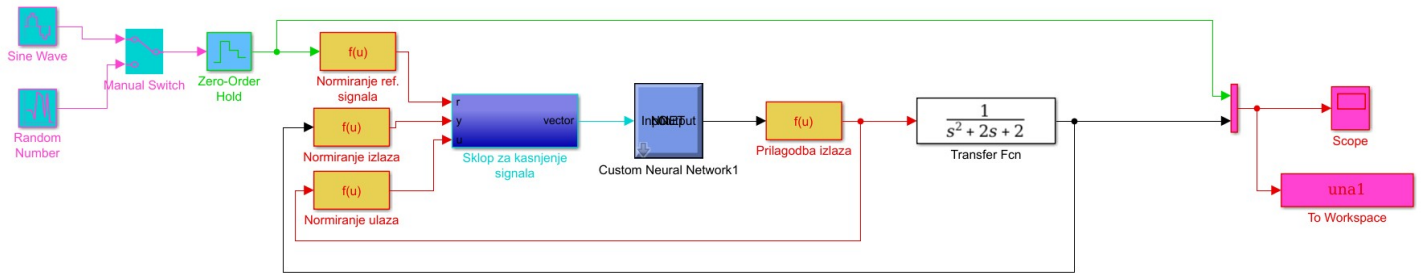
izlaz=sim(net,ulaz);
izlaz=(izlaz+1)*(maxulaz-minulaz)./2 +minulaz;

figure
subplot(2,1,1),plot(ed(:,1));
title('Izlazni podaci iz sistema');
xlabel('uzorci')
ylabel('amplituda')
subplot(2,1,2),plot(izlaz,'r')
title('Podaci dobiveni sa treniranom mrežom');
xlabel('uzorci')
ylabel('amplituda')
gensim(net,0.1)

```



## c) završni model $t=500$



**Block Parameters: Sine Wave**  
parameters for sine waves are defined as follows:

Samples per period =  $2\pi / (\text{Frequency} * \text{Sample time})$   
Number of offset samples =  $\text{Phase} * \text{Samples per period} / (2\pi)$   
Use the sample-based sine type if numerical problems due to running for large times (e.g. overflow in absolute time) occur.

Parameters

Sine type: Time based  
Time (t): Use simulation time  
Amplitude: 2  
Bias: 0  
Frequency (rad/sec): 0.25  
Phase (rad): 0  
Sample time: 0.1  
☒ Interpret vector parameters as 1-D

**Block Parameters: Random Number**  
Output a normally (Gaussian) distributed random signal. Output is repeatable for a given seed.

Parameters

Mean: 0  
Variance: 0.05  
Seed: 0  
Sample time: 20

**Block Parameters: Normiranje ref. signala**  
Fcn  
General expression block. Use "u" as the input variable name. Example:  $\sin(u(1)*\exp(2.3*(-u(2))))$

Parameters

Expression:  $2*(u(1)-\min_{\text{izlaz}})/(\max_{\text{izlaz}}-\min_{\text{izlaz}})-1$   
Sample time: *Not recommended for this block. Set to -1 to inherit from the preceding block.* 0.1

**Block Parameters: Normiranje izlaza**  
Fcn  
General expression block. Use "u" as the input variable name. Example:  $\sin(u(1)*\exp(2.3*(-u(2))))$

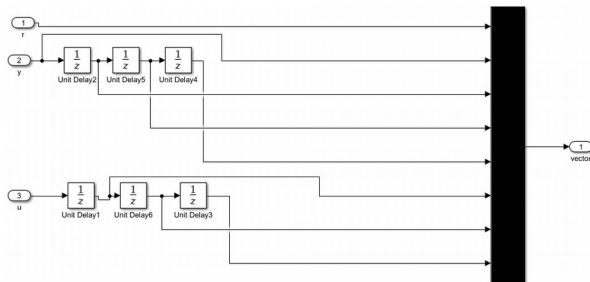
Parameters

Expression:  $2*(u(1)-\min_{\text{izlaz}})/(\max_{\text{izlaz}}-\min_{\text{izlaz}})-1$   
Sample time: *Not recommended for this block. Set to -1 to inherit from the preceding block.* 0.1

**Block Parameters: Normiranje ulaza**  
Fcn  
General expression block. Use "u" as the input variable name. Example:  $\sin(u(1)*\exp(2.3*(-u(2))))$

Parameters

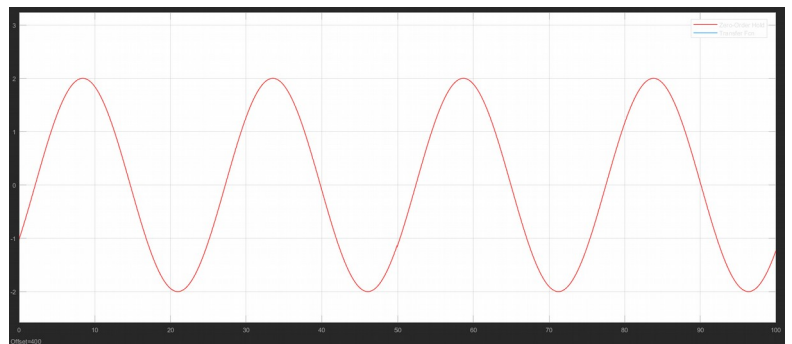
Expression:  $2*(u(1)-\min_{\text{ulaz}})/(\max_{\text{ulaz}}-\min_{\text{ulaz}})-1$   
Sample time: *Not recommended for this block. Set to -1 to inherit from the preceding block.* 0.1



**Block Parameters: Prilagodba izlaza**  
Fcn  
General expression block. Use "u" as the input variable name. Example:  $\sin(u(1)*\exp(2.3*(-u(2))))$

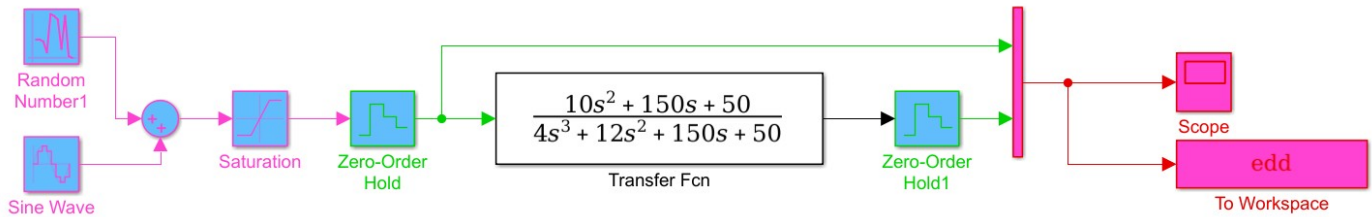
Parameters

Expression:  $(u(1)+1)*(\max_{\text{ulaz}}-\min_{\text{ulaz}})/2+\min_{\text{ulaz}}$   
Sample time: *Not recommended for this block. Set to -1 to inherit from the preceding block.* 0.1



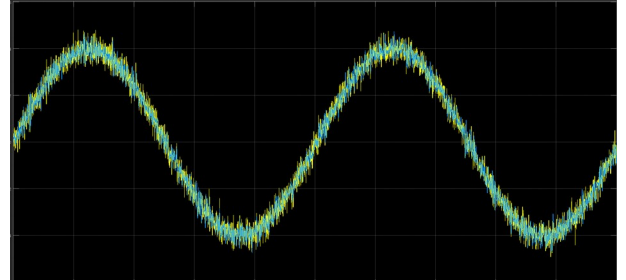
NARKS

t=500



Block Parameters: Random Number1	
Random Number	
Output a normally (Gaussian) distributed random signal, repeatable for a given seed.	
Parameters	
Mean:	0
Variance:	0.1
Seed:	0
Sample time:	0.1

Block Parameters: Sine Wave	
Sine Wave	
Output a sine wave:	
$O(t) = \text{Amp} \cdot \sin(\text{Freq} \cdot t + \text{Phase}) + \text{Bias}$	
Sine type determines the computational technique used. The parameters in the two types are related through:	
Samples per period = $2 \cdot \pi / (\text{Frequency} \cdot \text{Sample time})$	
Number of offset samples = $\text{Phase} \cdot \text{Samples per period} / (2 \cdot \pi)$	
Use the sample-based sine type if numerical problems due to ru for large times (e.g. overflow in absolute time) occur.	
Parameters	
Sine type:	Time based
Time (t):	Use simulation time
Amplitude:	4
Bias:	0
Frequency (rad/sec):	0.025
Phase (rad):	0
Sample time:	0.1



## b) Matlab kod

```
P= edd(:, 1);
T = edd(:, 2);
vel = length(P);
minulaz = min(P);
maxulaz = max(P); %opseg ulaznih vrijednosti
minizlaz = min(T);
maxizlaz = max(T); %opseg moguceg izlaza

% normiranje ulaza i izlaza na opseg [-1, 1]
p= 2 * (P - minulaz) ./ (maxulaz - minulaz) - 1;
t = 2 * (T - minimizlaz) ./ (maxizlaz - minimizlaz) - 1;
N=4;
p=p;
t=t;
for k = N+1 : vel
    t1 = flipud( t(k-N:k-1) );
    p1 = flipud( p(k-N:k-1) );
    ulaz(:,k) = [t1; p1];
    izlaz(k) = t(k)';
end

ulaz
izlaz

net = newff([-1 1;-1 1;-1 1;-1 1;-1 1;-1 1;-1 1;-1 1], [15 1], {'tansig',
'purelin'}, 'trainlm');
```

```

net.trainParam.epochs = 2000;
net.trainParam.goal = 2e-4;
net.trainParam.show = 300;
net.trainParam.time = Inf;
net.performFcn='sse';

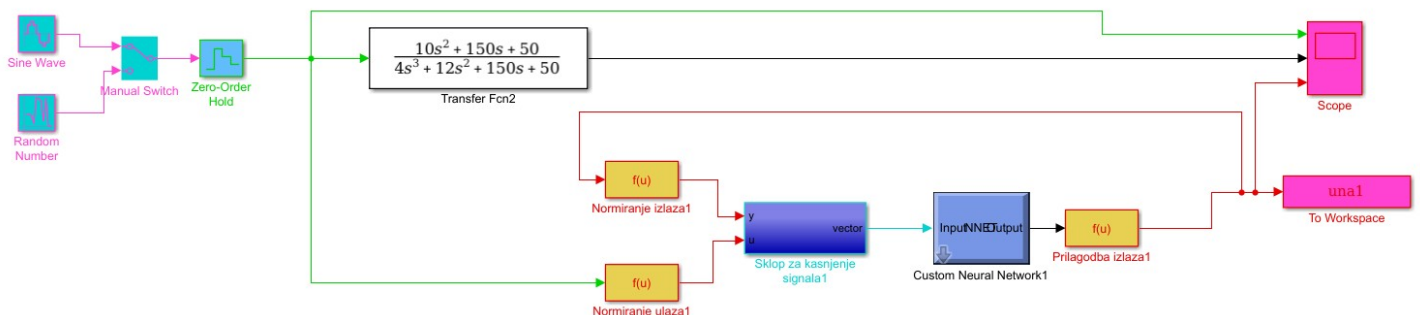
% Treniranje...
fprintf('Po?etak treniranja\n');
tic
net = train(net, ulaz, izlaz);
toc

izlaz=sim(net,ulaz);
izlaz=(izlaz+1)*(maxizlaz-minizlaz)./2 +minizlaz;

figure
subplot(2,1,1),plot(edd(:,1));
title('Izlazni podaci iz sistema');
xlabel('uzorci')
ylabel('amplituda')
subplot(2,1,2),plot(izlaz,'r')
title('Podaci dobiveni sa treniranom mrežom');
xlabel('uzorci')
ylabel('amplituda')
gensim(net,0.1)

```

### c) Zadnji model



$$2 \cdot (u(1) - \text{minizlaz}) / (\text{maxizlaz} - \text{minizlaz}) - 1$$

$$2 \cdot (u(1) - \text{minulaz}) / (\text{maxulaz} - \text{minulaz}) - 1$$

$$(u(1) + 1) \cdot (\text{maxizlaz} - \text{minizlaz}) / 2 + \text{minizlaz}$$

