4.6.7

EE25BTECH11019 – Darji Vivek M.

Question:

Find the equation of the line which passes through the point $(3, 4, 5)$ and is parallel to the vector $2\mathbf{i} + \mathbf{j} - 3\mathbf{k}$.

$(12, 2018)$

Solution

Matrix Method:
Let the point be

$$\mathbf{A} = \begin{pmatrix} 3 \\ 4 \\ 5 \end{pmatrix}, \tag{1}$$

and the direction vector be

$$\mathbf{d} = \begin{pmatrix} 2 \\ 1 \\ -3 \end{pmatrix}. \tag{2}$$

Solution

The general form of a line is

$$\mathbf{r} = \mathbf{A} + \lambda\mathbf{d}. \tag{3}$$

Substituting values,

$$\mathbf{r} = \begin{pmatrix} 3 \\ 4 \\ 5 \end{pmatrix} + \lambda \begin{pmatrix} 2 \\ 1 \\ -3 \end{pmatrix}. \tag{4}$$

$$\mathbf{r} = \begin{pmatrix} 3 + 2\lambda \\ 4 + \lambda \\ 5 - 3\lambda \end{pmatrix} \tag{5}$$

Equation of line in symmetric form

$$\frac{x-3}{2} = \frac{y-4}{1} = \frac{z-5}{-3} \tag{6}$$

C Code

```
#include <stdio.h>

void line_point(double lambda, double *out) {
    // Line: r = A + lambda*d
    double A[3] = {3.0, 4.0, 5.0};
    double d[3] = {2.0, 1.0, -3.0};

    for(int i=0; i<3; i++) {
        out[i] = A[i] + lambda * d[i];
    }
}
```

Python (Call)

```python
import ctypes
import numpy as np
import matplotlib.pyplot as plt

# Load shared library
lib = ctypes.CDLL("./7.so")
lib.line_point.argtypes = [ctypes.c_double, np.
    ctypeslib.ndpointer(dtype=np.float64)]
lib.line_point.restype = None

def line_point(lambda_val):
    out = np.zeros(3, dtype=np.float64)
    lib.line_point(lambda_val, out)
    return out

# Generate line points
lambdas = np.linspace(-5, 5, 50)
points = np.array([line_point(l) for l in lambdas])
```

Python (Plot)

```python
# Given point A
A = np.array([3, 4, 5])

# Plot
fig = plt.figure()
ax = fig.add_subplot(111, projection='3d')

ax.plot(points[:,0], points[:,1], points[:,2], label="
    Line")
ax.scatter(A[0], A[1], A[2], color='red', s=50, label=
    "Point A (3,4,5)")

# Annotate the point
ax.text(A[0], A[1], A[2], "A(3,4,5)", fontsize=10,
    color='red')

ax.set_xlabel("X")
ax.set_ylabel("Y")
ax.set_zlabel("Z")
```
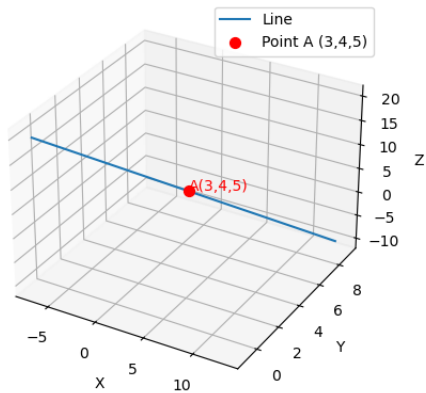
Python Output and Plot

Figure: Line through **A** parallel to **d**