Power Systems Lab

Experiment 3

Laboratory Report

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Experiment 3

1 Objective

To find the receiving end voltage, power and voltage regulation of a medium length transmission line using MATLAB.

Let the given problem be as follows:

The sending-end voltage on a 3-phase, 60 Hz, transmission line is 120 kV.
The line is 100 km long and has the following constants,
Impedance (Z) = 0.017 + j 0.12 Ω per km
Admittance (Y) = j 1.2 $\times 10^{-6}$ S per km
Find the receiving end voltage and power if the line is delivering a load of 17.12 MVA.
Also find the voltage regulation.

2 Theoretical Background

The transmission matrix, i.e. the ABCD parameters, of the line relate the sending end voltage and current to the receiving end voltage and current, according to the following equation:

$$\begin{bmatrix} V_S \\ I_S \end{bmatrix} = \begin{bmatrix} A & B \\ C & D \end{bmatrix} \begin{bmatrix} V_R \\ I_R \end{bmatrix}$$

$$\begin{bmatrix} V_R \\ I_R \end{bmatrix} = \begin{bmatrix} A & B \\ C & D \end{bmatrix}^{-1} \begin{bmatrix} V_S \\ I_S \end{bmatrix}$$

To find the receiving end power, we can simply use the following:

$$S_R = V_R I_R$$

Voltage Regulation

Voltage regulation is a measure of change in the voltage magnitude between the sending and receiving end of a component. It is commonly used in power engineering to describe the percentage voltage difference between no load and full load voltages distribution lines, transmission lines, and transformers.

The voltage regulation can be calculated as follows:

$$\% \text{ Regulation} = \frac{|V_S| - |V_R|}{|V_R|} * 100$$

3 Implementation

```
% Receiving end voltage, power and voltage regulation of
% 3-phase medium transmission line.

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Vs = 120;    % Sending voltage in kV
Ss = 17.12;  % Sending power in MVA

Zp  = 0.017 + 0.12i; % Impedance per km
Yp  = 1.2e-6i;       % Admittance per km
len = 100;           % Length in km

% ABCD Parameters
Z = len * Zp;
Y = len * Yp;

A = ((Y*Z)/2) + 1;
B = Z;
C = Y*(((Y*Z)/4) + 1);
D = A;

T = [ A B; C D; ]
T = inv(T);

% Calculating sending end voltage and power

Is = Ss / Vs;         % Sending current

Rc = T \ [Vs;Is];
Vr = Rc(1)            % Received voltage
Ir = Rc(2);           % Received current

Sr = abs(Vr * Ir)     % Received power in MVA

% Calculating voltage regulation

R = ((Vs - abs(Vr))/abs(Vr)) * 100 % Voltage regulation
```

4 Observations

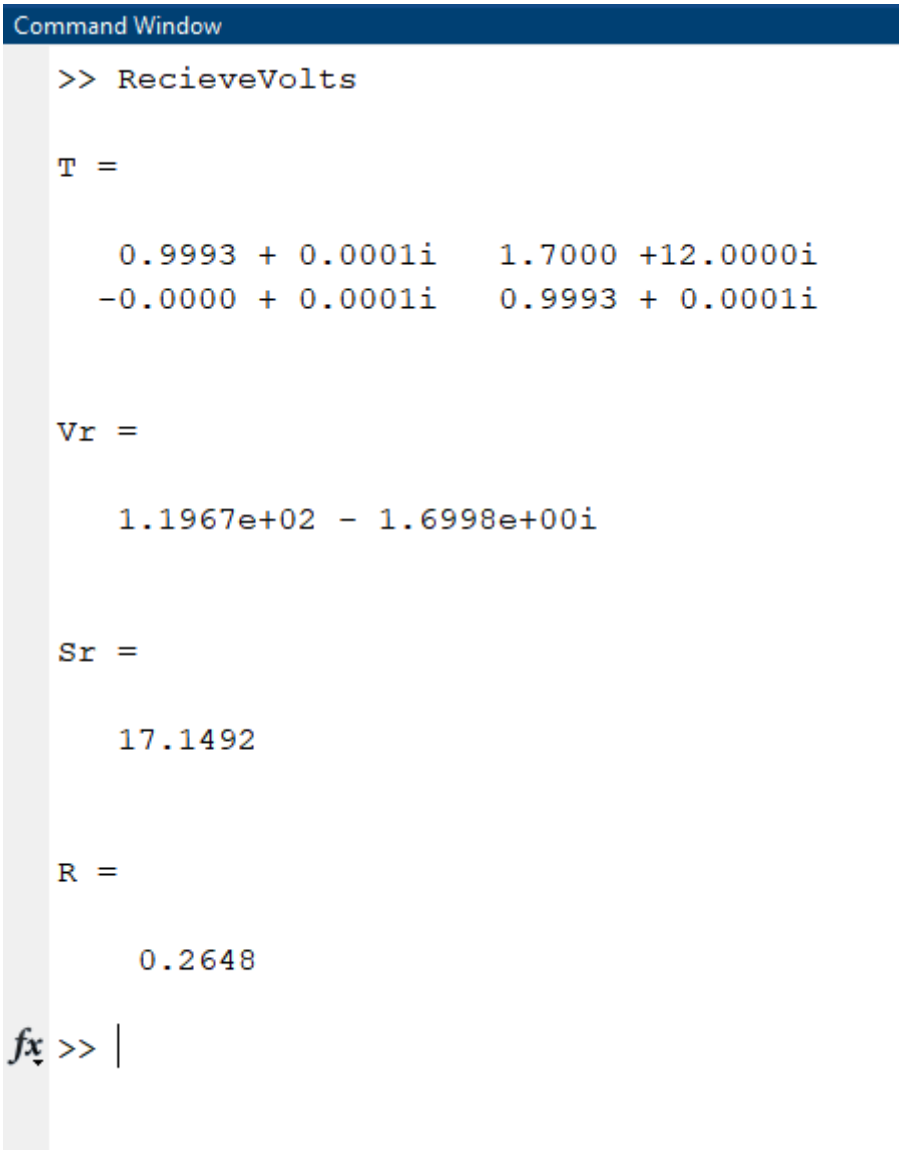

Figure 1: Result in MATLAB

The result of the above program with the given parameters is shown in figure 1.

5 Result

For the given problem, the calculated **receiving end voltage is 119.6831 kV.** The **receiving end power is 17.1492 MVA,** which means a power loss of 29.2 KVA and a voltage drop of 1.7313 kV over the line.

The calculated **voltage regulation of the transmission line is 0.2648%.**

Thus we calculated the requied quantities using a program in MATLAB.