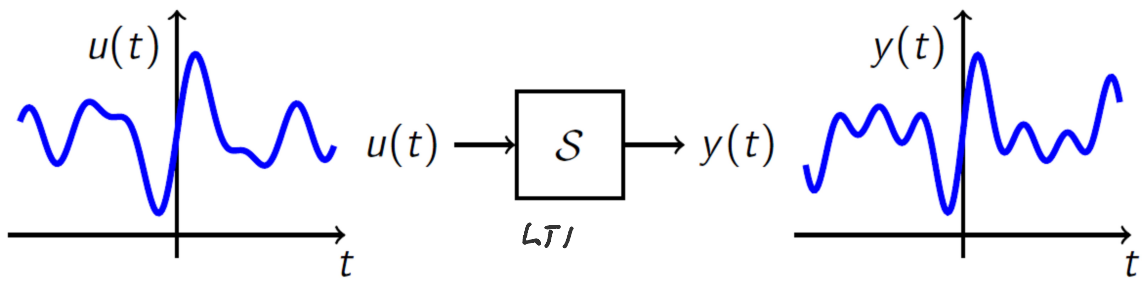
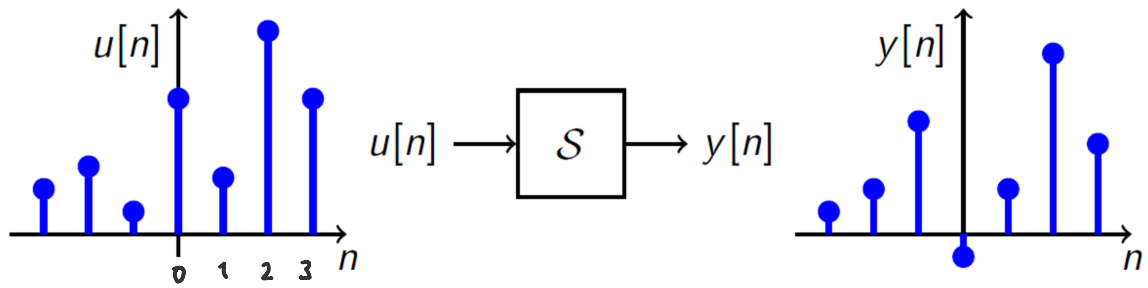
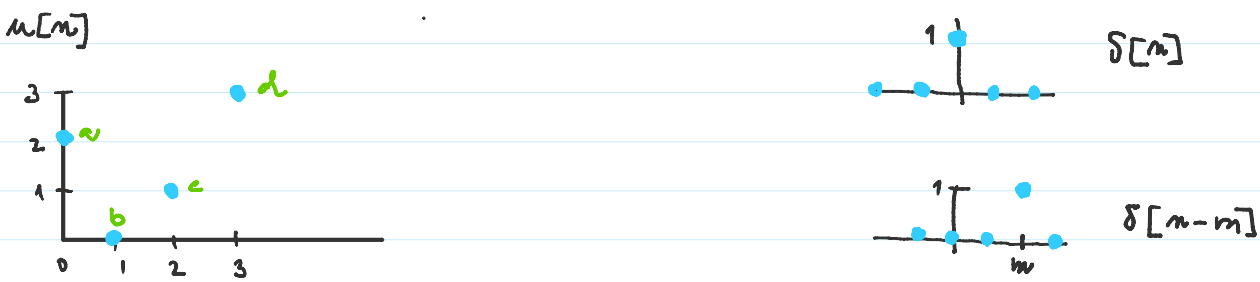
Poznámky ke 4. přednášce







a) $u[n]\cdot\delta[n]$

b) $u[n]\cdot\delta[n-1]$

⋮

d) $u[n]\cdot\delta[n-3]$

$$\left.\right\} \sum_{m=-\infty}^{\infty} u[m]\cdot\delta[n-m]$$

$$y[n] = S\{u[n]\} = S\left\{\sum_{m=-\infty}^{\infty} u[m]\cdot\delta[n-m]\right\} =$$

$$= \sum_{m=-\infty}^{\infty} u[m]\cdot S\{\delta[n-m]\} = \sum_{m=-\infty}^{\infty} u[m]\cdot h[n,m]$$

KONVOLUCE

KONVOLUCE

$$y[n] = \sum_{m=-\infty}^{\infty} h[n-m] \cdot u[m] = \sum_{k=-\infty}^{\infty} h[k] \cdot u[n-k],$$

$$y[n] = h[n] * u[n].$$

NENÍ TO NÁSOBENÍ

$$\cancel{h[n] = \frac{y[n]}{u[n]}}$$

KAUZALITA

$$y[n] = \sum_{k=-\infty}^{\infty} h[k]\, u[n-k]$$

kauzální

$$= \underbrace{\sum_{k=-\infty}^{-1} h[k]\, u[n-k]}_{0} + \sum_{k=0}^{\infty} h[k]\, u[n-k]$$

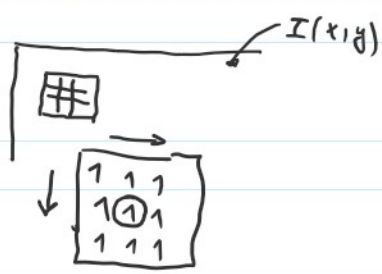
nekauzální

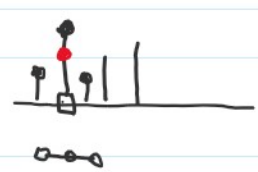
$$y[n+2] + \sin(n) \cdot y[n] = \sin(n)$$

$\sin(n)$, $\sin(n+1)$, $\sin(n+2)$ } kauzální

$\sin(n+3)$ -> nekauzální

	diskrétní	spojité
Signály	$\delta[n]$	$\delta(t)$
	$\delta[n-m]$	$\delta(t-\tau)$
	$\mathbb{1}[n]$	$\mathbb{1}(t)$
	$\mathbb{1}[n-m]$	$\mathbb{1}(t-\tau)$
Odezvy	$h[n] = S\{\delta[n]\}$	$h(t) = S\{\delta(t)\}$
	$h[n,m] = S\{\delta[n-m]\}$	$h(t,\tau) = S\{\delta(t-\tau)\}$
	$s[n] = S\{\mathbb{1}[n]\}$	$s(t) = S\{\mathbb{1}(t)\}$
	$y[n] = \sum_{k=-\infty}^{\infty} h[k]\, u[n-k]$	$y(t) = \int_{-\infty}^{\infty} h(\tau)\, u(t-\tau)\, d\tau$





Vnitřní (stavový) popis

NELINEÁRNÍ

Spojitý systém	Diskrétní systém
vstup $\mathbf{u}(t)$ vektor	$\mathbf{u}[n]$
stav $\mathbf{x}(t)$	$\mathbf{x}[n]$
výstup $\mathbf{y}(t)$	$\mathbf{y}[n]$
$\mathbf{x}'(t) = \mathbf{f}(t, \mathbf{x}(t), \mathbf{u}(t))$	$\mathbf{x}[n+1] = \mathbf{f}(n, \mathbf{x}[n], \mathbf{u}[n])$
$\mathbf{y}(t) = \mathbf{g}(t, \mathbf{x}(t), \mathbf{u}(t))$	$\mathbf{y}[n] = \mathbf{g}(n, \mathbf{x}[n], \mathbf{u}[n])$

LINEÁRNÍ ČASOVĚ PROMĚNNÝ

NESTACIONÁRNÍ

Spojitý systém	Diskrétní systém
$\mathbf{u}(t)$ ... vstup	$\mathbf{u}[n]$
stav $\mathbf{x}(t)$	$\mathbf{x}[n]$
výstup $\mathbf{y}(t)$	$\mathbf{y}[n]$
$\mathbf{x}'(t) = \mathbf{A}(t)\,\mathbf{x}(t) + \mathbf{B}(t)\,\mathbf{u}(t)$	$\mathbf{x}[n+1] = \mathbf{M}(n)\,\mathbf{x}[n] + \mathbf{N}(n)\,\mathbf{u}[n]$
$\mathbf{y}(t) = \mathbf{C}(t)\,\mathbf{x}(t) + \mathbf{D}(t)\,\mathbf{u}(t)$	$\mathbf{y}[n] = \mathbf{C}[n]\,\mathbf{x}[n] + \mathbf{D}[n]\,\mathbf{u}[n]$

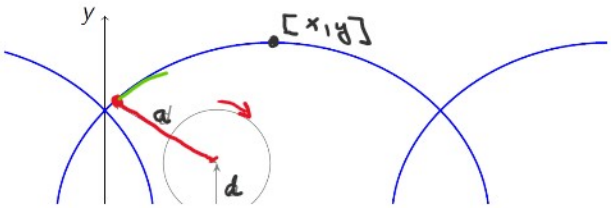
!

Spojitý systém	Diskrétní systém
$\mathbf{u}(t)$ ... vstupní (řídicí) vektor	$\mathbf{u}[n]$ ... vstupní (řídicí) vektor
$\mathbf{x}(t)$ ... stavový vektor	$\mathbf{x}[n]$ ... stavový vektor
$\mathbf{y}(t)$ ... výstupní vektor	$\mathbf{y}[n]$ ... výstupní vektor
$\mathbf{x}'(t) = \mathbf{A}\,\mathbf{x}(t) + \mathbf{B}\,\mathbf{u}(t)$	$\mathbf{x}[n+1] = \mathbf{M}\,\mathbf{x}[n] + \mathbf{N}\,\mathbf{u}[n]$
$\mathbf{y}(t) = \mathbf{C}\,\mathbf{x}(t) + \mathbf{D}\,\mathbf{u}(t)$	$\mathbf{y}[n] = \mathbf{C}\,\mathbf{x}[n] + \mathbf{D}\,\mathbf{u}[n]$
$\mathbf{A}$ je matice systému $(n \times n)$	$\mathbf{M}$ je matice systému $(n \times n)$
$\mathbf{B}$ je matice vstupů (řízení) $(n \times r)$	$\mathbf{N}$ je matice vstupů (řízení) $(n \times r)$
$\mathbf{C}$ je výstupní matice $(m \times n)$	$\mathbf{C}$ je výstupní matice $(m \times n)$
$\mathbf{D}$ je výstupní matice $(m \times r)$	$\mathbf{D}$ je výstupní matice $(m \times r)$

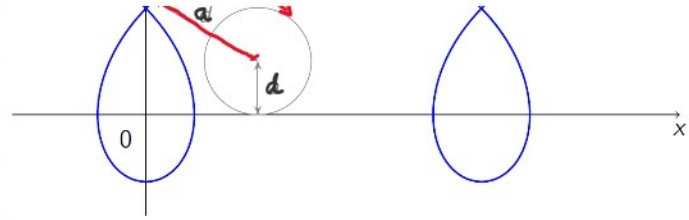
Cykloida

$x = x_1(t) = at - d \sin t$

$y = x_2(t) = a - d \cos t$



$y = x_2(t) = a - d\cos t$



$x_1(0) = a\cdot 0 - d\cdot\sin 0 = 0$

$x_2(0) = a - d\cos 0 = a - d$

$$\begin{bmatrix} x_1'(t) \\ x_2'(t) \end{bmatrix} = \overset{A}{\begin{bmatrix} ? & ? \\ ? & ? \end{bmatrix}} \begin{bmatrix} x_1(t) \\ x_2(t) \end{bmatrix} + \overset{B}{\begin{bmatrix} ? \\ ? \end{bmatrix}} t$$

$$y(t) = \overset{C}{\begin{bmatrix} ? & ? \end{bmatrix}} \begin{bmatrix} x_1(t) \\ x_2(t) \end{bmatrix} + D\cdot t$$

$D = 0$

$$\rightarrow \begin{bmatrix} x_1'(t) \\ x_2'(t) \end{bmatrix} = \begin{matrix} a - d\cdot\cos t = x_2(t) \\ d\cdot\sin t = -x_1(t) + at \end{matrix}$$

$y = x_2(t) = a - d\cos t$

$x = x_1(t) = at - d\sin t$

$d\cdot\sin t = -x_1(t) + at$

$$\begin{bmatrix} x_1'(t) \\ x_2'(t) \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -1 & 0 \end{bmatrix} \begin{bmatrix} x_1(t) \\ x_2(t) \end{bmatrix} + \begin{bmatrix} 0 \\ a \end{bmatrix} t$$

$$\begin{bmatrix} \bullet \end{bmatrix} = \begin{bmatrix} a_1 & a_2 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} \quad a_1\cdot x_1 + a_2\cdot x_2$$

$$y(t) = \begin{bmatrix} 0 & 1 \end{bmatrix} \begin{bmatrix} x_1(t) \\ x_2(t) \end{bmatrix}$$

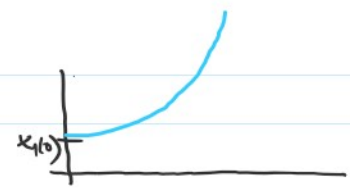
Lotka - Volterra (predator - prey)

$$\frac{d}{dt}x_1(t) = a\,x_1(t) - b\,x_1(t)x_2(t),$$
$$\frac{d}{dt}x_2(t) = -c\,x_2(t) + d\,x_1(t)x_2(t).$$

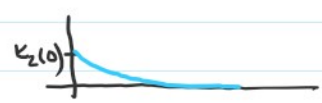
$x_1(t)$ ... populace ovcí

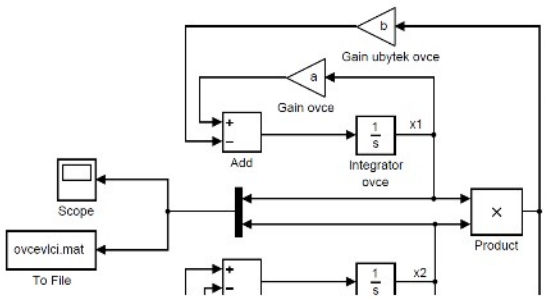
$x_2(t)$ ... - " - vlků

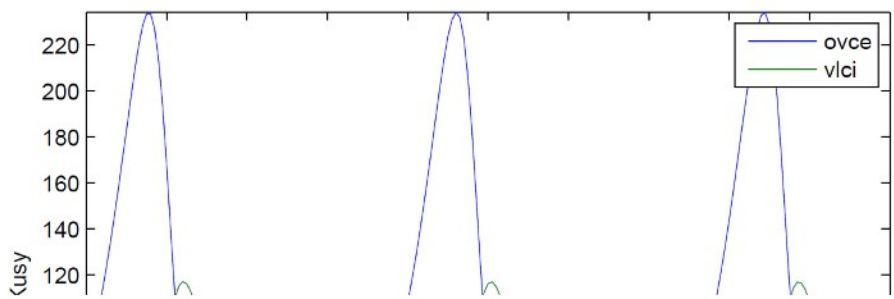
$x_1'(t) = a\cdot x_1(t) \rightarrow x_1(t) = x_1(0)\cdot e^{at}$

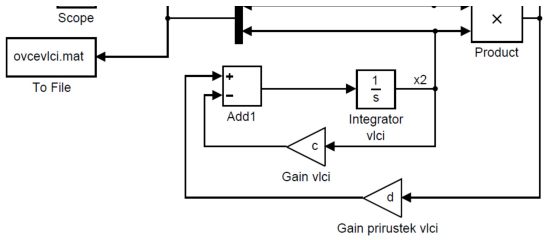


$x_2'(t) = -c\cdot x_2(t) \rightarrow x_2(t) = x_2(0)\cdot e^{-ct}$





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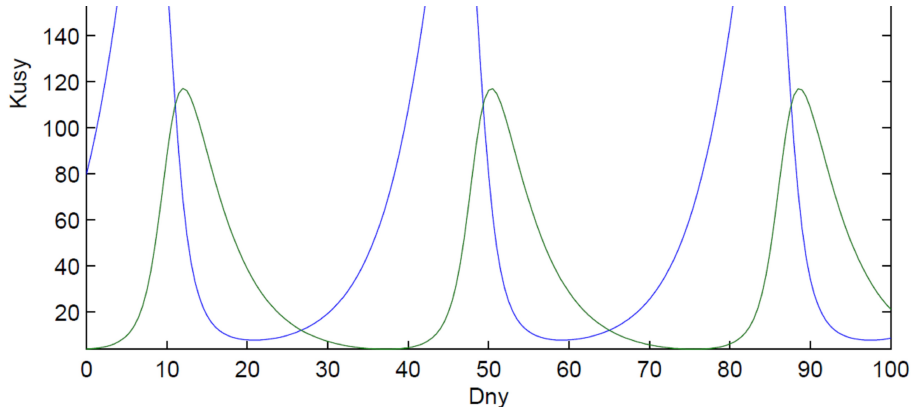
To File
Product
Add1
Integrator
vlci
x2
Gain vlci
Gain prirustek vlci


Kusy
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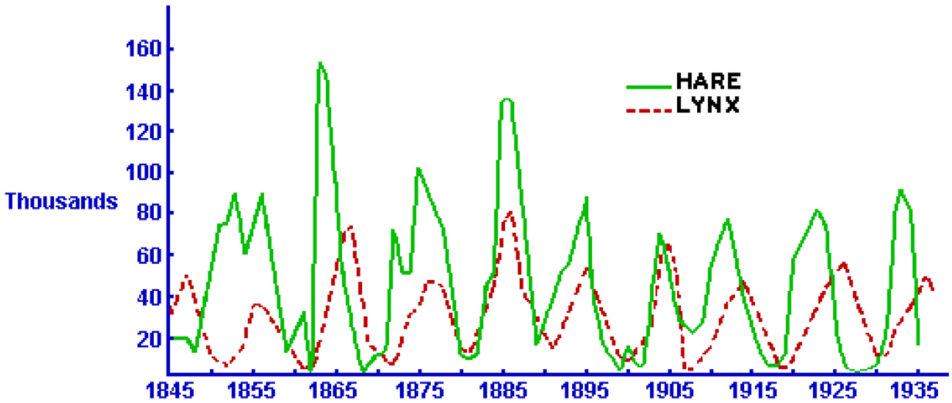
HARE
LYNX
Thousands