

$$\frac{N \times 1}{1) S = \begin{pmatrix} 3 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix} \quad T = \begin{pmatrix} 1 & 0 & 3 \\ 0 & 1 & 5 \\ 0 & 0 & 1 \end{pmatrix} \quad M = ST = \begin{pmatrix} 3 & 0 & 3 \\ 0 & 1 & 5 \\ 0 & 0 & 1 \end{pmatrix}}$$

$$M_x^1 = \begin{pmatrix} 3 & 0 & 3 \\ 0 & 1 & 5 \\ 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} x \\ y \\ 1 \end{pmatrix} = \begin{pmatrix} 3x + 3 \\ y + 5 \\ 1 \end{pmatrix}$$

$$2) R = \begin{pmatrix} \cos(-60^\circ) & -\sin(-60^\circ) & 0 \\ \sin(-60^\circ) & \cos(-60^\circ) & 0 \\ 0 & 0 & 1 \end{pmatrix} = \begin{pmatrix} \frac{1}{2} & \frac{\sqrt{3}}{2} & 0 \\ -\frac{\sqrt{3}}{2} & \frac{1}{2} & 0 \\ 0 & 0 & 1 \end{pmatrix}$$

$$T = \begin{pmatrix} 1 & 0 & 3 \\ 0 & 1 & 5 \\ 0 & 0 & 1 \end{pmatrix} \quad M = RT = \begin{pmatrix} \frac{1}{2} & \frac{\sqrt{3}}{2} & 3 \\ -\frac{\sqrt{3}}{2} & \frac{1}{2} & 3 \\ 0 & 0 & 1 \end{pmatrix}$$

$$M_x^1 = \begin{pmatrix} \frac{1}{2}x + \frac{\sqrt{3}}{2}y + 3 \\ -\frac{\sqrt{3}}{2}x + \frac{1}{2}y + 3 \\ 1 \end{pmatrix}$$

$$3) M = \begin{pmatrix} 1 & \tan 45^\circ & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix} = \begin{pmatrix} 1 & 1 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix} \quad M_x^1 = \begin{pmatrix} x+y \\ y \\ 1 \end{pmatrix}$$

$$(4) \quad T_1 = \begin{pmatrix} 1 & 0 & 7 \\ 0 & 1 & -7 \\ 0 & -7 & 1 \end{pmatrix}$$

$$R = \begin{pmatrix} \cos(-120) & -\sin(-120) & 0 \\ \sin(-120) & \cos(-120) & 0 \\ 0 & 0 & 1 \end{pmatrix}$$

$$T_2 = \begin{pmatrix} 1 & 0 & 5 \\ 0 & 1 & 5 \\ 0 & 5 & 1 \end{pmatrix}$$

$$M = T_2 R T_1 = \begin{pmatrix} \frac{1}{2} & \frac{\sqrt{3}}{2} & 5 + \frac{1}{2} \cdot 7 - \frac{\sqrt{3}}{2} \cdot 7 \\ -\frac{\sqrt{3}}{2} & \frac{1}{2} & 5 + \frac{\sqrt{3}}{2} \cdot 7 + \frac{1}{2} \cdot 7 \\ 0 & 0 & 1 \end{pmatrix}$$

VL

$$\text{Ortsvektor } o = \begin{pmatrix} 1 \\ 2 \\ 3 \end{pmatrix}$$

① Punkt x_B hat Koord. in A : $x_A = o + B \cdot x_B$

$$M_{B \rightarrow A} = \begin{pmatrix} 2 & 3 & 1 & 1 \\ 5 & 2 & -3 & 2 \\ 1 & 1 & 1 & 3 \\ 0 & 0 & 0 & 1 \end{pmatrix} \quad \text{so dass } \begin{pmatrix} x_A \\ 1 \end{pmatrix} = M_{B \rightarrow A} \begin{pmatrix} x_B \\ 1 \end{pmatrix}$$

② $P_B = (1, 1, 1)^T$ gilt:

$$x_A = o + B (1, 1, 1)^T = \begin{pmatrix} 1 \\ 2 \\ 3 \end{pmatrix} + \begin{pmatrix} 2+3+1 \\ 5+2-3 \\ 1+1+1 \end{pmatrix} = \begin{pmatrix} 7 \\ 6 \\ 6 \end{pmatrix}$$

[N, 3]

① $R_{90^\circ} = \begin{pmatrix} \cos 90 & -\sin 90 \\ \sin 90 & \cos 90 \end{pmatrix} = \begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix}$ $\begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix} \begin{pmatrix} 2 \\ 1 \end{pmatrix} = \begin{pmatrix} -1 \\ 2 \end{pmatrix}$

② $R_z(90) = \begin{pmatrix} 0 & -1 & 0 \\ 1 & 0 & 0 \\ 0 & 0 & 1 \end{pmatrix}$ $R_z(90) \begin{pmatrix} 5 \\ 0 \\ 6 \end{pmatrix} = \begin{pmatrix} 0 & -1 & 0 \\ 1 & 0 & 0 \\ 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} 5 \\ 0 \\ 6 \end{pmatrix} = \begin{pmatrix} 0 \\ 5 \\ 6 \end{pmatrix} \checkmark$

③ Ja

Adressskalierung:

$$\begin{pmatrix} s \\ 0 \\ 1 \\ 1 \end{pmatrix} \begin{pmatrix} 1 & 0 \\ 0 & s \\ 1 & 1 \end{pmatrix} \begin{pmatrix} 1 & 0 \\ 0 & 1 \\ 0 & s \end{pmatrix}$$

Sprengung Koordin. Ebene:

$$\begin{pmatrix} -1 & 0 \\ 0 & 1 \\ 1 & 1 \end{pmatrix} \begin{pmatrix} 1 & 0 \\ 0 & -1 \\ 0 & 1 \end{pmatrix} \begin{pmatrix} 1 & 0 \\ 0 & 1 \\ 0 & -1 \end{pmatrix}$$

