0/2019 ロボット概論 ①

$$\begin{bmatrix} x' \\ y' \end{bmatrix} = \begin{bmatrix} x \\ y \end{bmatrix} + \begin{bmatrix} a \\ b \end{bmatrix} = \begin{bmatrix} x+a \\ y+b \end{bmatrix}$$

$$\begin{bmatrix} x' \\ y' \end{bmatrix} \cdot \begin{bmatrix} C\theta & -S\theta \\ S\theta & C\theta \end{bmatrix}$$

$$R(\theta) = \begin{bmatrix} C(\theta) & -S\theta \\ S(\theta) & C\theta \end{bmatrix}$$

$$P \xrightarrow{\text{回転}} \blacksquare \xrightarrow{\text{並進}} P' \longrightarrow$$

$$P = [1 \quad 0]^T$$

$$\cancel{P' = [1 \quad 0]^T}$$

$$P' = R(\theta)P + \begin{bmatrix} a \\ b \end{bmatrix}$$

$$= \begin{bmatrix} C(\theta) & -S(\theta) \\ S(\theta) & C(\theta) \end{bmatrix} \begin{bmatrix} 1 \\ 0 \end{bmatrix} + \begin{bmatrix} a \\ b \end{bmatrix}$$

$\cancel{\theta = 45^\circ}$,

$a = 2$

$b = 3$ 时,

$$p' = R(45^\circ)\begin{bmatrix}1\\0\end{bmatrix} + \begin{bmatrix}2\\3\end{bmatrix}$$

$$\begin{bmatrix} C(45^\circ) & -S(45^\circ) \\ S(45^\circ) & C(45^\circ) \end{bmatrix}\begin{bmatrix}1\\0\end{bmatrix} + \begin{bmatrix}2\\3\end{bmatrix}$$

$$, \frac{1}{\sqrt{2}}\begin{bmatrix} \frac{\sqrt{2}}{2} & \frac{\sqrt{2}}{2} \\ \frac{\sqrt{2}}{2} & \frac{\sqrt{2}}{2} \end{bmatrix}\begin{bmatrix}1\\0\end{bmatrix} + \begin{bmatrix}2\\3\end{bmatrix}$$

$=$

$$p' = \begin{bmatrix} C(45^\circ) & S(45^\circ) \\ -S(45^\circ) & C(45^\circ) \end{bmatrix}\begin{bmatrix}1\\0\end{bmatrix} + \begin{bmatrix}2\\3\end{bmatrix}$$

$$= \begin{bmatrix} \frac{\sqrt{2}}{2} & \frac{\sqrt{2}}{2} \\ -\frac{\sqrt{2}}{2} & \frac{\sqrt{2}}{2} \end{bmatrix}\begin{bmatrix}1\\0\end{bmatrix} + \begin{bmatrix}2\\3\end{bmatrix}$$

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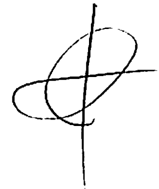
$R(\theta)P + \begin{bmatrix} a \\ b \end{bmatrix}$

↳ 1つの行列で表す!

↳ 同次変換



$$\begin{bmatrix} x \\ y \\ 1 \end{bmatrix} = \begin{bmatrix} C\theta & -S\theta & a \\ S\theta & C\theta & b \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} x' \\ y' \\ 1 \end{bmatrix}$$

例)根本側　　　　例)手先側

Trans(3, 0) Rot($\frac{\pi}{2}$) Trans(1, 0)

$$= \begin{bmatrix} 1 & 0 & 3 \\ 0 & 1 & 0 \\ 0 & 0 & 0 \end{bmatrix} \begin{bmatrix} C\frac{\pi}{2} & -S\frac{\pi}{2} & 0 \\ S\frac{\pi}{2} & C\frac{\pi}{2} & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 1 & 0 & 1 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

$$= \begin{bmatrix} 1 & 0 & 3 \\ 0 & 1 & 0 \\ 0 & 0 & 0 \end{bmatrix} \begin{bmatrix} 0 & -1 & 0 \\ 1 & 0 & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 1 & 0 & 1 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

$$= \begin{bmatrix} \cancel{1\cdot 0 + 0\cdot 1} + 3\cdot 0 & 1\cdot(-1) + \cancel{0\cdot 0} + 3\cdot 0 & \cancel{1\cdot 0 + 0\cdot 0} + 3\cdot 1 \\ 0\cdot 0 + 1\cdot 1 + 0\cdot 0 & \cancel{0\cdot(-1) + 1\cdot 0 + 0\cdot 0} & 0\cdot 0 + 1\cdot 0 + 0\cdot 1 \\ 0 & 0 & 0 \end{bmatrix} \begin{bmatrix} 1 & 0 & 1 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

$$= \begin{bmatrix} 0 & -1 & 3 \\ 1 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix} \begin{bmatrix} 1 & 0 & 1 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

$$= \begin{bmatrix} \cancel{0\cdot 1} + \cancel{(-1)\cdot 0} + \cancel{3\cdot 0} & 0\cdot 0 + (-1)\cdot 1 + 3\cdot 0 & 0\cdot 1 + (-1)\cdot 0 + 3\cdot 1 \\ 1\cdot 1 + 0 + 0 & 0\cdot 0 + 0 + 0 & 1 + 0 + 0 \\ 0 & 0 & 0 \end{bmatrix}$$

$$= \begin{bmatrix} 0 & -1 & 3 \\ 1 & 0 & 1 \\ 0 & 0 & 0 \end{bmatrix}$$

ロボット概論 第5回

問1

$$
\begin{aligned}
{}^{B}T_{H} &= Trans(L_1, 0)\,Rot(\theta_1)\,Trans(L_2, 0) \\
&= \begin{bmatrix} 1 & 0 & L_1 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}\begin{bmatrix} C\theta & -S\theta & 0 \\ S\theta & C\theta & 0 \\ 0 & 0 & 1 \end{bmatrix}\begin{bmatrix} 1 & 0 & L_2 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} \\
&= \begin{bmatrix} 1 & 0 & L_1 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}\begin{bmatrix} C\theta & -S\theta & C\theta \cdot L_2 \\ S\theta & C\theta & S\theta \cdot L_2 \\ 0 & 0 & 1 \end{bmatrix} \\
&= \begin{bmatrix} C\theta \cdot 1 + 0 + 0 & -S\theta + 0 + 0 & C\theta \cdot L_2 + 0 + L_1 \\ 0 + S\theta + 0 & 0 + C\theta + 0 & S\theta \cdot L_2 \\ 0 + 0 + 0 & 0 + 0 + 0 & 1 \end{bmatrix} \\
&= \begin{bmatrix} C\theta & -S\theta & C\theta \cdot L_2 + L_1 \\ S\theta & C\theta & S\theta \cdot L_2 \\ 0 & 0 & 1 \end{bmatrix} \\
&= \begin{bmatrix} C\frac{\pi}{6} & -S\frac{\pi}{6} & C\frac{\pi}{6} \times 0.8 + 1 \\ S\frac{\pi}{6} & C\frac{\pi}{6} & S\frac{\pi}{6} \times 0.8 \\ 0 & 0 & 1 \end{bmatrix} \\
&= \begin{bmatrix} \frac{\sqrt{3}}{2} & -\frac{1}{2} & \frac{\sqrt{3}}{2} \times 0.8 + 1 \\ \frac{1}{2} & \frac{\sqrt{3}}{2} & \frac{1}{2} \times 0.8 \\ 0 & 0 & 1 \end{bmatrix}
\end{aligned}
$$

問2

$$
\begin{aligned}
\begin{bmatrix} {}^{B}P \\ 1 \end{bmatrix} &= {}^{B}T_{H} \begin{bmatrix} {}^{H}P \\ 1 \end{bmatrix} \\
&= \begin{bmatrix} \frac{\sqrt{3}}{2} & -\frac{1}{2} & 0.4\sqrt{3} + 1 \\ \frac{1}{2} & \frac{\sqrt{3}}{2} & 0.4 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 0.4 \\ 0.2 \\ 1 \end{bmatrix} \\
&= \begin{bmatrix} \frac{\sqrt{3}}{2} \times 0.4 + \left(-\frac{1}{2}\right) \times 0.2 + (0.4\sqrt{3} + 1) \cdot 1 \\ \frac{1}{2} \times 0.4 + \frac{\sqrt{3}}{2} \times 0.2 + 0.4 \times 1 \\ 0 + 0 + 1 \end{bmatrix} \\
&= \begin{bmatrix} 0.2\sqrt{3} - 0.1 + 0.4\sqrt{3} + 1 \\ 0.2 + 0.1\sqrt{3} + 0.4 \\ 1 \end{bmatrix} = \begin{bmatrix} 0.6\sqrt{3} + 0.9 \\ 0.1\sqrt{3} + 0.6 \\ 1 \end{bmatrix}
\end{aligned}
$$

$$
\begin{bmatrix} {}^{B}P \\ 1 \end{bmatrix} = \begin{bmatrix} 0.6\sqrt{3} + 0.9 \\ 0.1\sqrt{3} + 0.6 \\ 1 \end{bmatrix}
$$

$$
\Rightarrow {}^{B}P = \begin{bmatrix} 0.6\sqrt{3} + 0.9 & 0.1\sqrt{3} + 0.6 \end{bmatrix}^{T}
$$