

Electromagnetics 2FH4  
MATLAB Set (1) – Vector Analysis

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## MATLAB Set (1) – Vector Analysis

### Problem

Exercise: Given the vectors  $R1 = ax + 2ay + 3az$ ,  $R2 = 3ax + 2ay + az$ . Find a) the dot product  $R1 \cdot R2$ , b) the projection of  $R1$  on  $R2$ , c) the angle between  $R1$  and  $R2$ .

### Solution

Consider,

```
R1 = [1, 2, 3];  
R2 = [3, 2, 1];
```

```
% Dot product between R1 and R2  
dotP = dot(R1,R2)
```

```
% Projection of R1 onto R2  
proj = (dotP/norm(R2)^2) * R2
```

```
% Angle between R1 and R2  
angle = acos(dotP / (norm(R1)*norm(R2)))
```

With the following output,

```
dotP =
```

```
10
```

```
proj =
```

```
2.1429    1.4286    0.7143
```

```
angle =
```

```
0.7752
```

Also consider the hand-calculated solution,

Matlab Set 1 - Vector Operations

$R1 = [1, 2, 3]$   
 $R2 = [3, 2, 1]$

Dot Product

$$R1 \cdot R2 = (1)(3) + (2)(2) + (3)(1)$$

$$= 3 + 4 + 3$$

$$= 10, \text{ confirmed via matlab } \checkmark$$

Vector Projection, R1 onto R2

$$\text{Proj}_{R2} R1 = \frac{R1 \cdot R2}{|R2|^2} R2, \quad R1 \cdot R2 = 10$$

$$|R2| = \sqrt{1^2 + 2^2 + 3^2}$$

$$|R2| = \sqrt{4 + 9 + 1}$$

$$= \sqrt{14}$$

$$\Rightarrow \frac{10}{\sqrt{14}} [3, 2, 1]$$

$$\Rightarrow [2.1429, 1.4286, 0.7143] \checkmark, \text{ confirmed}$$

Angle Between

$$\cos \theta = \frac{R1 \cdot R2}{|R1| |R2|} \quad |R1| = |R2|$$

$$\theta = \cos^{-1} \left( \frac{10}{\sqrt{14} \sqrt{14}} \right)$$

$$\theta = 44.415^\circ, \text{ cos is } 0.775 \text{ confirmed. } \checkmark$$

Which results in the same values as found in MATLAB, relatively speaking.