

ECE 417 - Introduction to Robotics

Notes

Matrix review:

Multiplication:

$$\begin{bmatrix} r_{11} & r_{12} \\ r_{21} & r_{22} \\ r_{31} & r_{32} \end{bmatrix} \begin{bmatrix} s_{11} & s_{12} & s_{13} & s_{14} \\ s_{21} & s_{22} & s_{23} & s_{24} \end{bmatrix} = \begin{bmatrix} t_{11} & t_{12} & t_{13} & t_{14} \\ t_{21} & t_{22} & t_{23} & t_{24} \\ t_{31} & t_{32} & t_{33} & t_{34} \end{bmatrix} \quad \text{where } t_{ij} = r_{row\ i} \cdot s_{col\ j} \text{ (dot product)}$$

sizes: 3×2 times $2 \times 4 = 3 \times 4$

Remember: Row, Column (RC)

Note: Matrix multiplication does not commute:

$$\text{In general } \mathbf{AB} \neq \mathbf{BA}$$

But associate property holds:

$$(\mathbf{AB})\mathbf{C} = \mathbf{A}(\mathbf{BC})$$

For many matrices \mathbf{A} (i.e., non-singular matrices) there exists an inverse \mathbf{A}^{-1} such that

$$\mathbf{AA}^{-1} = \mathbf{A}^{-1}\mathbf{A} = \mathbf{I}$$

Where \mathbf{I} is an identity matrix. E.g.,

$$\mathbf{I}_{33} = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

Matrix transpose: \mathbf{A}^T interchanges rows and columns

$$\begin{bmatrix} r_{11} & r_{12} \\ r_{21} & r_{22} \\ r_{31} & r_{32} \end{bmatrix} \rightarrow \begin{bmatrix} r_{11} & r_{21} & r_{31} \\ r_{12} & r_{22} & r_{32} \end{bmatrix}$$