Dinaminės sistemos

$$\begin{cases} x' = x + y, \\ y' = 4x - 2y. \end{cases}$$

analizė ir fazinis portretas (normuotame krypčių lauke).

```
syms x(t) y(t) t
[x,y]=meshgrid(-10:0.5:10,-10:0.5:10);
dy=4*x-2*y;
dx=x+y;
dyu = dy./sqrt(dx.^2+dy.^2);
dxu = dx./sqrt(dx.^2+dy.^2);
quiver(x,y,dxu,dyu)
xmin=x(1)-(x(1)-x(2))/2;
xmax=x(end)+(x(1)-x(2))/2;
ymin=y(1)-(y(1)-y(2))/2;
ymax=y(end)+(y(1)-y(2))/2;
axis([xmin xmax ymin ymax]);
hold on;
axis square; xlabel('x'), ylabel('y')
title('Dinaminės sistemos krypčių laukas')

clear all;
syms x(t) y(t) t
DL=[diff(x,t)==x+y,diff(y,t)==4*x-2*y];
sal=[x(0)==2,y(0)==-3];
[xspr,yspr]=dsolve(DL,sal)
```

xspr = $e^{2t} + e^{-3t}$

yspr = $e^{2t} - 4\,e^{-3t}$

```
fplot(xspr,yspr,'b')
hold on;
sal1=[x(0)==-1,y(0)==-8];
[xspr1,yspr1]=dsolve(DL,sal1)
```

xspr1 =

$$\frac{7\,e^{-3t}}{5} - \frac{12\,e^{2t}}{5}$$

yspr1 =

$$-\frac{12\,e^{2t}}{5} - \frac{28\,e^{-3t}}{5}$$

```
fplot(xspr1,yspr1,'b')
hold on;
sal2=[x(0)==-1,y(0)==8];
[xspr2,yspr2]=dsolve(DL,sal2)
```

xspr2 =

$$\frac{4\,e^{2t}}{5} - \frac{9\,e^{-3t}}{5}$$

yspr2 =

$$\frac{4\,e^{2t}}{5} + \frac{36\,e^{-3t}}{5}$$

```
fplot(xspr2,yspr2,'b')
hold on;
sal3=[x(0)==-3,y(0)==-1];
[xspr3,yspr3]=dsolve(DL,sal3)
```

xspr3 =

$$-\frac{13\,e^{2t}}{5} - \frac{2\,e^{-3t}}{5}$$

yspr3 =

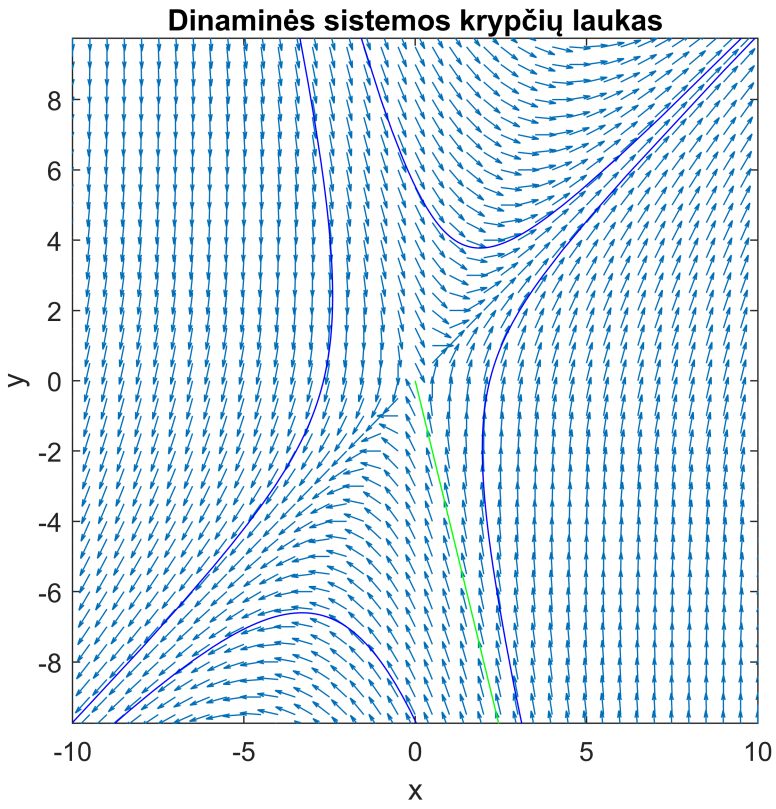
$$\frac{8\,e^{-3t}}{5} - \frac{13\,e^{2t}}{5}$$

```
fplot(xspr3,yspr3,'b')
hold on;
sal4=[x(0)==1,y(0)==-4];
[xspr4,yspr4]=dsolve(DL,sal4)
```

xspr4 = e^{-3t}

yspr4 = $-4\,e^{-3t}$

```
fplot(xspr4,yspr4,'g')
hold off;
```




```
A=[1 1;4 -2]
```

```
A = 2×2
     1     1
     4    -2
```

```
eig(A)
```

```
ans = 2×1
     2
    -3
```

```
[V,D]=eig(A)
```

```
V = 2×2
    0.7071   -0.2425
    0.7071    0.9701
D = 2×2
     2     0
     0    -3
```

Dinaminės sistemos

$$\begin{cases} x' = x + y, \\ y' = 4x - 2y. \end{cases}$$

analizė ir fazinis portretas (nenormuotame krypčių lauke). Juodai pažymėta stabilioji ašis, o žaliai – nestabilioji.

```
syms x(t) y(t) t
[x,y]=meshgrid(-10:0.5:10,-10:0.5:10);
dy=4*x-2*y;
dx=x+y;
quiver(x,y,dx,dy)
xmin=x(1)-(x(1)-x(2))/2;
xmax=x(end)+(x(1)-x(2))/2;
ymin=y(1)-(y(1)-y(2))/2;
ymax=y(end)+(y(1)-y(2))/2;
axis([xmin xmax ymin ymax]);
hold on;
axis square; xlabel('x'), ylabel('y')
title('Dinaminės sistemos krypčių laukas')

clear all;
syms x(t) y(t) t
DL=[diff(x,t)==x+y,diff(y,t)==4*x-2*y];
sal=[x(0)==2,y(0)==-3];
[xspr,yspr]=dsolve(DL,sal)
```

```
xspr = e^(2*t) + e^(-3*t)
yspr = e^(2*t) - 4*e^(-3*t)
```

```
fplot(xspr,yspr,'r')
hold on;
sal1=[x(0)==-1,y(0)==-8];
[xspr1,yspr1]=dsolve(DL,sal1)
```

```
xspr1 =
```

$$\frac{7\,e^{-3t}}{5} - \frac{12\,e^{2t}}{5}$$

```
yspr1 =
```

$$-\frac{12\,e^{2t}}{5} - \frac{28\,e^{-3t}}{5}$$

```
fplot(xspr1,yspr1,'r')
hold on;
sal2=[x(0)==-1,y(0)==8];
[xspr2,yspr2]=dsolve(DL,sal2)
```

```
xspr2 =
```

$$\frac{4\,e^{2t}}{5}-\frac{9\,e^{-3t}}{5}$$

yspr2 =

$$\frac{4\,e^{2t}}{5}+\frac{36\,e^{-3t}}{5}$$

```
fplot(xspr2,yspr2,'r')
hold on;
sal3=[x(0)==-3,y(0)==-1];
[xspr3,yspr3]=dsolve(DL,sal3)
```

xspr3 =

$$-\frac{13\,e^{2t}}{5}-\frac{2\,e^{-3t}}{5}$$

yspr3 =

$$\frac{8\,e^{-3t}}{5}-\frac{13\,e^{2t}}{5}$$

```
fplot(xspr3,yspr3,'r')
hold on;
sal4=[x(0)==1,y(0)==-4];
[xspr4,yspr4]=dsolve(DL,sal4)
```

xspr4 = e^{-3t}

yspr4 = $-4\,e^{-3t}$

```
fplot(xspr4,yspr4,'black')
hold on;
sal5=[x(0)==-1,y(0)==4];
[xspr5,yspr5]=dsolve(DL,sal5)
```

xspr5 = $-e^{-3t}$

yspr5 = $4\,e^{-3t}$

```
fplot(xspr5,yspr5,'black')
hold on;
%text(-1,4,'v')
plot(-1,4,'kv')
hold on;
plot(1,-4,'k^')
hold on;
plot(-1,8,'kv')
hold on;
plot(-1,-8,'k^')
hold on;
plot(-3,-1,'kv')
hold on;
plot(2,-3,'k^')
hold on;
```

```
sal6=[x(0)==1,y(0)==1];
[xspr6,yspr6]=dsolve(DL,sal6)
```

$$\text{xspr6} = e^{2t}$$

$$\text{yspr6} = e^{2t}$$

```
fplot(xspr6,yspr6,'g')
hold on;
sal7=[x(0)==-1,y(0)==-1];
[xspr7,yspr7]=dsolve(DL,sal7)
```

$$\text{xspr7} = -e^{2t}$$

$$\text{yspr7} = -e^{2t}$$

```
fplot(xspr7,yspr7,'g')
hold off;
```