

Matrix theory - Assignment1

Banoth Upender
EE20MTECH11011

Abstract—This document illustrates the distance of the point from the point of intersection of the line and the plane.

Download all python codes from

<https://github.com/upender20/EE5600/tree/master>

1 PROBLEM

Find the distance of the point $\begin{pmatrix} -1 \\ -5 \\ -10 \end{pmatrix}$ from the point of intersection of the line \mathbf{x} and the plane $(1 \ -1 \ 1) \cdot \mathbf{x} = 5$

$$\mathbf{x} = \begin{pmatrix} 2 \\ -1 \\ 2 \end{pmatrix} + \lambda \begin{pmatrix} 3 \\ 4 \\ 2 \end{pmatrix} \quad (1.0.1)$$

2 CONSTRUCTION

We know that equation of the line passing through given a point and a plane

$$\mathbf{r} = \mathbf{a} + \lambda \mathbf{b} \quad (2.0.1)$$

Also we can find direction vector from the Cartesian form of equation

$$\frac{x - x_1}{a} = \frac{y - y_1}{b} = \frac{z - z_1}{c} \quad (2.0.2)$$

This can be expressed as

$$\begin{pmatrix} x \\ y \\ z \end{pmatrix} = \begin{pmatrix} x_1 \\ y_1 \\ z_1 \end{pmatrix} + \lambda \begin{pmatrix} a \\ b \\ c \end{pmatrix} \quad (2.0.3)$$

where $\mathbf{a} = \begin{pmatrix} x_1 \\ y_1 \\ z_1 \end{pmatrix}$ is a point on given line and $\mathbf{b} = \begin{pmatrix} a \\ b \\ c \end{pmatrix}$ is the direction vector.

Distance between the point and point of intersection.

$$D = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2 + (z_2 - z_1)^2} \quad (2.0.4)$$

3 SOLUTION

Writing given equation (1.0.1) in vector form as

$$\begin{pmatrix} x \\ y \\ z \end{pmatrix} = \begin{pmatrix} 2 \\ -1 \\ 2 \end{pmatrix} + \lambda \begin{pmatrix} 3 \\ 4 \\ 2 \end{pmatrix} \quad (3.0.1)$$

So the direction vector of equation given is

$$\mathbf{b} = \begin{pmatrix} 3 \\ 4 \\ 2 \end{pmatrix} \quad (3.0.2)$$

and the point on which line passes is

$$\mathbf{P} = \begin{pmatrix} -1 \\ -5 \\ -10 \end{pmatrix} \quad (3.0.3)$$

Substituting (3.0.3) and (3.0.2) in (2.0.1) we get

$$\mathbf{r} = \begin{pmatrix} -1 \\ -5 \\ -10 \end{pmatrix} + \lambda \begin{pmatrix} 3 \\ 4 \\ 2 \end{pmatrix} \quad (3.0.4)$$

which is the line parallel to line (1.0.1) and passes through point $\begin{pmatrix} 2 \\ -1 \\ 2 \end{pmatrix}$.

Finally the distance between the point

$$\mathbf{P} = \begin{pmatrix} -1 \\ -5 \\ -10 \end{pmatrix}$$

and intersection point $\begin{pmatrix} 2 \\ -1 \\ 2 \end{pmatrix} = 13. \quad (3.0.5)$