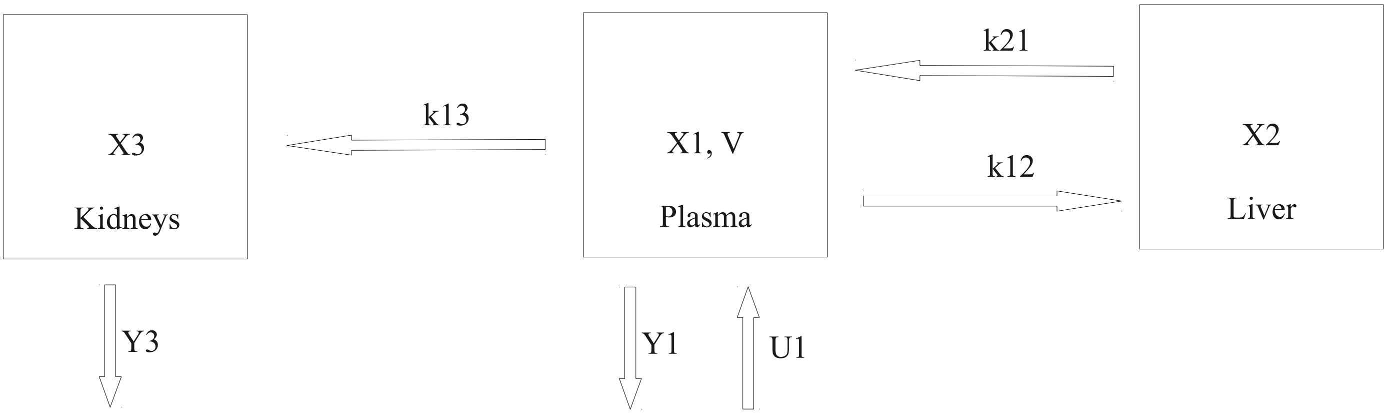
Identyfiability analysis



k12 = 0.5
k21 = 0.4
k13 = 0.3
U1 = 200 mg
V = 5 l

$$A = \begin{pmatrix} -0.8 & 0.4 & 0 \\ 0.5 & -0.4 & 0 \\ 0.3 & 0 & 0 \end{pmatrix} \qquad B = \begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix}$$

$$\dot{X}1 = U1 - X1*0.5 - X1*0.3 + X2*0.4$$
$$\dot{X}2 = X1*0.5 - X2*0.4$$
$$\dot{X}3 = X1*0.3$$

$$C = \begin{pmatrix} 1/V & 0 & 0 \\ 0 & 0 & 1 \end{pmatrix} \qquad D = [0\ 0\ 0]$$

Solving the task in Matlab:

```
syms k13 k12 k21 V s ;
A=[-k13-k12 k21 0 ; k12 -k21 0 ; k13 0 0] ;
B=[1 ; 0 ; 0] ;
C=[1/V 0 0 ; 0 0 1] ;
I=eye(3) ;
TF = C*(inv(s*I-A))*B ;
```

We have 2 transfer functions for this model:

1)

$$TF = \frac{s + k21}{V \cdot \left(s^2 + (k12 + k13 + k21) \cdot s + k13 \cdot k21\right)}$$

2)

$$TF = \frac{k13 \cdot (s + k21)}{s^3 + (k12 + k13 + k21) \cdot s^2 + k13 \cdot k21 \cdot s}$$

So, our observation parameters are: $a1=1/V$, $a0=k21/V$, $b0=k13*k21$, $b1=k12+k13+k21$, $b2=1$; in the second case: $a0=k21$, $a1=k13$, $b1=k13*k21$, $b2=k12+k13+k21$, $b3=1$.

In the first case model is identifiable and model parameters are:
$V=1/a1$,
$k12=-(a0^2 - b1*a0*a1 + b0*a1^2)/(a0*a1)$,
$k13=(a1*b0)/a0$,
$k21=a0/a1$

in the second case model is partly identifiable, because there are 4 equations for 3 variables and there are no explicit solution in the case.

Figure 2: simulation model

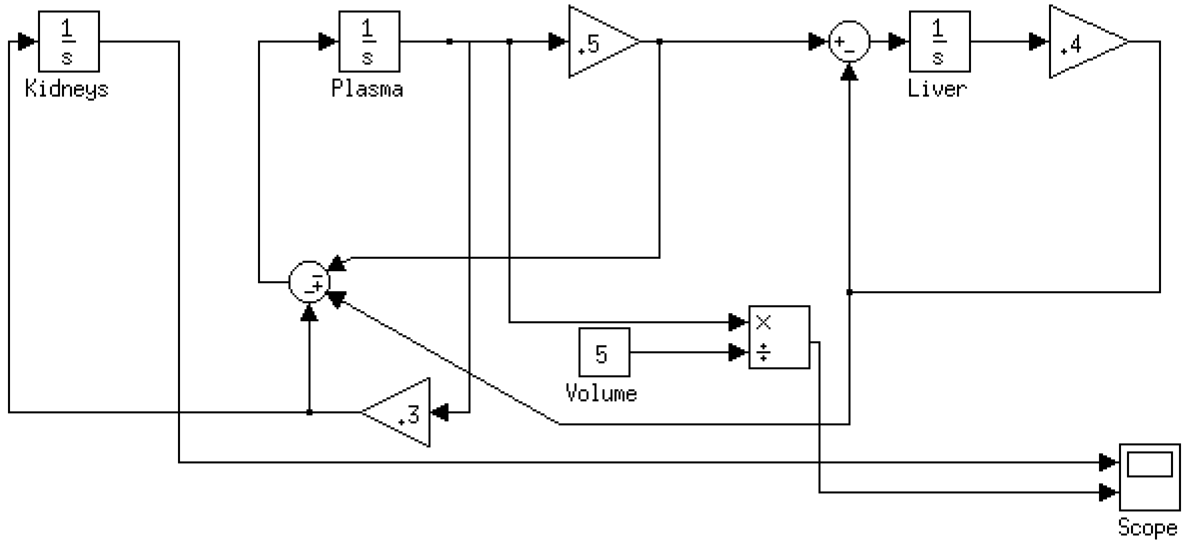


Figure 2: simulation plot