Introduction to PowerWorld Simulator: Interface and Common Tools

I16: TransLineCalc

PowerWorld Corporation

TransLineCalc Tool

- The Transmission Line Parameter Calculator (TransLineCalc) is a tool designed to compute characteristic line parameters

  – Input data: Type of conductor and tower configuration of a three-phase overhead transmission line

  – Output data: Resistance R, reactance X, susceptance B, conductance G

  – Values computed as distributed, lumped or total, and in per-unit

- As a stand-alone program or as an automation server that interacts with Simulator or from an external application

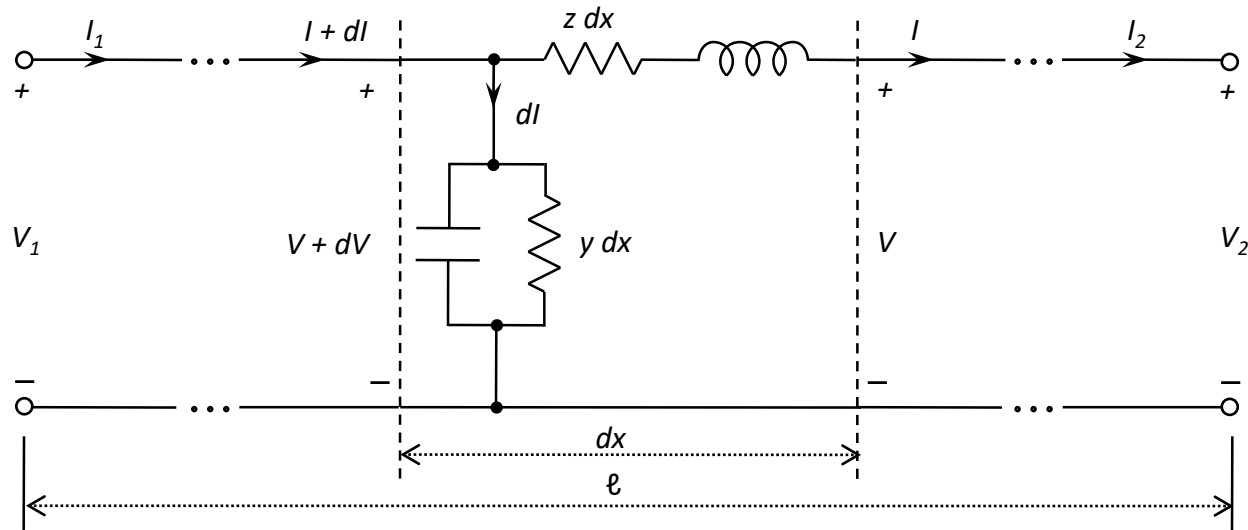# Distributed Transmission Line Model

- ## Distributed parameter line

$z = r + j\omega l = $ series impedance per unit length/phase

$y = g + j\omega c = $ shunt admittance per unit length/phase

$\ell = $ length of the line

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Distributed Transmission Line Model (cont'd)

- The relationship between the per-phase voltages and currents at the two ends of the transmission line is specified by:

$$V_1 = V_2 \cosh \gamma\ell + Z_C I_2 \sinh \gamma\ell$$

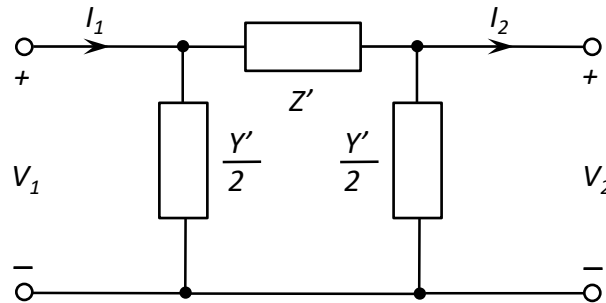$$I_1 = I_2 \cosh \gamma\ell + \frac{V_2}{Z_C} \sinh \gamma\ell$$

where

- z is the series impedance
- y is the shunt admittance
- γ is the propagation constant = $\sqrt{zy}$
- Z_C is the characteristic impedance = $\sqrt{z/y}$

Π Transmission Line Model

- Use of equivalent Π circuit of a transmission line

- The same relationship between terminal voltages and currents in a matrix form:

$$V_1 = AV_2 + BI_2$$
$$I_1 = CV_2 + DI_2$$

Π Transmission Line Model (cont'd)

- The *A*, *B*, *C*, *D* parameters are given by:

$$A = 1 + \left(\frac{Z'Y'}{2} \right) \qquad B = Z'$$

where

$$C = Y' \left(1 + \frac{Z'Y'}{4} \right) \qquad D = 1 + \frac{Z'Y'}{2}$$

- $Z \triangleq z\ell$ is the total series impedance of the line, and

$$Z' = Z \frac{\sinh \gamma \ell}{\gamma \ell}$$

- $Y \triangleq y\ell$ is the total line-neutral admittance of the line, and

$$\frac{Y'}{2} = \frac{Y}{2} \frac{\tanh(\gamma \ell / 2)}{\gamma \ell / 2}$$

TransLineCalc Calculations

- Three types of calculations available in TransLineCalc:

  - Parameters Calculation. Computes distributed and lumped or total values of R, X, G and B

  - Amp to MVA Conversion. Converts the limits of transmission lines from Amps to MVA's, and viceversa, given the voltage base

  - Reverse Lookup. Given the tower configuration and the characteristic line parameters in per unit, lists the conductors that match those characteristic line parameter given values

Parameters Calculation

Edit conductors table and tower configurations

Characteristic line parameters
(lumped, per-unit, distributed and intermediate values)

Select
Conductor Type

Select
Tower Configuration

Line length and units

Automatic calculation
of parameters when
any of the input data
changes

PowerWorld Transmission Line Parameter Calculator v...

| Calculations | Conductor Type | Tower Configuration |

| Parameters Calculation | Amp to MVA Conversion | Reverse Lookup |

Input Data

Conductor Type	Bittern
Tower Configuration	Default
Line Length	10.000 mi
Length Units	English
Power Base	100.000 MVA
Voltage Base	138.000 kV
Impedance Base	190.440 Ohms
Admittance Base	0.00525 Mhos

Results

| Lumped Results | Distributed Results | Intermediate Results |

R =	0.75889093	Ohms per phase
X =	5.4981041	Ohms per phase
B =	7.8482692E-05	Siemens per phase
G =	3.8988057E-10	Siemens per phase

R =	0.0039849345	PU per phase
X =	0.028870532	PU per phase
B =	0.014946244	PU per phase
G =	7.4248856E-08	PU per phase

| Surge Impedance Loading | 71.608762 | MVA |

Note: Calculated using the long-line model of a transmission line (hyperbolic equations)

✓ OK   ✗ Cancel   Select Conductors and Configurations Database   ? Help

Editing Conductors and Tower Configurations

Create a new conductor, modify or delete an existing one

Values can be changed for the specific conductor/tower configuration or as a table form

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Amp to MVA Limit Conversion

The stand-alone version displays only three limits. When used from Simulator, it will display the current 8 line limits of a transmission line

The voltage base is the only input data

As the user modify either the Amp Limits or the MVA Limits, they are automatically converted

Reverse Lookup

Enter the Tower Configuration, line length and units, and per-unit characteristic line parameter values

Conductors are listed according to the match found

Interaction with Simulator

- TransLineCalc can be open from Simulator.

    - Transmission/Line/Transformer options dialog for each line in Edit Mode

    - **Parameters** tab,

    - Click on **Calculate Impedances** button,

    - Select **From Conductor Type and Tower Configuration**.