Appendix A

Genetic Tuning the weights of the NNs.

% Programs to tune the weights of RNNs %

```
function fit=basicunderdamped(z)
theta = input ( ' theta = ' ); % put theta =[0.2  0.7  1.0  1.2  1.0  0.5] in BEN & MEN.
wn=sqrt(20);wd=wn*sqrt(1-theta^2);
numc=1;denc=[1 2*theta*wn wn^2];
tp=pi/wd;Ts=tp/10;
[numd dend]=c2dm(numc,denc,Ts,'tustin');
a=dend/dend(1);b=numd/dend(1);
a1=-a(2);a2=-a(3);b1=b(1);b2=b(2);b3=b(3);
u=[ones(1,100),-ones(1,100),ones(1,100)];
y1=0;y2=0;u2=1;u1=1;
for k=1:length(u)
   yd(k)=a1*y1+a2*y2+b1*u(k)+b2*u1+b3*u2;
   y2=y1;y1=yd(k);u2=u1;u1=u(k);
end
order=2;
N=length(u);
a=size(z);
M=a(1,1);
for t=1:M
   %======== Wxc
   n=1 ;
   for k=1:order
      for l=1:order
         Wxc(k,l)=z(t,n);
         n=n+1;
      end
    end
       %-----------Wyx
```