

Kinematika

- **hmotný bod:** těleso s nekonečně malými rozměry, ale nenulovou hmotností, tj. žádné otáčení, žádná deformace atd.
bodová hmotnost
- popis pohybu hmotného bodu – tj. poloha hmotného bodu v závislosti na čase
- polohový (radius) vektor \vec{r}
- **trajektorie:** křivka, kterou vytváří koncový bod polohového vektoru
- parametrické vyjádření trajektorie $\vec{r} = r(\vec{t})$

kartézské souřadnice

$$x = x(t)$$

$$y = y(t)$$

$$z = z(t)$$

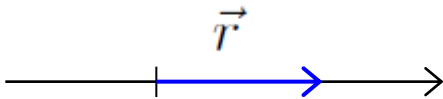
Fyzikální veličiny

Míry fyzikálních vlastností: $X = x [X]$

- **skalární** : invariantní vůči volbě souřadnicové soustavy
- **vektorové**: závisí na volbě souřadnicové soustavy

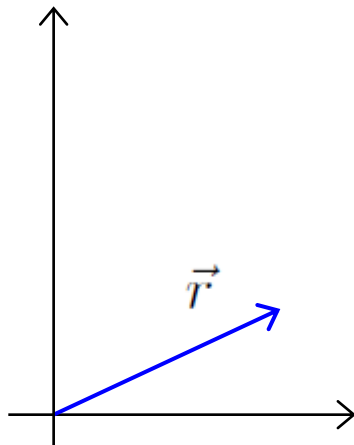
1 D

- skalár: x
- vektor: $\pm x$



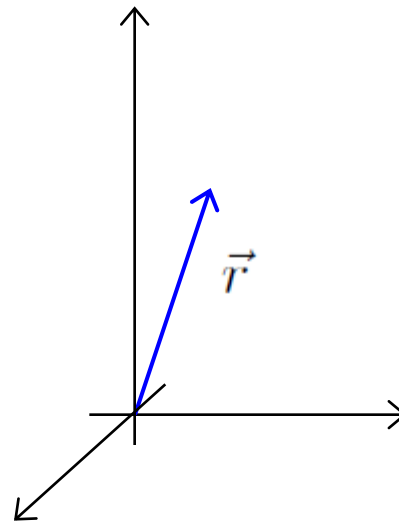
2 D

- skalár: x
- vektor: (x,y)



3 D

- skalár: x
- vektor: (x,y,z)



n D

- skalár: x
- vektor: (x_1, x_2, \dots, x_n)

Vektorové veličiny

Označení:

vektor: \vec{v}

velikost vektoru: v nebo $|\vec{v}|$

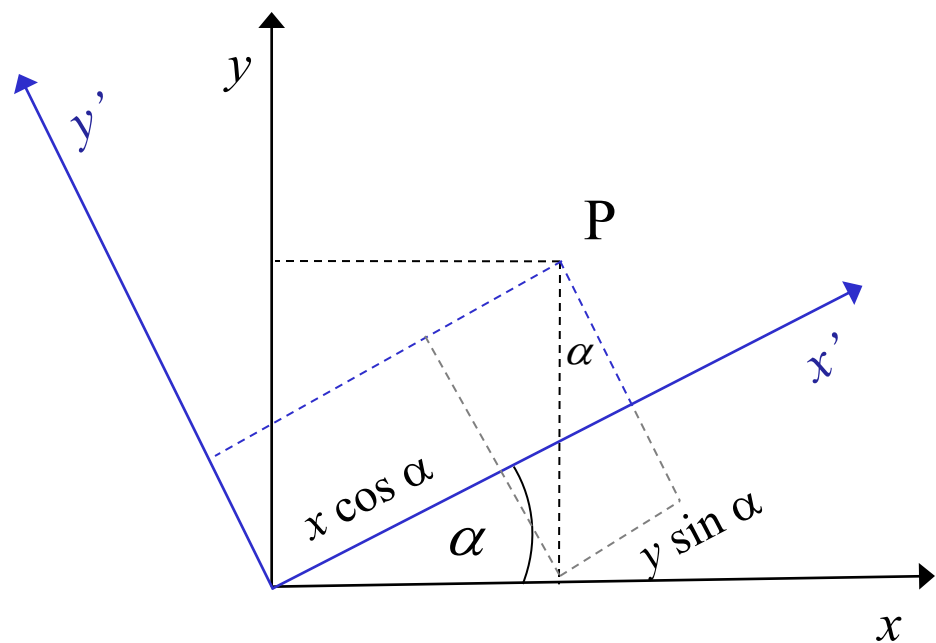
x-ová složka vektoru: v_x nebo v_1

y-ová složka vektoru: v_y nebo v_2

z-ová složka vektoru: v_z nebo v_3

Transformace souřadnic – otočení v rovině

- kartézská soustava souřadnic: x, y
- kartézská soustava otočená kolem osy z : x', y'



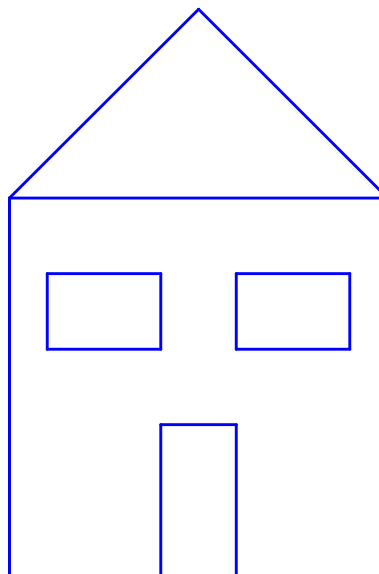
$$\begin{aligned}x' &= x \cos \alpha + y \sin \alpha \\y' &= -x \sin \alpha + y \cos \alpha\end{aligned}$$

$$\begin{pmatrix} x' \\ y' \end{pmatrix} = \begin{pmatrix} \cos \alpha & \sin \alpha \\ -\sin \alpha & \cos \alpha \end{pmatrix} \begin{pmatrix} x \\ y \end{pmatrix}$$

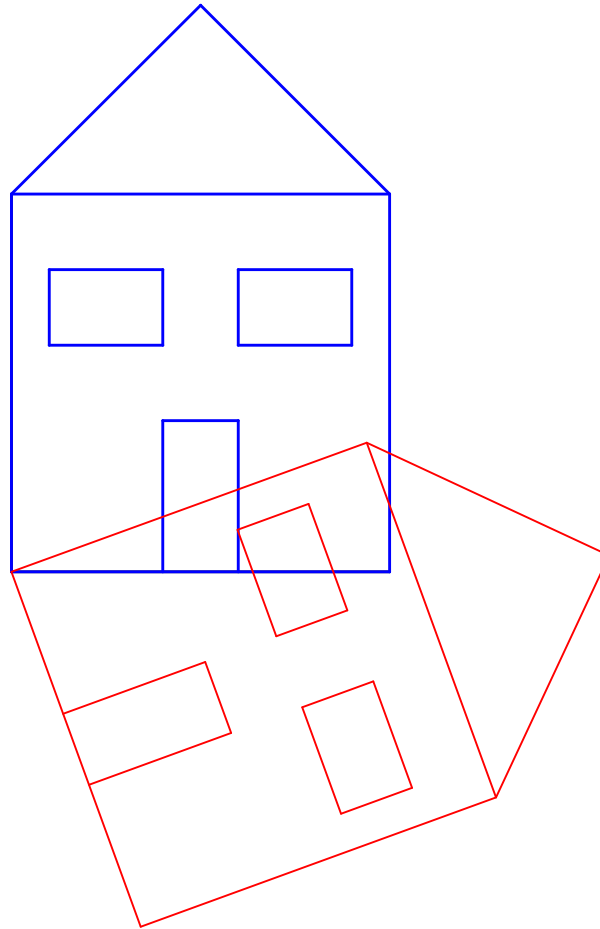
$$X' = AX$$

$$A = \begin{pmatrix} \cos \alpha & \sin \alpha \\ -\sin \alpha & \cos \alpha \end{pmatrix}$$

Transformace souřadnic – otočení v rovině



Transformace souřadnic – otočení v rovině



$$x' = x \cos \alpha + y \sin \alpha$$

$$y' = -x \sin \alpha + y \cos \alpha$$

Transformace souřadnic – otočení v prostoru

- kartézská soustava souřadnic: x, y, z

- otočení kolem osy \boldsymbol{o} o úhel α $\vec{o} = (o_x, o_y, o_z)$ $o_x^2 + o_y^2 + o_z^2 = 1$

$$X' = AX$$

$$A = \begin{pmatrix} \cos \alpha + o_x^2(1 - \cos \alpha) & o_x o_y(1 - \cos \alpha) + o_z \sin \alpha & o_x o_z(1 - \cos \alpha) - o_y \sin \alpha \\ o_x o_y(1 - \cos \alpha) - o_z \sin \alpha & \cos \alpha + o_y^2(1 - \cos \alpha) & o_y o_z(1 - \cos \alpha) + o_x \sin \alpha \\ o_x o_z(1 - \cos \alpha) + o_y \sin \alpha & o_y o_z(1 - \cos \alpha) - o_x \sin \alpha & \cos \alpha + o_z^2(1 - \cos \alpha) \end{pmatrix}$$

Transformace souřadnic – obecně

- původní soustava souřadnic: x_1, x_2, x_3
- nová soustava souřadnic: x'_1, x'_2, x'_3

$$x'_i = \sum_{j=1}^3 a_{i,j} x_j$$

$$X' = AX$$

- **skalár** je veličina invariantní při transformaci souřadnic: $S(x') = S(x)$
- **vektor** je trojice veličin $\vec{v} = (v_1, v_2, v_3)$, která se při transformaci souřadnic transformuje jako souřadnice:

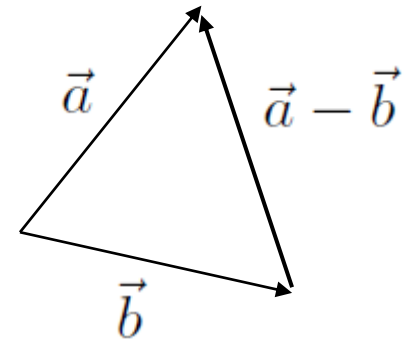
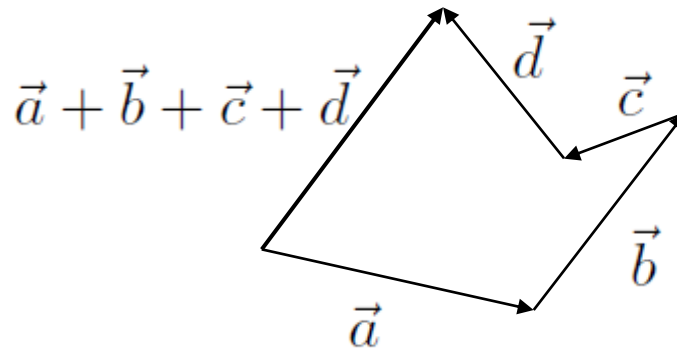
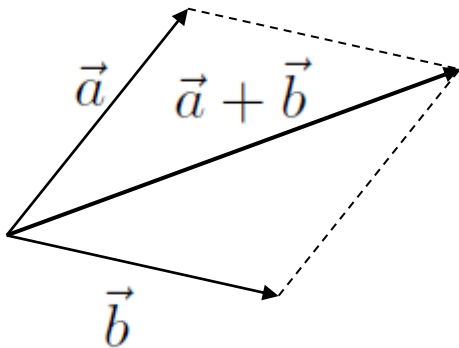
$$v'_i = \sum_{j=1}^3 a_{i,j} v_j \quad V' = AV$$

Vektorové fyzikální veličiny

- **velikost vektoru:** $|\vec{a}| = \sqrt{a_x^2 + a_y^2 + a_z^2}$ (skalár)

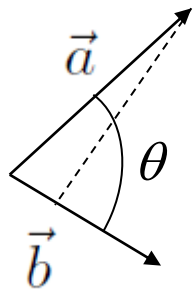
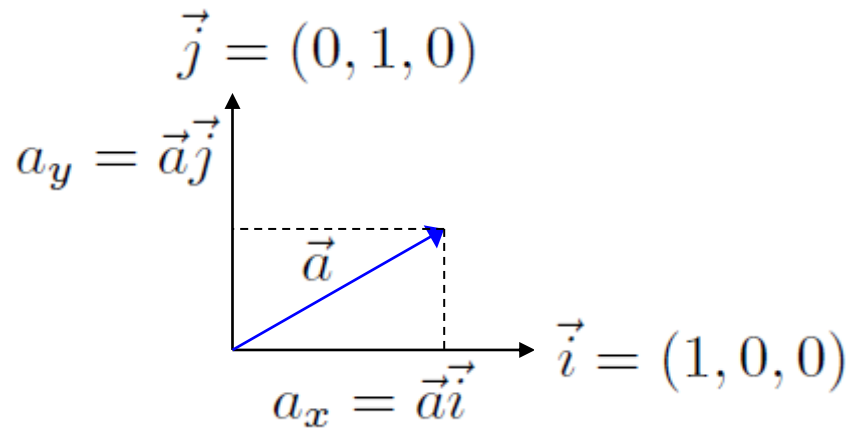
často se píše: $|\vec{a}| \equiv a$

- **součet / rozdíl vektorů:**



Vektorové fyzikální veličiny

- **skalární součin:** $\vec{a}\vec{b} = a_x b_x + a_y b_y + a_z b_z = ab \cos \theta$ (skalár)



velikost průmětu vektoru do směru: $\frac{\vec{a}\vec{b}}{|\vec{b}|} = a \cos \theta$

Vektorové fyzikální veličiny

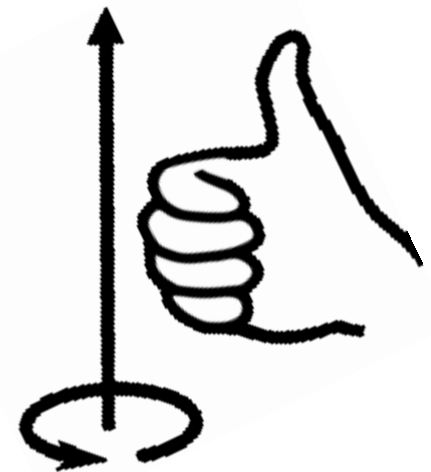
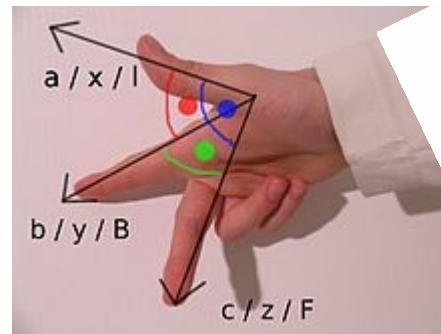
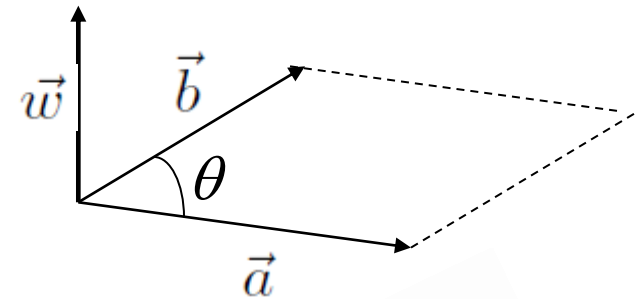
- vektorový součin v 3D:

$$\vec{w} = \vec{a} \times \vec{b} = \begin{vmatrix} \vec{i} & \vec{j} & \vec{k} \\ a_x & a_y & a_z \\ b_x & b_y & b_z \end{vmatrix} = (a_y b_z - a_z b_y, a_z b_x - a_x b_z, a_x b_y - a_y b_x)$$

(vektor kolmý na \vec{a} a \vec{b}) $\vec{w}\vec{a} = 0$ $\vec{w}\vec{b} = 0$

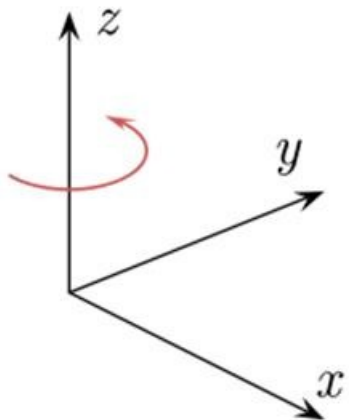
$$|\vec{w}| \equiv w = ab \sin \theta$$

$\vec{a}, \vec{b}, \vec{w}$ tvoří pravotočivý systém

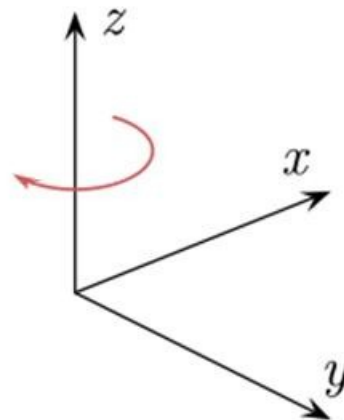


Kartézská soustava souřadnic

Pravotočivá



Levotočivá



jednotkové vektory ve směru souřadnicových os

$$\vec{i} = (1, 0, 0)$$

$$\vec{j} = (0, 1, 0)$$

$$\vec{k} = (0, 0, 1)$$

Kartézská soustava souřadnic

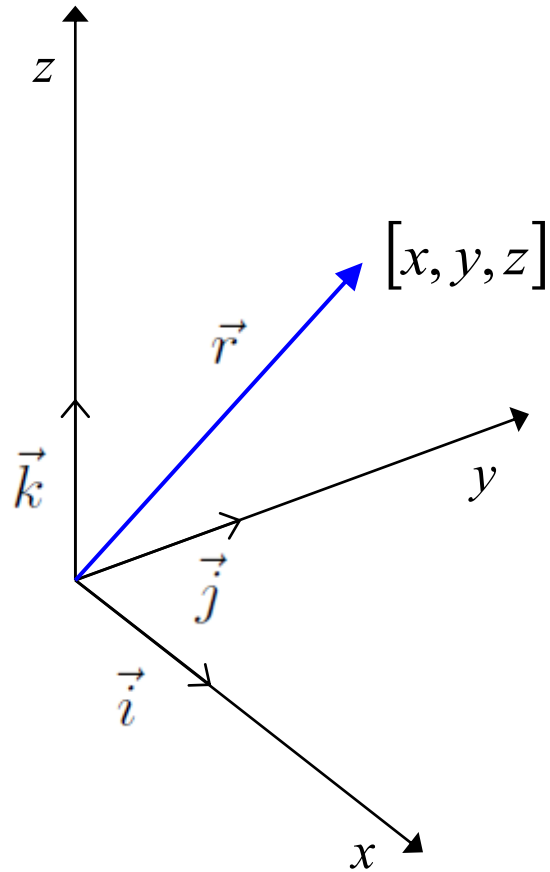
- ortonormální báze

$$|\vec{i}| = |\vec{j}| = |\vec{k}| = 1$$

$$\vec{i} \cdot \vec{j} = 0$$

$$\vec{i} \cdot \vec{k} = 0$$

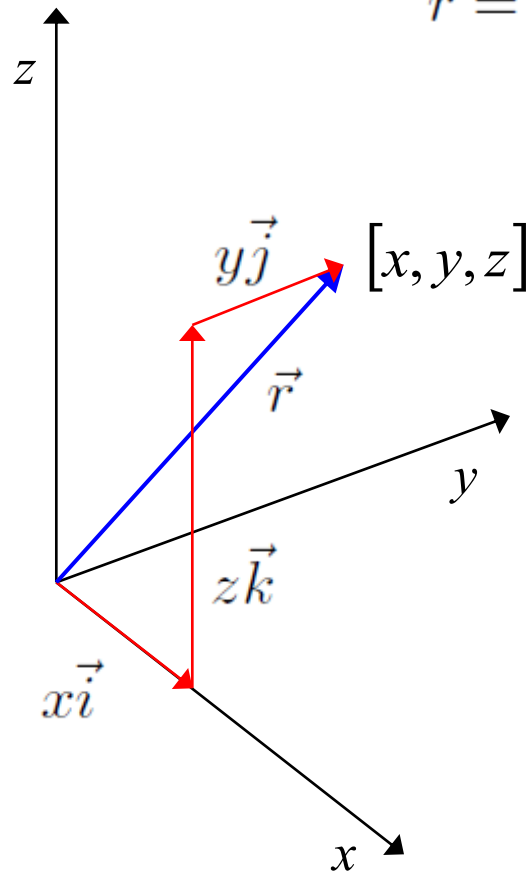
$$\vec{j} \cdot \vec{k} = 0$$



Kartézská soustava souřadnic

- polohový (radius) vektor

$$\vec{r} = x\vec{i} + y\vec{j} + z\vec{k} = (x, y, z)$$



velikost polohového vektoru:

$$r \equiv |\vec{r}| = \sqrt{x^2 + y^2 + z^2}$$

Obecné souřadnice

- kartézské souřadnice: x, y, z
- obecné souřadnice: q_1, q_2, q_3

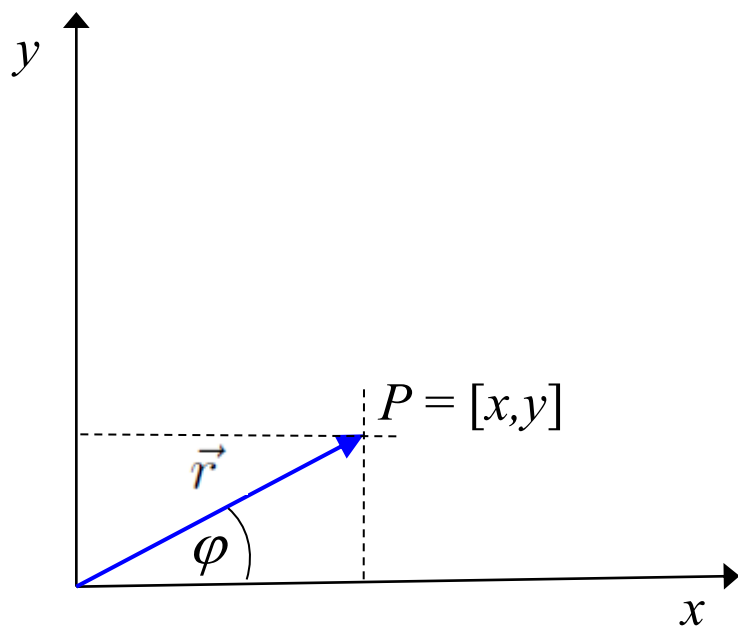
$$x = x(q_1, q_2, q_3) \qquad q_1 = q_1(x, y, z)$$

$$y = y(q_1, q_2, q_3) \qquad q_2 = q_2(x, y, z)$$

$$z = z(q_1, q_2, q_3) \qquad q_3 = q_3(x, y, z)$$

Polární soustava souřadnic

- kartézská soustava souřadnic: x, y
- polární soustava souřadnic: r, φ



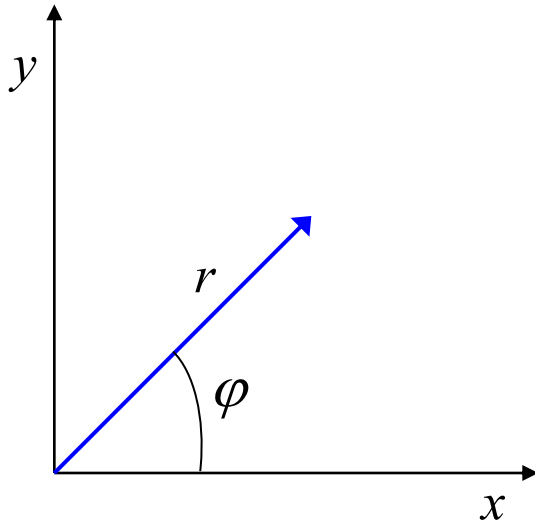
$$x = r \cos \varphi$$

$$y = r \sin \varphi$$

$$r = \sqrt{x^2 + y^2}$$

$$\varphi = \operatorname{arctg} \frac{y}{x}$$

Rovnoměrný pohyb po kružnici



polární souřadnice

$$r(t) = r$$

$$\varphi(t) = \omega t$$

ω - úhlová rychlost

$$T = \frac{2\pi}{\omega} \quad \text{- perioda}$$

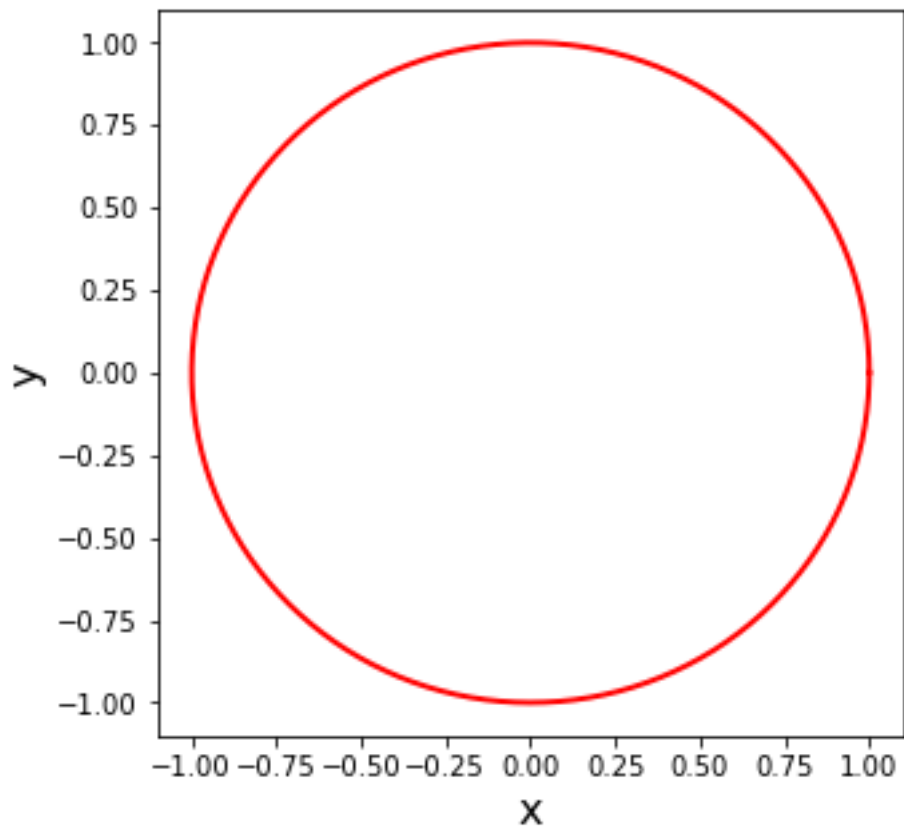
kartézské souřadnice

$$x(t) = r \cos \varphi = r \cos(\omega t)$$

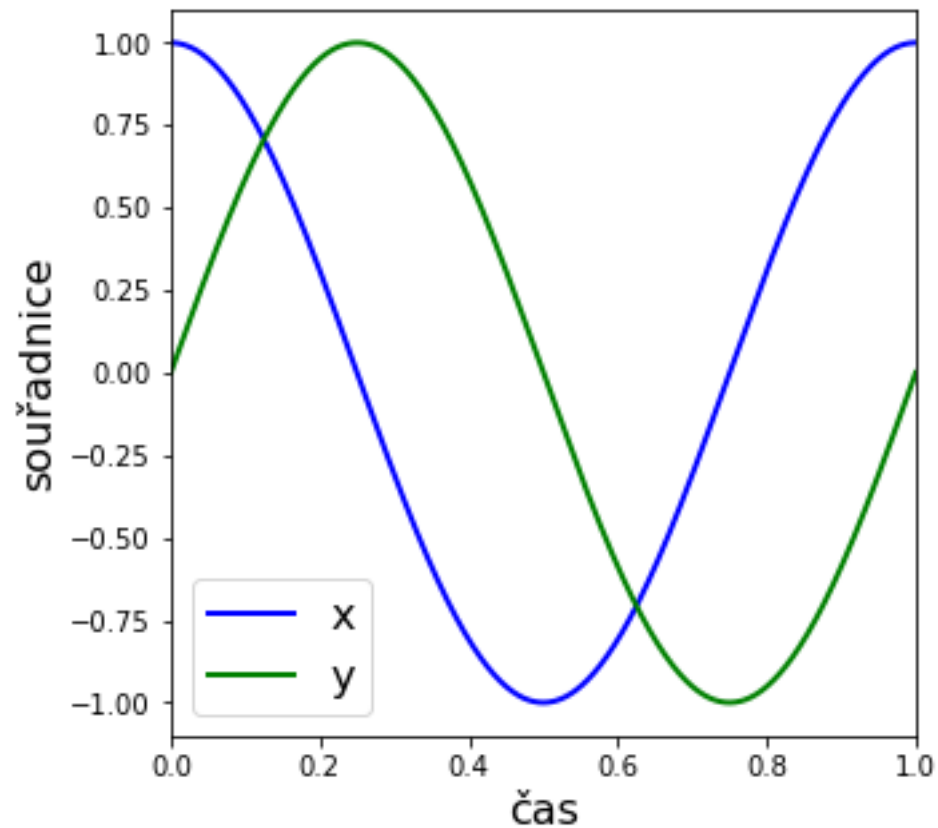
$$y(t) = r \sin \varphi = r \sin(\omega t)$$

Rovnoměrný pohyb po kružnici

trajektorie



časová závislost souřadnic



Python

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Windows 

Python 3.8

64-Bit Graphical Installer (477 MB)


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MacOS 

Python 3.8

64-Bit Graphical Installer (440 MB)

64-Bit Command Line Installer (433 MB)

Linux 

Python 3.8

64-Bit (x86) Installer (544 MB)

64-Bit (Power8 and Power9) Installer (285 MB)

64-Bit (AWS Graviton2 / ARM64) Installer (413 M)

64-bit (Linux on IBM Z & LinuxONE) Installer (292 M)

Python



CMD.exe Prompt

0.1.1

Run a cmd.exe terminal with your current environment from Navigator activated

Launch



Datalore

Online Data Analysis Tool with smart coding assistance by JetBrains. Edit and run your Python notebooks in the cloud and share them with your team.

Launch



IBM Watson Studio Cloud

IBM Watson Studio Cloud provides you the tools to analyze and visualize data, to cleanse and shape data, to create and train machine learning models. Prepare data and build models, using open source data science tools or visual modeling.

Launch



JupyterLab

3.1.7

An extensible environment for interactive and reproducible computing, based on the Jupyter Notebook and Architecture.

Launch



Jupyter Notebook

6.4.3

Web-based, interactive computing notebook environment. Edit and run human-readable docs while describing the data analysis.

Launch



Powershell Prompt

0.0.1

Run a Powershell terminal with your current environment from Navigator activated

Launch



Qt Console

5.1.0

PyQt GUI that supports inline figures, proper multiline editing with syntax highlighting, graphical calltips, and more.

Launch



Spyder

5.0.5

Scientific PYTHON Development Environment. Powerful Python IDE with advanced editing, interactive testing, debugging and introspection features

Launch



Glueviz

1.0.0

Multidimensional data visualization across files. Explore relationships within and among related datasets.

Install



Orange 3

3.26.0

Component based data mining framework. Data visualization and data analysis for novice and expert. Interactive workflows with a large toolbox.

Install



PyCharm Professional

A full-fledged IDE by JetBrains for both Scientific and Web Python development. Supports HTML, JS, and SQL.

Install



RStudio

1.1.456

A set of integrated tools designed to help you be more productive with R. Includes R essentials and notebooks.

Install

Spyder

Python - Spyder

Spyder (Python 3.8)

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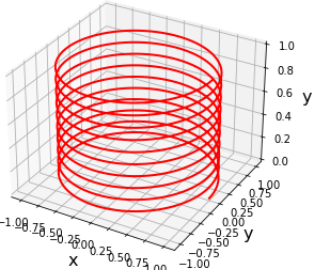
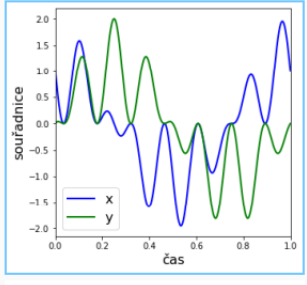
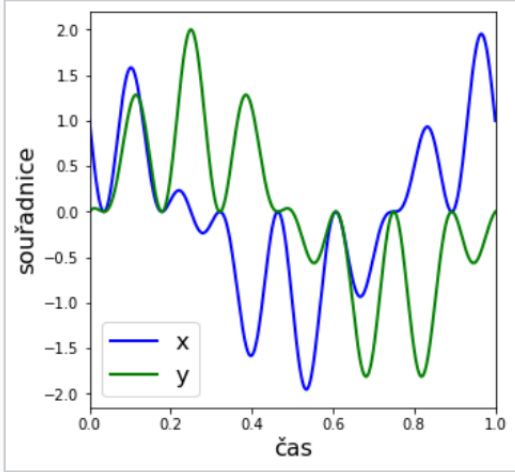
F:\text\teach\FyzikaI\2021\prednaska\prednaska2

F:\text\teach\FyzikaI\2021\prednaska\prednaska2\sroubovnice.py

```
1 import numpy as np
2 import matplotlib.pyplot as plt
3
4 r=1
5 T=1
6 omega=2*np.pi/T
7 vz=T/10
8 t=np.linspace(0,10*T,1000)
9 x=r*np.cos(omega*t)
10 y=r*np.sin(omega*t)
11 z=vz*t
12
13 fig=plt.figure(figsize=(8,8))
14 ax=fig.add_subplot(projection='3d')
15 ax.plot(x,y,z,lw=2,c='red')
16 ax.set_xlabel("x",fontSize=16)
17 ax.set_ylabel("y",fontSize=16)
18 ax.set_zlabel("z",fontSize=16)
19
```

HEA_sim.py - bulk\sc2 x HEA_sim.py - bulk\sc2b x HEA_sim.py - bulk\sc6 x DPL_spectra.py x DPL_view.py x dsc_bcg.py x sroubovnice.py x

137 %



Help Variable Explorer Plots Files

Console 1/A x

In [32]: runfile('F:/text/teach/FyzikaI/2021/prednaska/prednaska2/sroubovnice.py', wdir='F:/text/teach/FyzikaI/2021/prednaska/prednaska2')

In [33]: runfile('F:/text/teach/FyzikaI/2021/prednaska/prednaska2/sroubovnice.py', wdir='F:/text/teach/FyzikaI/2021/prednaska/prednaska2')

IPython console History