SISTEM ROBOT OTONOM

M. Q. Zaman

PREVIOUSLY

APPERCEPTION

Previous section:

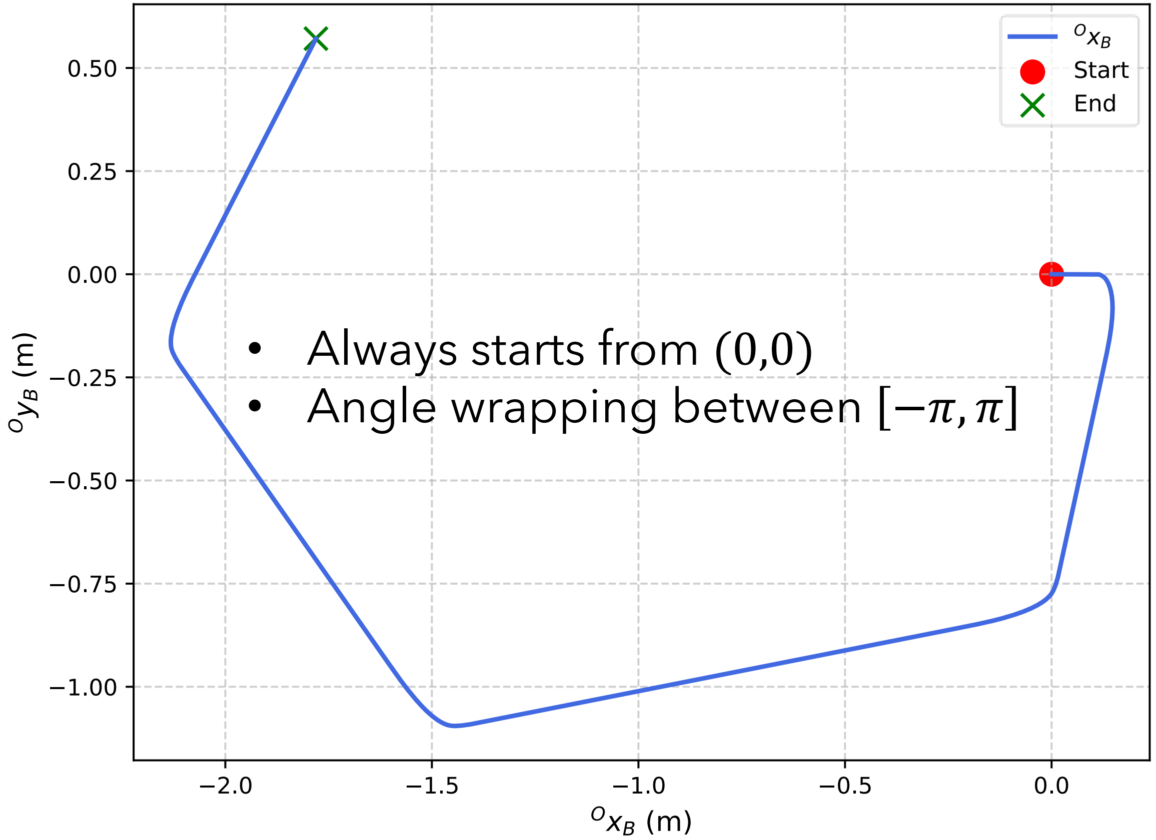
- Odometry

This section:

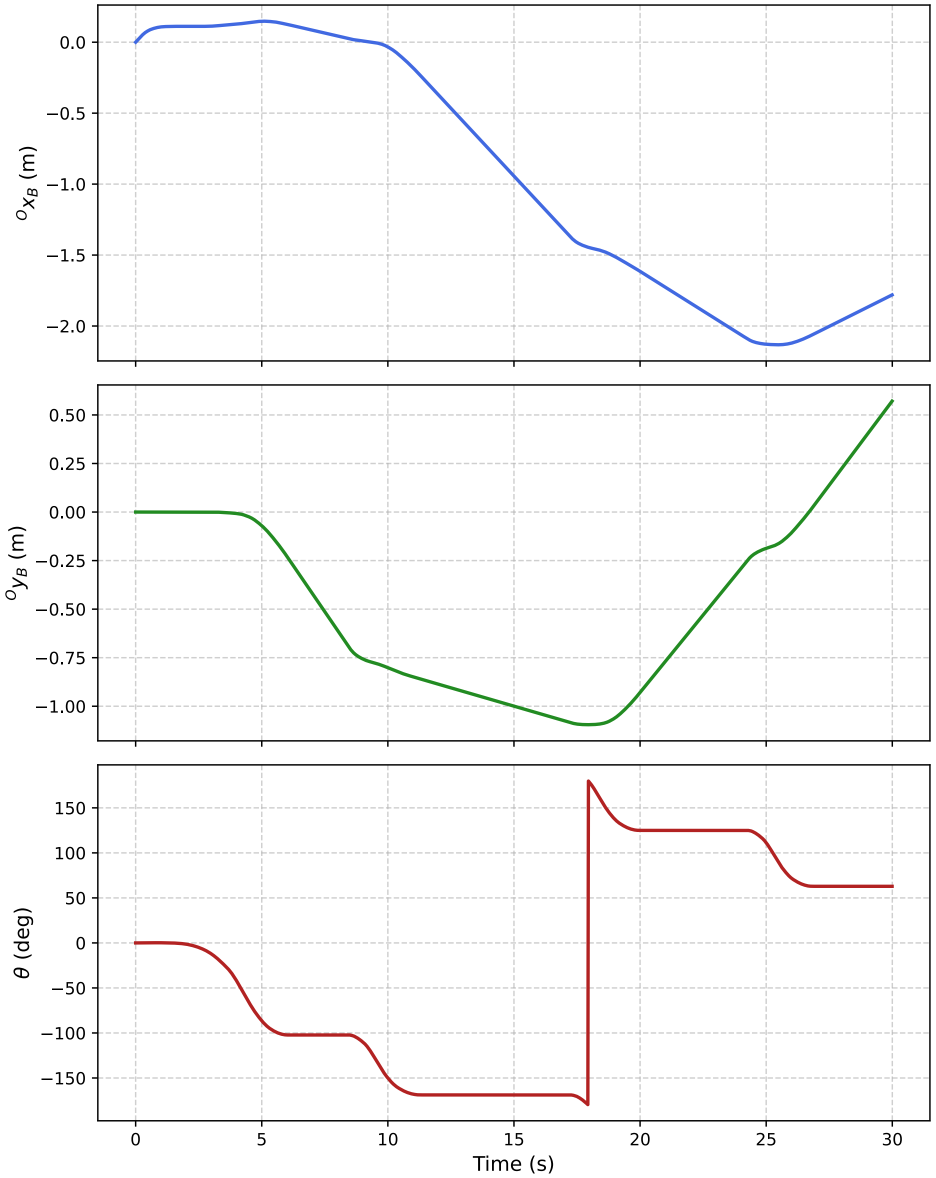
- P3DX Odometry
- Coordinate transformation

P3DX ODOMETRY

ODOMETRY OF P3DX

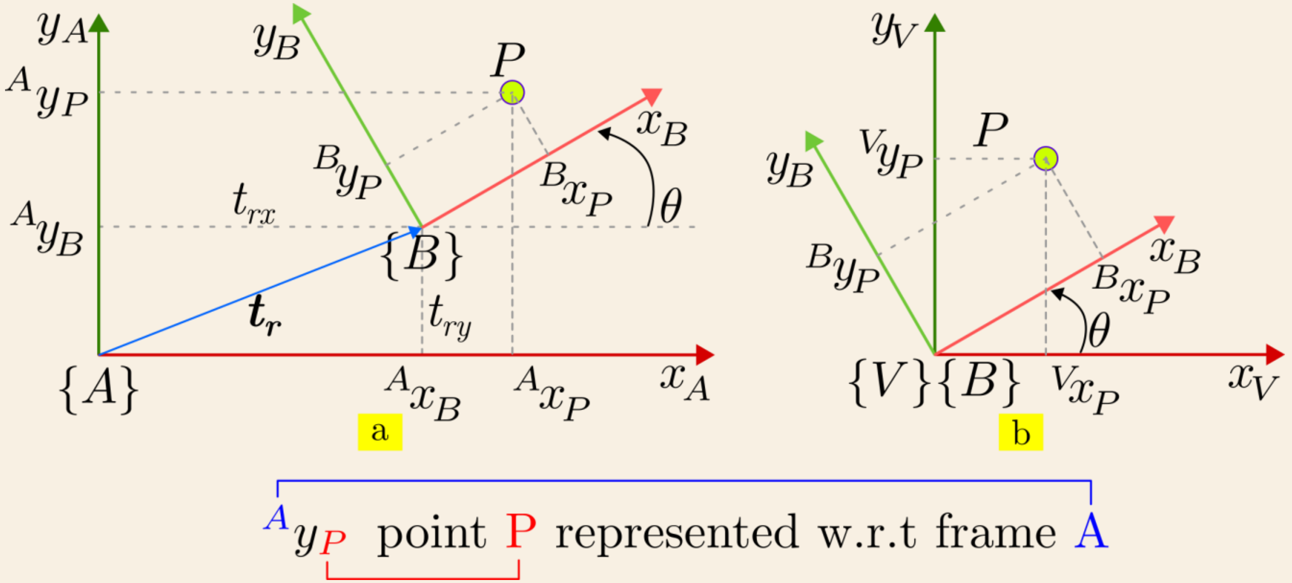


- Always starts from (0,0)
- Angle wrapping between $[-\pi, \pi]$



COORDINATE TRANSFORMATION

RELATIVE POSE



$$\begin{bmatrix} {}^{V}x_P \\ {}^{V}y_P \end{bmatrix} = R(\theta)\begin{bmatrix} {}^{B}x_P \\ {}^{B}y_P \end{bmatrix}$$

$$= \begin{bmatrix} \cos\theta & -\sin\theta \\ \sin\theta & \cos\theta \end{bmatrix}\begin{bmatrix} {}^{B}x_P \\ {}^{B}y_P \end{bmatrix}$$

$$\begin{bmatrix} {}^{A}x_P \\ {}^{A}y_P \end{bmatrix} = \begin{bmatrix} {}^{V}x_P \\ {}^{V}y_P \end{bmatrix} + \begin{bmatrix} t_{rx} \\ t_{ry} \end{bmatrix}$$

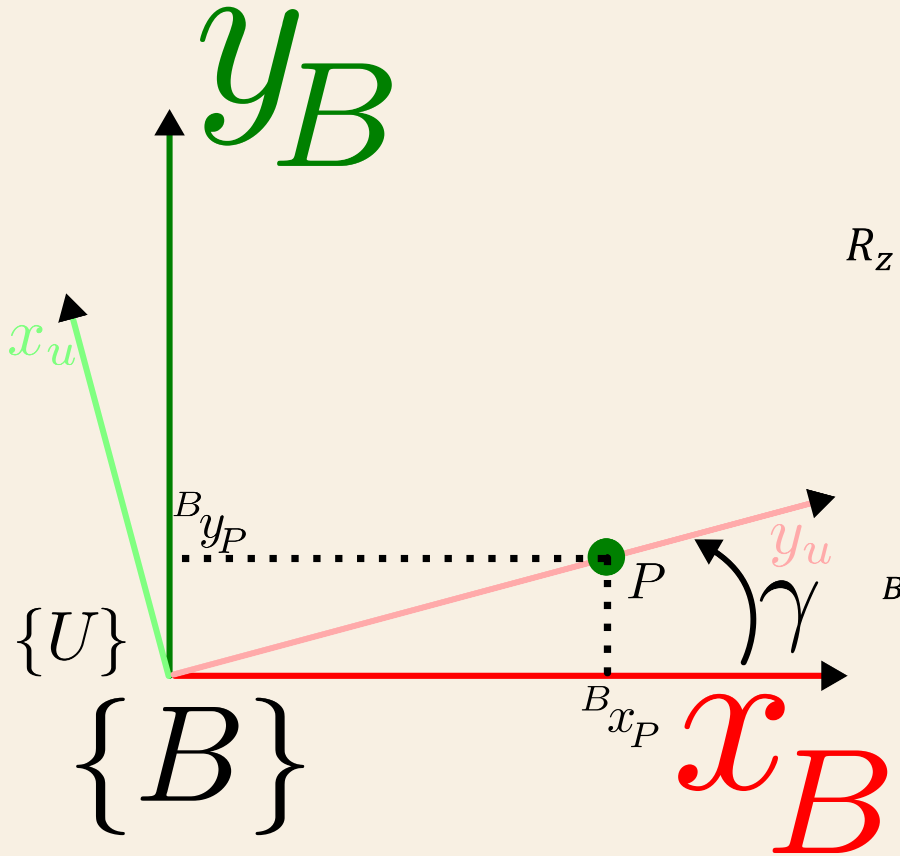
$$= \begin{bmatrix} \cos\theta & -\sin\theta \\ \sin\theta & \cos\theta \end{bmatrix}\begin{bmatrix} {}^{B}x_P \\ {}^{B}y_P \end{bmatrix} + \begin{bmatrix} t_{rx} \\ t_{ry} \end{bmatrix}$$

$$= \begin{bmatrix} \cos\theta & -\sin\theta & t_{rx} \\ \sin\theta & \cos\theta & t_{ry} \end{bmatrix}\begin{bmatrix} {}^{B}x_P \\ {}^{B}y_P \\ 1 \end{bmatrix}$$

$$\begin{bmatrix} {}^{A}x_P \\ {}^{A}y_P \\ 1 \end{bmatrix} = \begin{bmatrix} R(\theta) & t_{r\,2\times1} \\ 0_{1\times2} & 1 \end{bmatrix}\begin{bmatrix} {}^{B}x_P \\ {}^{B}y_P \\ 1 \end{bmatrix}$$ (Homogeneous Coordinates)

$$= {}^{A}T_{B}\begin{bmatrix} {}^{B}x_P \\ {}^{B}y_P \\ 1 \end{bmatrix}$$

RELATIVE POSE EXAMPLE 1



$$R_z(\gamma) = \begin{bmatrix} \cos\gamma & -\sin\gamma & 0 \\ \sin\gamma & \cos\gamma & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

$$T = \begin{bmatrix} R_{3\times3} & t_{3\times1} \\ 0_{1\times3} & 1 \end{bmatrix}$$

$$^BT_U = \begin{bmatrix} c\,\gamma & -s\,\gamma & 0 & t_x \\ s\,\gamma & c\,\gamma & 0 & t_y \\ 0 & 0 & 1 & t_z \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

$$t_x = 0; t_y = 0; t_z = 0$$

$$^BP = {}^BT_U\,{}^UP$$

$$\begin{bmatrix} ^Bx_P \\ ^By_P \\ ^Bz_P \\ 1 \end{bmatrix} = {}^BT_U \begin{bmatrix} ^Ux_P \\ ^Uy_P \\ ^Uz_P \\ 1 \end{bmatrix}$$

$$^BP_U = \begin{bmatrix} c\,\gamma & -s\,\gamma & 0 & 0 \\ s\,\gamma & c\,\gamma & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} ^Ux_P \\ ^Uy_P \\ ^Uz_P \\ 1 \end{bmatrix}$$

https://manual.coppeliarobotics.com/en/positionOrientationTransformation.htm#euler

ASSIGNMENT

Assignment: Simulate with numpy

Using the known information:

- $({}^{u}x_P,\ {}^{u}y_P,\ {}^{u}z_P) = (2,0,0)$
- $(\alpha, \beta, \gamma) = (0,0,90°)$
- $(t_x, t_y, t_z) = (0,0,0)$

1. Create a rotation matrix $R_z(\gamma)$
2. Create a translation vector $\left[t_x, t_y, t_z\right]^T$
3. Create transformation matrix ${}^{B}T_U$
4. Make a homogeneous coordinate of $({}^{u}x_P,\ {}^{u}y_P,\ {}^{u}z_P)$
5. Calculate $\left({}^{B}x_P,\ {}^{B}y_P,\ {}^{B}z_P\right)$!

Repeat the process for $({}^{u}x_P,\ {}^{u}y_P,\ {}^{u}z_P) = (0,2,0)$

Repeat the process for $({}^{u}x_P,\ {}^{u}y_P,\ {}^{u}z_P) = (2,0,2)$

Repeat the process for $({}^{u}x_P,\ {}^{u}y_P,\ {}^{u}z_P) = (2,0,2)$ and $(\alpha, \beta, \gamma) = (0,0,-180°)$

Submit the code and step by step explanation in *.pdf report format

CONCLUSION

CONCLUSION

This section:

- Odometry

Next section:

- P3DX Odometry
- Coordinate transformation

CLOSURE


Do not let what you cannot do interfere with what you can do.
John Wooden
quotefancy

THANK YOU

Muhammad Qomaruz Zaman

muhammad.zaman@its.ac.id