

# Assessment of Impedance and Transmission Parameters for Different Feeder Interconnections

Pinaki Chakraborty<sup>1</sup>

Department of Electrical Engineering, MCKVIE, Liluah, West Bengal, India<sup>1</sup>

**ABSTRACT:** In power system, power transmission line performance analysis in different feeder inter connection systems case study where a technique can be used for diagnostic purpose of performance parameter. The technique based on branch-matrix optimization has been utilized on a single electrical network system which consisting of single two port network. This network has been extended to different types of three layer system by introducing several two port network of same property by different feeder inter-connections. Four types of interconnections like multiple layer multidirectional radial system, multiple layer unidirectional radial system, multiple layer ring system and multi-elemental multilayer radial-ring system have been designed. Comparative study has been done on the basis of real data. The study has been tested to reach the conclusion by simulation.

**KEYWORDS:** Branch Matrix, Branch Reallocation, Matrix-system analysis, Optimal operating condition

## I. INTRODUCTION

In order of comparative study such inter connection arrangements has been taken for this complex scenario of delegate and predefined procedure of control methods [1]. The delegate Transmission Line system and modeling using multi-objective optimization Techniques [2],[4] are demanding “Power system” trends into this section of electrical engineering for more complex application concept to cope up the target of reduction of losses. Power transmission is the most vital part of concentration to minimize or optimize [3], [4], the transmission losses by analyzing its parameters keeping view on the voltage gain, transmission line optimization [5], [6], voltage-drop and admittance characteristics in optimal form.

## II. BRANCH REALLOCATION

Transmission parameters of a two port network equation theorem are defined by following conventional notification as;

$$\begin{bmatrix} V_S \\ I_S \end{bmatrix} = \begin{bmatrix} A & B \\ C & D \end{bmatrix} \begin{bmatrix} V_R \\ I_R \end{bmatrix} \quad (1)$$

In this paper a single network has been defined by value of the transmission line elements from available standard values. Those values has been used for developing single layer - single branch equivalent network with the basis of above given mathematical matrix model.

Tree formed by single layer - single branch equivalent of a network has been shown in Fig. 1. The Fig. 2 shows Tree of three layer multidirectional radial system. A Tree by three layer system shown in Fig. 1. Again reallocated branches has been shown in Fig. 1.a to Fig. 1.e.

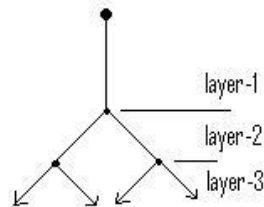


Fig. 1 Tree formed by three layer multidirectional radial system

Different mode of network arrangement has been arranged in the form of different scheme as follows;

Scheme-I defined by Layer -1 has been represented by a matrix of 150km. (shown in Fig. 1.a ) long equivalent parameter matrix for a single network .

Scheme-II defined by Layer -1 and Layer -2 has been represented by a matrix of 75km. each (Layer1 and Layer2) (shown in Fig. 1.b) equivalent parameter matrix for network.

Scheme-III defined by Layer -1, 2 and 3 are represented by a matrix of 50km. for each (Layer1, Layer2 and Layer3) (shown in Fig. 1.c) equivalent parameter matrix for network.

Scheme-IV defined by a matrix of Layer-1 (25km.), Layer-2 (50Km.) and Layer-3 (75Km.) (shown in Fig. 1.d) equivalent parameter matrix network.

Scheme-V (Fig. 1.e) has been defined by a matrix of Layer-1(25km.), Layer-2 (50Km.) and Layer-3 (75Km.) equivalent parameter matrix network for radial system.

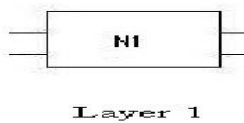


Fig. 1.a, (150Km. long single network)

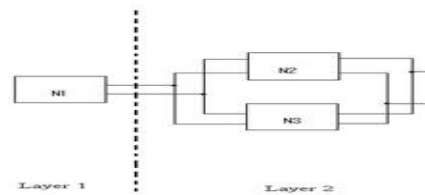


Fig. 1.b, (75-75Km. long for individual layer network)

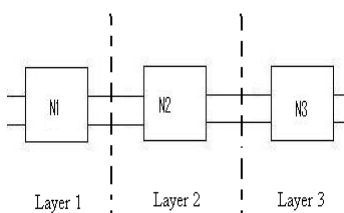


Fig.1.c, (50-50-50Km long apart for individual layer network) 75Km long

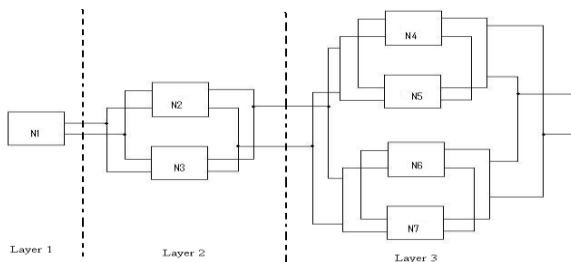


Fig. 1.d, (Layer-1 by 25km., Layer-2 by 50Km. and Layer-3 by apart for individual layer network)

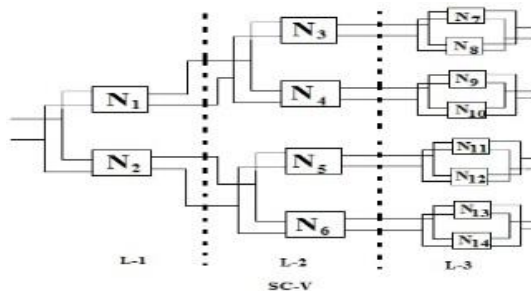


Fig.1.e, (25-50-75Km. long apart for individual layer network)

For the mathematical calculation following symbols and notifications are considered: L= inductance,  $l$  = length of the transmission line,  $\mu_0$ =permeability, d= adjacent distance between two conductors, r = radius of the conductor, C= capacitance,  $R_{ac}$ = resistance due to ac supply and D = outer dia. of the conductor. In this paper following data have been used sending end voltage  $V_s = 11KV$ , frequency  $f = 50Hz$ ,  $d = 3.05m$ ,  $r = 0.0175m$ . Taking the practical value for the parameters of the individual port network arrangement for different schemes (figures). TABLE -1 has been developed by using the over given data,

TABLE-1 (R, X, L FOR DIFFERENT LENGTH OF TRANSMISSION LINE)

Length	$R_{ac} \Omega$	X	L
25	11.36	52.8	495.5
50	22.73	310.6	991
75	34.10	432.5	1486.5
150	68.20	916.3	2973

The length of transmission line taken as 25 Km. long and T-arrangement has been considered. Then the equation (2) shows the values of ABCD in form of matrix for the length of 50km. long transmission line.

$$\begin{bmatrix} A & B \\ C & D \end{bmatrix}_{25km.} = \begin{bmatrix} 1.486 & 67.12 \\ 0.0184 & 1.486 \end{bmatrix} \quad (2)$$

The length of transmission line taken as 50 Km. long and T-arrangement has been considered. Then the equation (3) shows the values of ABCD in form of matrix for the length of 50km. long transmission line.

$$\begin{bmatrix} A & B \\ C & D \end{bmatrix}_{50km.} = \begin{bmatrix} 1.49 & 389.2 \\ 3.21 \times 10^{-4} & 1.49 \end{bmatrix} \quad (3)$$

The length of transmission line taken as 75 Km. long and T-arrangement has been considered. Then the equation (4) shows the values of ABCD in form of matrix for the length of 75km. long transmission line.

$$\begin{bmatrix} A & B \\ C & D \end{bmatrix}_{75km.} = \begin{bmatrix} 1.47 & 537.3 \\ 2.2 \times 10^{-4} & 1.47 \end{bmatrix} \quad (4)$$

The length of transmission line taken as 150 Km. long and T-arrangement has been considered. Then the equation (5) shows the values of ABCD in form of matrix for the length of 150km. long transmission line.

$$\begin{bmatrix} A & B \\ C & D \end{bmatrix}_{150km.} = \begin{bmatrix} 1.49 & 389.2 \\ 3.21 \times 10^{-4} & 1.49 \end{bmatrix} \quad (5)$$

### III. NUMERICAL STUDY

TABLE-2 [Z] AND [ABCD] OF DIFFERENT FIGURE

Fig.	Length variation (l)	[Z]	[ABCD]
1.a	150	$\begin{bmatrix} 1379.6 & 907.4 \\ 925.9 & 1379.6 \end{bmatrix}$	$\begin{bmatrix} 1.49 & 1148.2 \\ 1.08 \times 10^{-4} & 1.49 \end{bmatrix}$
1.b	75-75	$\begin{bmatrix} 9893.57 & 13731.5 \\ 6733.6 & 9893.57 \end{bmatrix}$	$\begin{bmatrix} 1.46 & 804.9 \\ 1.08 \times 10^{-4} & 1.46 \end{bmatrix}$
1.c	50-50-50	$\begin{bmatrix} 13925.14 & 19532.7 \\ 9345.78 & 13925.14 \end{bmatrix}$	$\begin{bmatrix} 1.489 & 1215.6 \\ 1.07 \times 10^{-4} & 1.489 \end{bmatrix}$
1.d	25-50-75	$\begin{bmatrix} 3042.37 & 4160.29 \\ 2029.63 & 3042.37 \end{bmatrix}$	$\begin{bmatrix} 1.49 & 400.15 \\ 4.92 \times 10^{-4} & 1.49 \end{bmatrix}$
1.e	25-50-75	$\begin{bmatrix} 10462.3 & 14659.69 \\ 7017.52 & 10462.3 \end{bmatrix}$	$\begin{bmatrix} 1.49 & 938.37 \\ 1.42 \times 10^{-4} & 1.49 \end{bmatrix}$

The Table-2 shows the lengthwise [Z] and [ABCD] values of different scheme (figures). From the equation (1), (2), (3) and (4) [Z] has been calculated and corresponding [ABCD] has been calculated. The table-3 shows different A, B, C, D values of different scheme in terms of Z parameter and performance parameter,

TABLE –3,(A, B, C, D PARAMETER AND IMPEDANCE OF DIFFERENT FIG. 1.A- 1.D)

Parameters	Fig. 1.a	Fig. 1.b	Fig. 1.c	Fig. 1.d
$Z_{11}= Z_{22}$	1379.6	9893.57	13925.14	3042.37
$Z_{12}$	907.4	13731.5	19532.7	4160.29
$Z_{21}$	925.9	6733.6	9345.78	2029.63
A=D	1.49	1.46	1.489	1.49
B	1148.2	804.9	1215.6	400.15
C	$1.08 \times 10^{-3}$	$1.48 \times 10^{-3}$	$1.07 \times 10^{-4}$	$4.92 \times 10^{-4}$

TABLE –4, (A, B, C, D PARAMETER AND IMPEDANCE OF FIG. 1.E)

Parameters	Fig. 1.e
$Z_{11}= Z_{22}$	10462.3
$Z_{12}$	14659.69
$Z_{21}$	7017.52
A=D	1.49
B	938.37
C	$1.42 \times 10^{-4}$

Different circuit connection has been developed for simulation following the network as Fig. 1.a to Fig. 1.e respectively.

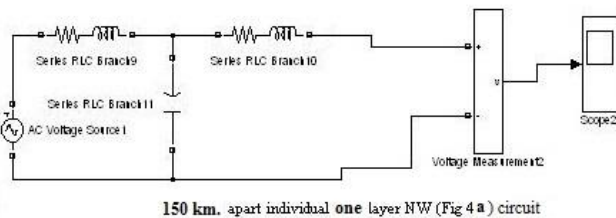


Fig. 2.a (150 km. apart single layer circuit diagram following fig.1.a)

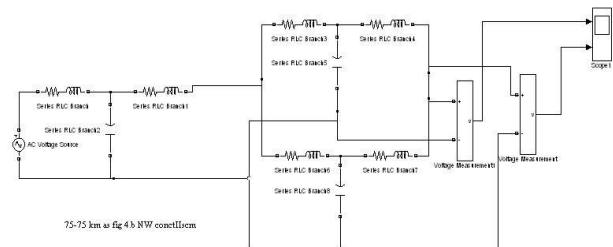


Fig. 2.b (75-75 km. apart two layer circuit diagram following fig.1.b)

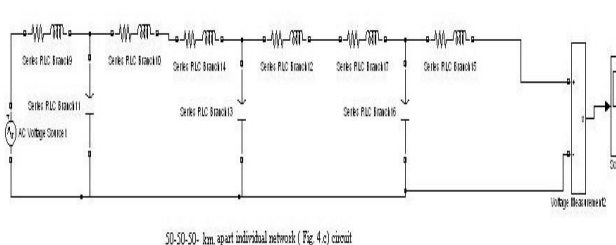


Fig. 2.c(50-50-50 km. apart three layer circuit diagram following fig.1.c)

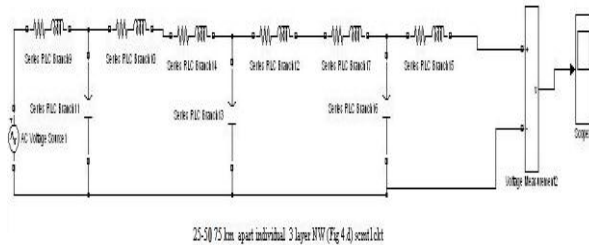


Fig. 2.d(25-50-75 km. apart three layer circuit diagram following fig.1.d)

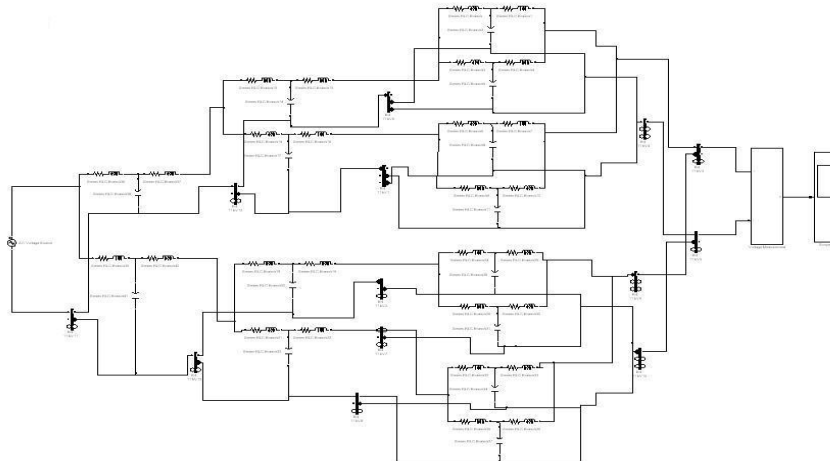


Fig. 2.e (25-50-75 km. apart three layer circuit diagram following fig.1.e)

#### IV.OBSERVATION

Simulated graphs are shown as following

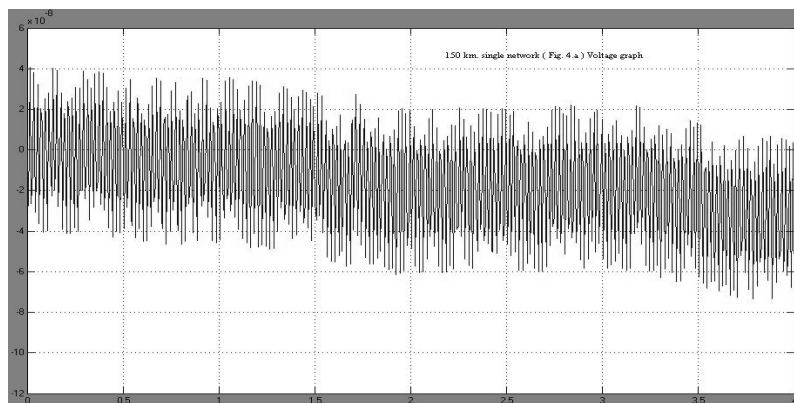


Fig.3.a (150 km. single layer network output voltage with fixed supply voltage)



Fig. 3.b (75-75 km. two layer network output voltage with fixed supply voltage)



Fig.3.c (50-50-50 km.3 layer network output voltage with fixed supply voltage)

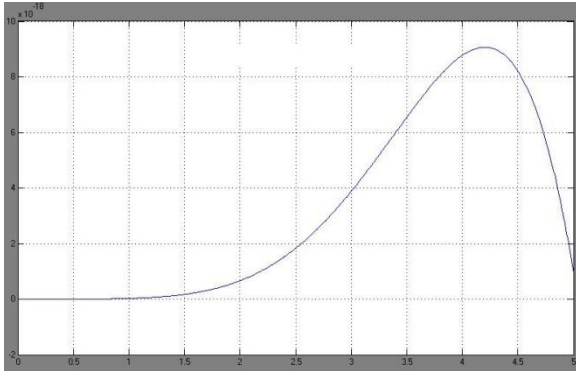


Fig.3.d (25-50-75 km. 3layer network output voltage with fixed supply voltage)

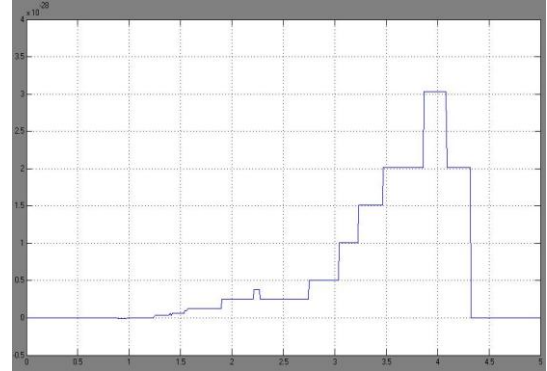


Fig. 3.e (25-50-75 km.3-layer network output voltage with fixed supply voltage)

### V.ANALYSIS

The Fig. 4.a shows that the comparative study of “A” parameter which is nothing but voltage gain having the Fig. 1. c, Fig. 1.d and Fig. 1.e are almost same.

The Fig. 4.b shows that the comparative study of “B” parameter i.e. impedances having the Fig. 1.a and Fig. 1.c are almost same value.

The Fig. 4.c shows that the comparative study of “C” parameter which is nothing but admittance having the Fig. 1.a and Fig. 1.e are maintaining a evitable difference whereas the Fig. 1.d shows a compromise in the scheme.

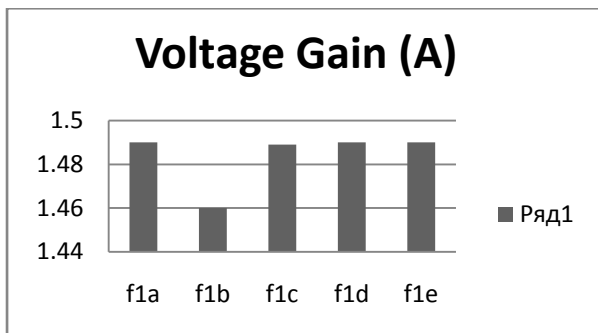


Fig. 4.a (comparative study of A parameter)

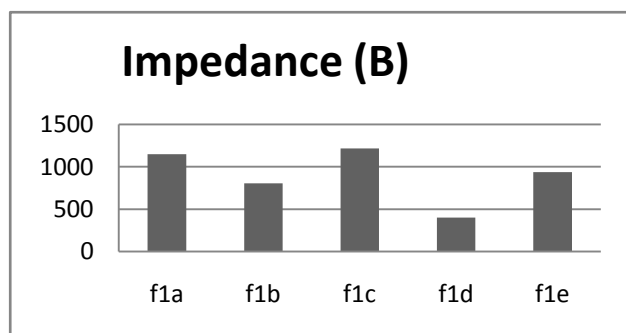


Fig. 4.b (comparative study of B parameter)

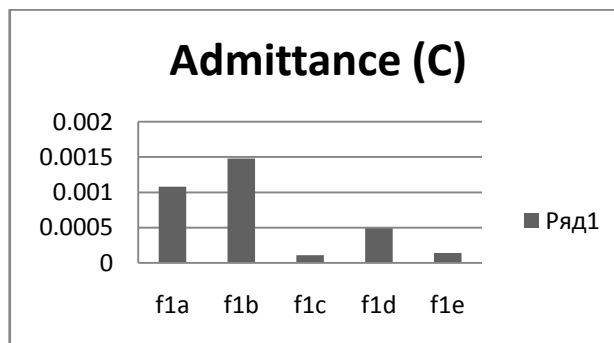


Fig. 4.c (comparative study of C parameter)

## VI.CONCLUSION

Analysis and observation clearly shows that (in the Fig. 4.a) the almost unchanged voltage gain with optimum drops due to transmission line impedance. Four types of interconnections like multiple layer multidirectional radial system, multiple layer unidirectional radial system, multiple layer ring system and multi-elemental multilayer radial-ring system have been considered for this comparative study.

The application of the Matrix reallocation technique on Fig. 2.b, Fig. 2.c, Fig. 2.d, Fig. 2.e reveals that for the case of Fig.1.b (from Fig. 4.c) have the maximum value of C in terms of (Admittance, Y) capacitive value. Again the Fig. 1.c (from Fig. 4.b) shows the minimum value of B in terms of Impedance (Z) where as for all the schemes are concern gains are almost same.

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