SPARSE IDENTIFICATION OF NON-LINEAR DYNAMICS (SINDy)

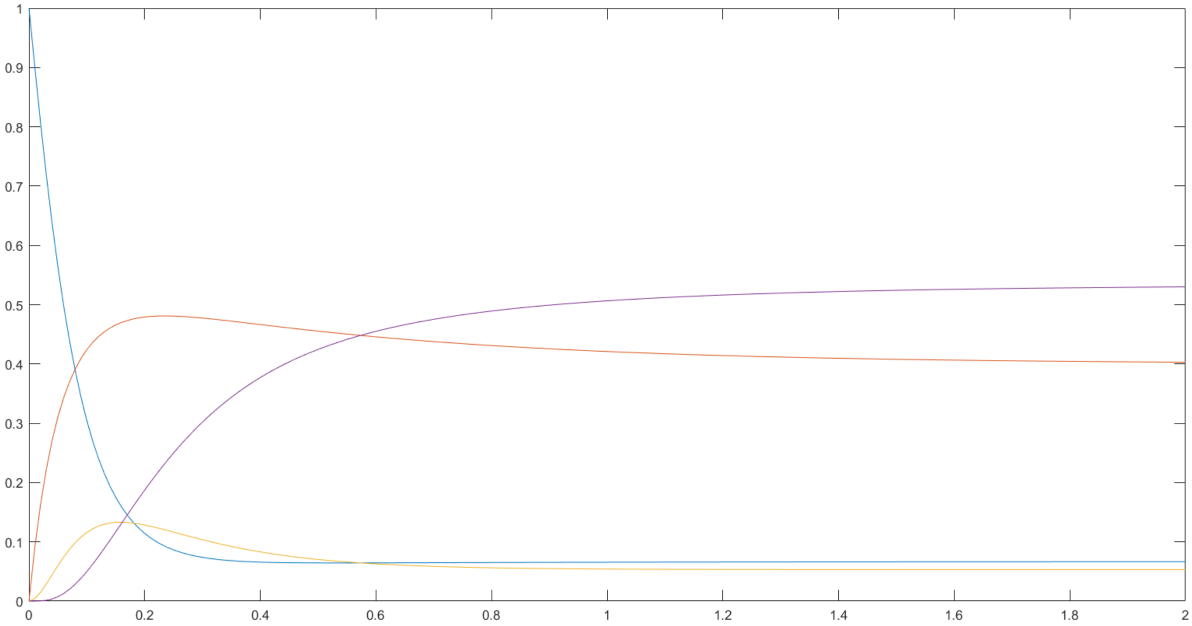
Data-driven recovery of governing equation of a Polymerization reaction in a CSTR using MATLAB.

Note: We are generating our own data for simplification, for this, we are using an ode solver to calculates the concentration for a particular time range.

1. CODE FOR DATA GENERATION

```
function [z_dot]= function_deri(t,z)
M=z(1);
P1=z(2);
P2=z(3);
P3=z(4);


% M --> P1           initiation step
% P1 + M --> P2      propagation step
% P2 + P1--> P3      terminal step

Fin=1;Fout=1;V=5;CMin=1;Ki=2;Kp=2;Kt=5;
z_dot(1,1)=Fin*CMin-Fout*M + V*(-Ki*M - Kp*M*(P1));
z_dot(2,1)=-Fout*P1 + V*(Ki*M - Kp*M*P1);
z_dot(3,1)=-Fout*P2 + V*(Ki*M*P1 - Kp*P1*P2);
z_dot(4,1)=-Fout*P3 + V*(Kt*P1*P2);


clc
z0=[1;0;0;0];
[tval,zval]=ode45(@(t,z) function_deri(t,z),[0:0.01:2],z0);
plot(tval,[zval(:,1) zval(:,2) zval(:,3) zval(:,4)])

zder_val=diff_fun(zval,tval);
```

In this way, we calculated the concentration of all elements in CSTR.



2. CODE FOR SINDY

```
zval_mod=zval(2:end,:)
M=zval_mod(:,1);
P1=zval_mod(:,2);
P2=zval_mod(:,3);
P3=zval_mod(:,1);

X=[ones(size(zval_mod,1),1) , zval_mod , zval_mod.^2  M.*( zval_mod(:,2:end))
P1.*(zval_mod(:,3:end)) P2.*P3];

[B,S] = lasso(X,zder_val(:,1),'CV',3);
theta_opt = (B(:,S.IndexMinMSE));
```

Here Theta_opt is our vector which should be multiplied by X to calculate Y1.