Chaotic Time Series - Matlab Code

Lukas Fu

Matlab Code

Main

```
clear;clc;clf;

% initialize variables
xTrain = load('training-set.csv');
xTest = load('test-set-5.csv');
nInput = size(xTrain,1);
nReservoir = 500;
kRidge = 0.01;
[wIn,wReservoir] = InitializeNetwork(nInput,nReservoir);

predictTimeStep = 500;

wOut = TrainReservoir(wIn,wReservoir,kRidge,xTrain);
predictionOutput = Predict(wIn,wReservoir,xTest,wOut,predictTimeStep);
hold on
grid on
plot3(predictionOutput(1,:),predictionOutput(2,:),predictionOutput(3,:), ...
    'b',LineWidth=0.01)
plot3(xTest(1,:),xTest(2,:),xTest(3,:),'r')
v = [-2 3 2];
[caz,cel] = view(v);
legend('Test Data','Prediction')
%% csv write
writematrix(predictionOutput(2,:),'prediction.csv')
```

Initialize Network

```
function [wIn,wReservoir] = InitializeNetwork(nInput,nReservoir)
variance1 = sqrt(0.002);
variance2 = 2/nReservoir;
wIn = normrnd(0,variance1,nReservoir,nInput);
wReservoir = normrnd(0,variance2,nReservoir,nReservoir);
end
```

Train Reservoir

```
function wOut = TrainReservoir(wIn,wReservoir,kRidge,xTrain)
    nReservoir = size(wReservoir,1);
    trainT = size(xTrain,2);
    R = zeros(nReservoir,trainT);
    rNext = zeros(nReservoir,1);

```

```
    for t = 1:trainT
        R(:,t) = rNext;
        xNext = xTrain(:,t);
        rNext = tanh(wReservoir * rNext + wIn * xNext);
    end
    wOut = xTrain * R.' * inv(R * R.' + kRidge * eye(nReservoir));
end
```

Predict

```
function predictionOutput = Predict(wIn,wReservoir,xTest,wOut,predictTimestep)
nInput = size(xTest,1);
nReservoir = size(wReservoir,2);
testT = size(xTest,2);
R = zeros(nReservoir,testT+predictTimestep);
rNext = zeros(nReservoir,1);
for t = 1:testT
    R(:,t) = rNext;
    xNext = xTest(:,t);
    rNext = tanh(wReservoir * rNext + wIn * xNext);
end

predictionOutput = zeros(nInput,predictTimestep);
for t = 1:predictTimestep
    outputNow = wOut*rNext;
    predictionOutput(:,t) = outputNow;
    rNext = tanh(wReservoir * rNext + wIn * outputNow);
end
end
```