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%{
    This is a simple script that performs an analysis of a time
    series, using
    the autocorrelational and the partial autocorrelational plots to
    find the
    best model (ARX, MAX, ARMAX) of the box-jenkins methodology, in
    order to
    make a parametric identification of the system.

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%}

% Clean up the Matlab workspace
clear; close all; clc;

% Load the database
fprintf('Loading database...\n');
load('mat-files/motor_identification.mat');

% Define the variables of the system
yd = ST(:,2); % System response from Simulink
u = ST(:,1); % System setpoint from Simulink

% Define the iteration vector
k = 1:1:size(yd);

% Plot the input and the time response of the system
figure
plot(k,u,'r',k,yd,'b','linewidth',2);
legend("Reference", "Time response")
ylabel("Amplitud")
xlabel("Iteraciones [k] - (Ts = 0.01s)")
prettygraph("Identificación del sistema dinámico","plot")

% Autocorrelation and partial autocorrelation plots
figure
autocorr(yd,size(yd,1) - 1); % Autocorrelation plot
prettygraph("Sample Autocorrelation Function","plot")
figure
parcorr(yd,100); % Partial autocorrelation plot
prettygraph("Sample Partial Autocorrelation Function","plot")

% Calculate the simulation matrix
data = iddata(yd,u,0.01); % iddata([out_sys],[in_sys],[Time_period])

%{ Autoregressive combined with moving mean model (ARMAX model) with
% exogenous input.
yarmax = armax(data,[2,1,2,0]) % [[out_sys_delays] [in_sys_delays]
    [error_delays] [delays_sys]]
ys1 = idsim(u,yarmax); % Simulate the armax system
figure

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plot(k,yd,'b',k,ys1,'r','linewidth',2);
legend("Real system", "armax model")
ylabel("Amplitud")
xlabel("Iteraciones [k] - (Ts = 0.01s)")
prettygraph("Comparación entre la planta y el modelo
paramétrico","plot")
fprintf('ARMAX model done!\n');

Loading database....

yarmax =
Discrete-time ARMAX model:  $A(z)Y(t) = B(z)u(t) + C(z)e(t)$ 
 $A(z) = 1 - 1.997 z^{-1} + 0.9968 z^{-2}$ 

 $B(z) = 1.354e-05$ 

 $C(z) = 1 - 1.728 z^{-1} + 0.741 z^{-2}$ 

Sample time: 0.01 seconds

Parameterization:
Polynomial orders: na=2 nb=1 nc=2 nk=0
Number of free coefficients: 5
Use "polydata", "getpvec", "getcov" for parameters and their
uncertainties.

Status:
Estimated using ARMAX on time domain data "data".
Fit to estimation data: 99.99% (prediction focus)
FPE: 6.009e-05, MSE: 6.008e-05
ARMAX model done!

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