

# Wave propagation

Draw voltage distribution and Current distribution for O.C.T.L using MATLAB

## Assignment 1

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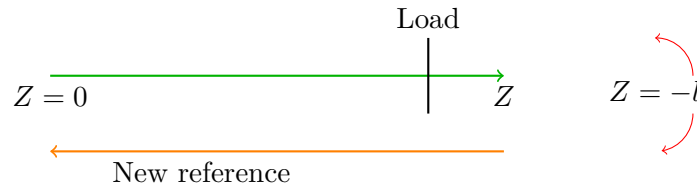
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# Chapter 1

## Current and Voltage Distribution

The tools used: MATLAB

We have the **current distribution** and **voltage distribution** equations for the open-circuit transmission line (TL):



As we changed ou

$$|V(l)| = \left| 2V_0^+ \right| |\cos(\beta l)|$$

Similarly, for the current  $I(l)$ :

$$|I(l)| = \left| \frac{2V_0^+}{Z_0} \right| |\sin(\beta l)|$$

Where:

- $V_0^+$  is the amplitude of the incident voltage wave
- $Z_0$  is the characteristic impedance of the line
- $\beta$  is the phase constant
- $l$  is the distance along the line

Using **MATLAB**, we plot these distributions to visualize how **Voltage** and **Current** vary along the length of the transmission line ( **Antenna** ).

## 1.1 MATLAB Code

```
1 % Define parameters
2 V0 = 1;
3 Z0 = 1;
4
5 % Define l and beta*l ranges
6 l = linspace(0, 2*pi, 1000);
7 beta_l = linspace(0, 2*pi, 1000);
8
9 % Define the voltage distribution & current distribution equations
10 I_1 = abs((2*V0/Z0) * abs(sin(beta_l)));
11 V_1 = abs(2*V0 * abs(cos(beta_l)));
12 % =====
13 % Plot current distribution
14 % ----- l -----
15 figure(1);
16 subplot(2,1,1);
17 plot(l, abs((2*V0/Z0) * abs(sin(l))), "r", "Linewidth", 2);
18 set(gca, 'XDir', 'reverse', 'YAxisLocation', 'right')
19 xlim([0 2*pi]);
20 title('Current Distribution along O.C.T.L for for l');
21 xlabel('l');
22 ylabel('|I(l)|');
23 xticks([0:pi/2:2*pi]);
24 xticklabels({'0', '\lambda/4', '\lambda/2', '3\lambda/4', '\lambda'});
25 grid on;
26 % ----- \beta l -----
27 subplot(2,1,2);
28 plot(beta_l, I_1, "b", "Linewidth", 2);
29 set(gca, 'XDir', 'reverse', 'YAxisLocation', 'right')
30 xlim([0 2*pi]);
31 title('Current Distribution along O.C.T.L for \beta l');
32 xlabel('\beta l');
33 ylabel('|I(l)|');
34 xticks([0:pi/2:2*pi]);
35 xticklabels({'0', '\pi/2', '\pi', '3\pi/2', '2\pi'});
36 grid on;
37 % =====
38 % Plot current distribution
39 % ----- l -----
40 figure(2);
41 subplot(2,1,1);
42 plot(l, abs(2*V0 * abs(cos(l))), "r", "Linewidth", 2);
43 set(gca, 'XDir', 'reverse', 'YAxisLocation', 'right')
44 xlim([0 2*pi]);
45 title('Voltage Distribution along O.C.T.L for for l');
46 xlabel('l');
47 ylabel('|V(l)|');
48 xticks([0:pi/2:2*pi]);
49 xticklabels({'0', '\lambda/4', '\lambda/2', '3\lambda/4', '\lambda'});
50 grid on;
51 % ----- \beta l -----
52 subplot(2,1,2);
53 plot(beta_l, V_1, "b", "Linewidth", 2);
54 title('Voltage Distribution along O.C.T.L for \beta l');
55 set(gca, 'XDir', 'reverse', 'YAxisLocation', 'right')
56 xlim([0 2*pi]);
57 xlabel('\beta l');
58 ylabel('|V(l)|');
59 xticks([0:pi/2:2*pi]);
60 xticklabels({'0', '\pi/2', '\pi', '3\pi/2', '2\pi'});
61 grid on;
```

## 1.2 MATLAB output

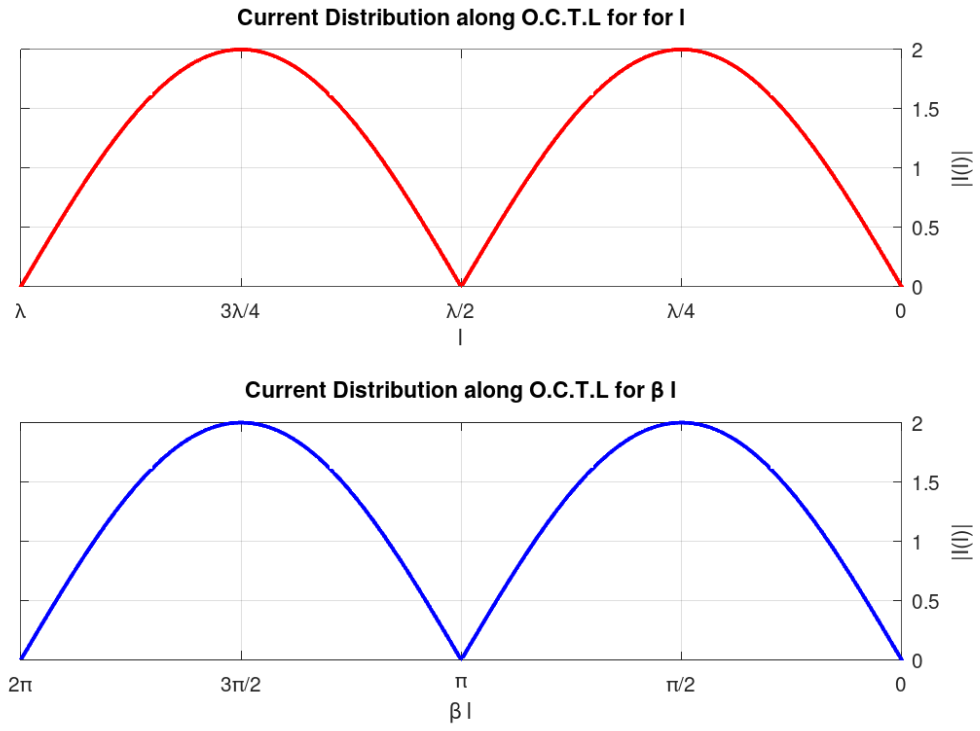


Figure 1.1: **Current** distribution plot for  $l$  and  $\beta l$

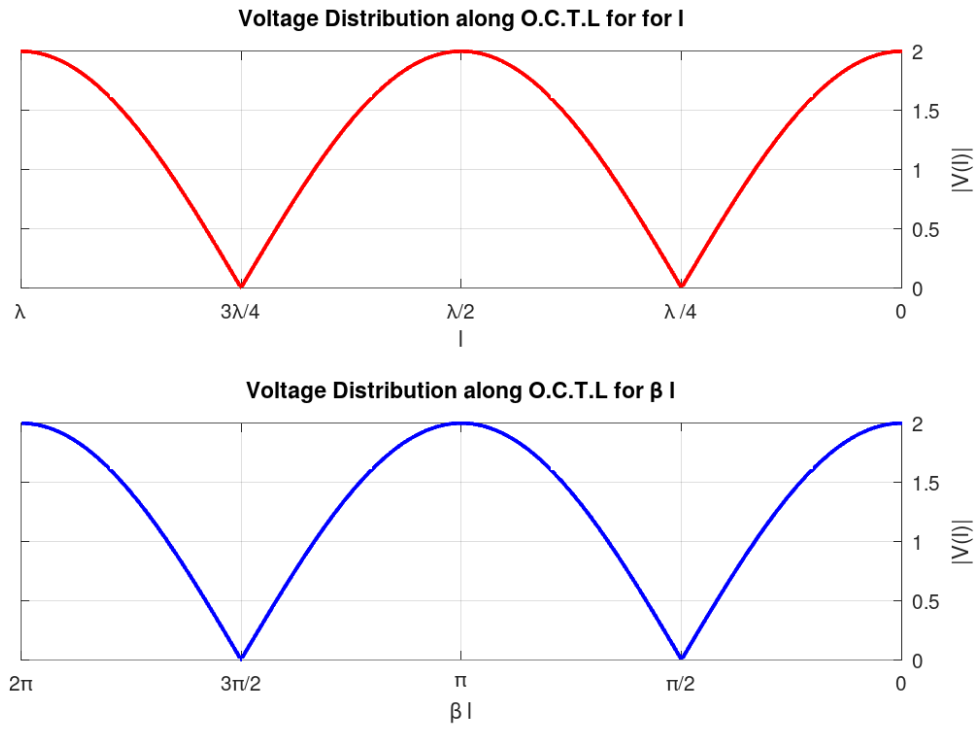


Figure 1.2: **Voltage** distribution plot for  $l$  and  $\beta l$

we can use this code to plot **Current** and **Voltage** on one figuer

```

1 % ----- l -----
2 figure(1);
3 subplot(2,1,1);
4 plot(1, abs(2*V0 * abs(cos(1))) , "r", "Linewidth", 2);
5 hold
6 plot(1, abs((2*V0/Z0) * abs(sin(1))) , "b", "Linewidth", 2);
7 set(gca, 'XDir', 'reverse', 'YAxisLocation', 'right')
8 xlim([0 2*pi]);
9 title('Current & Voltage Distribution along O.C.T.L for for l');
10 xlabel('l');
11 ylabel('|V(l)|');
12 xticks([0:pi/2:2*pi]);
13 xticklabels({'0', '\lambda /4', '\lambda/2', '3\lambda/4', '\lambda'});
14 grid on;
15 legend("Voltage", " Current ")
16
17 % ----- \beta l -----
18 subplot(2,1,2);
19 plot(beta_l, V_1, "r", "Linewidth", 2);
20 hold
21 plot(beta_l, I_1, "b", "Linewidth", 2);
22
23 title('Current & Voltage Distribution along O.C.T.L for \beta l');
24 set(gca, 'XDir', 'reverse', 'YAxisLocation', 'right')
25 xlim([0 2*pi]);
26 xlabel('\beta l');
27 ylabel('|V(l)|');
28 xticks([0:pi/2:2*pi]);
29 xticklabels({'0', '\pi/2', '\pi', '3\pi/2', '2\pi'});
30 grid on;
31 legend("Voltage", " Current ")

```

And we got :-

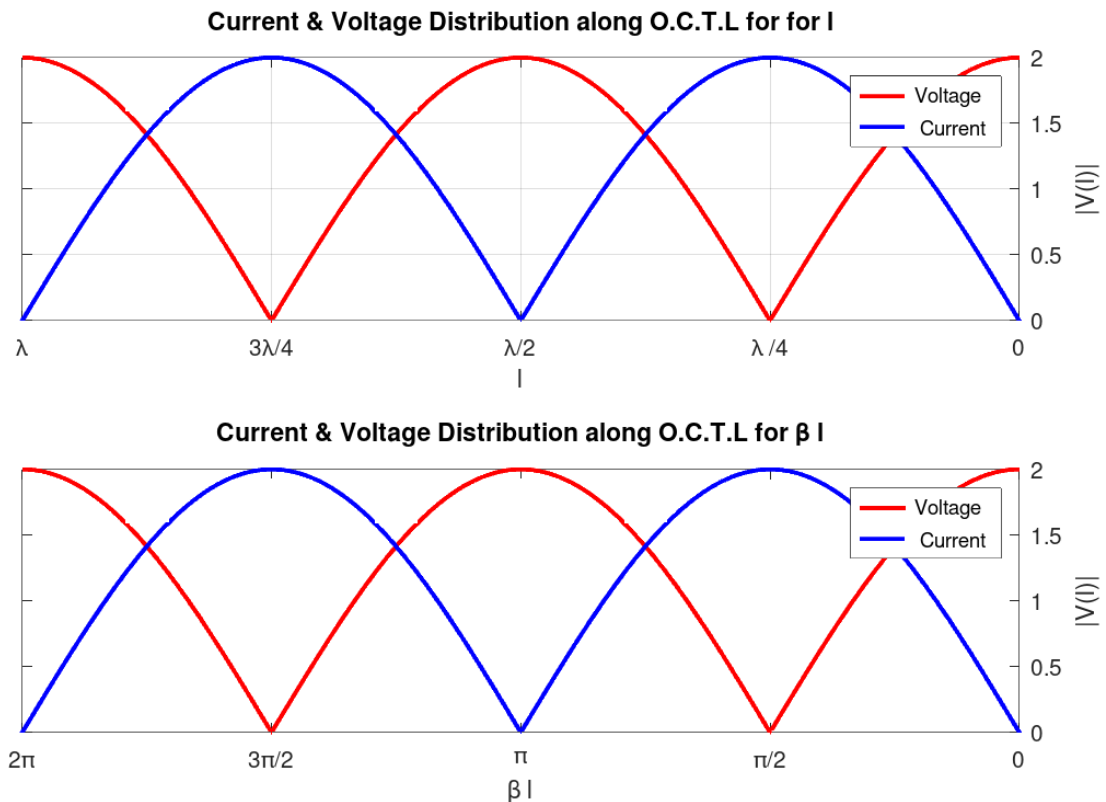


Figure 1.3: **Voltage** and **Current** distribution plot for  $l$  and  $\beta l$