SS-model:

$$x(t+T_s) = Ax(t) + Bu(t) + Ke(t)$$
$$y(t) = Cx(t) + Du(t) + e(t)$$

$A \in R^{n \times n}$, $B \in R^{n \times m}$, $C \in R^{1 \times n}$, $D \in R^{1 \times m}$
$x(t) \in R^{n}$, $y(t) \in R$, $u(t) \in R^{m}$,
$K \in R^{n \times m}$

$e(t)$ - difference between measured and predicted output of the model.

Parameter estimation using PEM

- ☐ ARX model (posible best chose)
- ☐ ARMAX model
- ☐ OE model
- ☐ BJ model

Models description:

1) Define state parameters :

$$x_1 = x$$

$$x_2 = dx$$

$$x_3 = p_A$$

$$x_4 = p_B$$

$$x(t) = f(x(t), u(t))$$

Models identification

Mechanical assembly:

F_f parameter represent Friction forces.

1) input data: $\dot{m}_A$, $\dot{m}_B$ - flows that can be measured.

output data: x - position

2) input data: $\dot{m}_A$, $\dot{m}_B$ - flows

output data: $\ddot{x}$ - accelerometer data.

Depends how to model, but generally:

- ☐ **C** - viscous friction coefficient
- ☐ **f_c** - Coulomb friction
- ☐ **f_s, f_d** - static, dynamic friction factor.

Cylinder :

- All parameters can be measured or taken from datasheets.

Valve :

With respect to equation for mass flow

$$\dot{m} = u(x_s)\, C \underbrace{p_1 \sqrt{\frac{2}{RT}}\, \Psi\left(\frac{p_2}{p_1}\right)}_{\text{const}}$$

where p_1 - supply pressure

p_2 - atmospheric pressure

1) C is valve coefficient that need to be identified.

in 1.st experement we