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ACTIVE DISTRIBUTION SYSTEMS AND DISTRIBUTED ENERGY RESOURCES C6

Paper ID_10767

Online Parameter Estimation for Balanced Radial Distribution System

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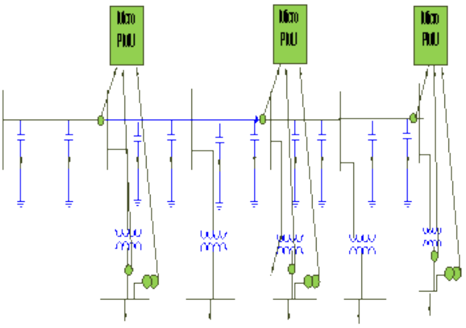
Motivation

- Micro-phasors measurement unit (µPMU) calculates and transmits phasors of current and voltage to a phasor data concentrator (PDC) by measuring highly accurate time-synchronized current and voltage samples.
- At present, there is a two way energy flow in electric distribution grids due to the growth of distributed energy resources (DER) and new customer devices. Therefore, there is growing interest in accurate power flow analysis and energy monitoring tools, which essential for the distribution management system (DMS).
- DMs is a tool or collection of applications to measure, manage, and control the distribution grid from a central operation center. For these requirements, it is required an accurate parameter estimation method for the medium voltage (MV) side and low voltage (LV) side.
- The aim of this study is calculating the error in µPMU measurements and calculating accurate balanced radial distribution grid parameters, including MV cable impedance and admittance.

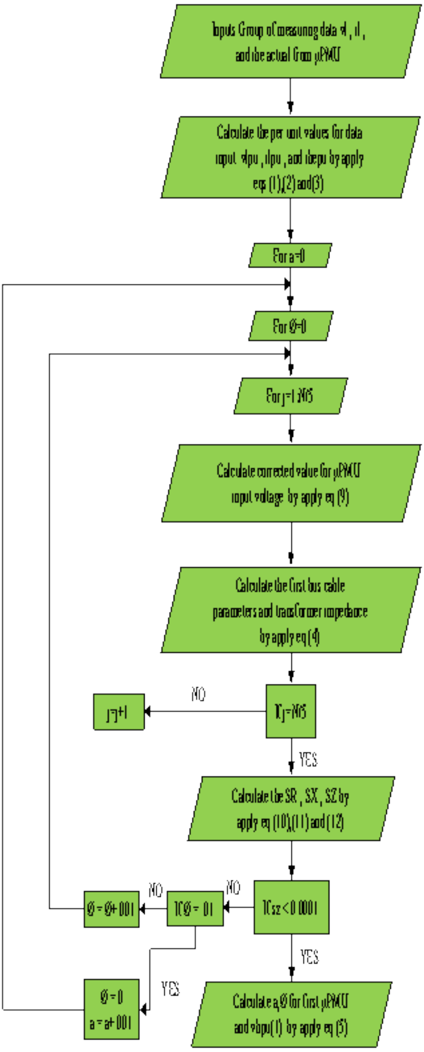
Method /Approach

- The radial distribution grid has a specific number of transformers (n) in each sub-feeder as follows: case I (n is odd) and case II (n is even).
- The distribution of µPMUs in the sub-feeder is shown in Fig (1) as an example for (n is odd) case .



FIG(1) . 5th transformers balanced radial distribution system sub-feeder with µPMU devices.

Objects of investigation



FIG(2) . Flowchart of the proposed algorithm for the first bus.

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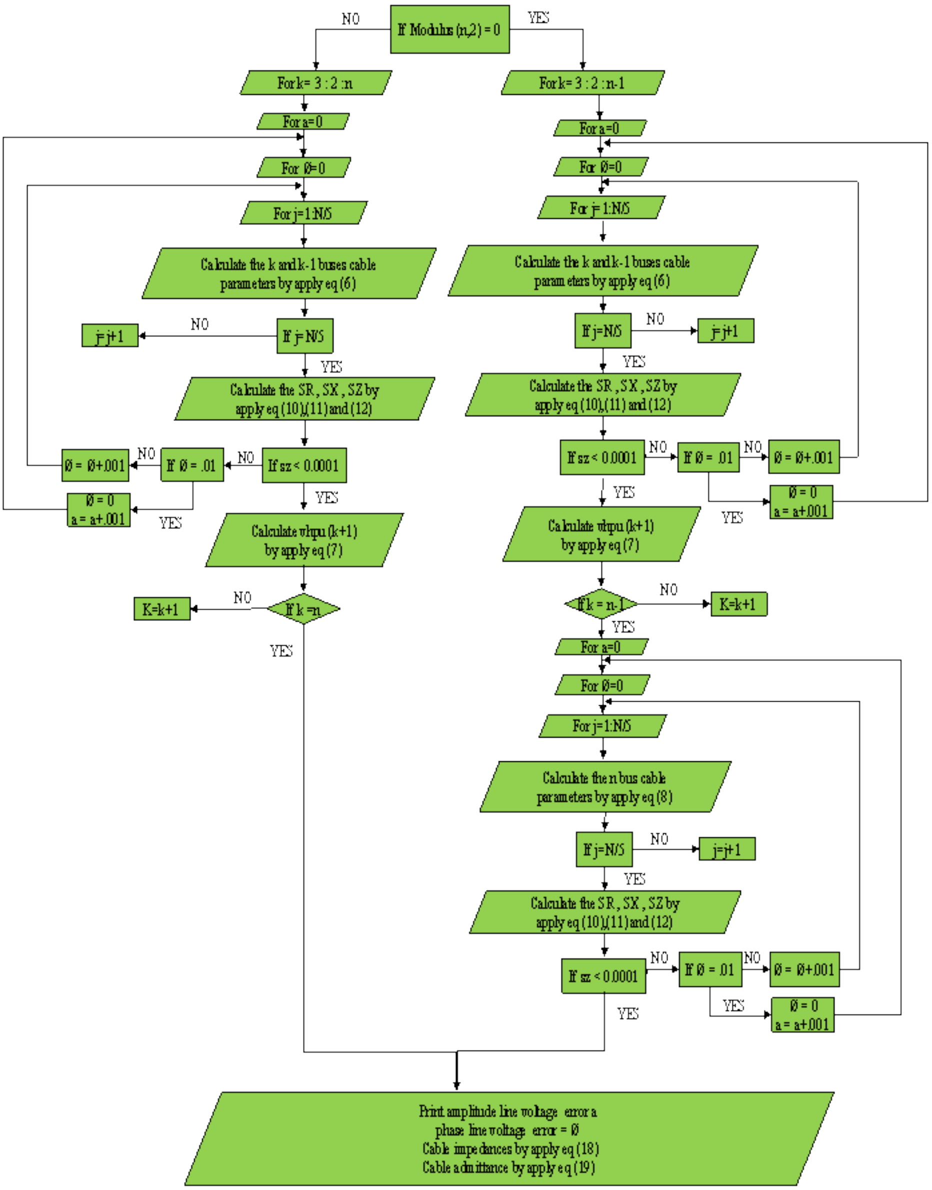

FIG(3) . Flowchart of the proposed algorithm for the other bus.

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Experimental setup & test results

- The proposed algorithm is applied on assiut university radial distribution grid .
- The input data are the measurements outputs of µPMU with certain known error which are simulated from power flow program.
- The outputs of proposed algorithm are the measurement error of µPMU, MV cable parameters .
- Tables I, II, and III present the input cable parameters to the power flow program, calculated cable parameters by the proposed algorithm, the error of the calculated parameters and the input added errors to µPMU measurements and estimated error by the proposed algorithm.

From: to	Cable impedance input to the load flow program	Cable impedance output from the algorithm	[illegible]
	Z (Ω)	Z (Ω)	%
NBS15:76	0.1300+0.0521i	0.1300+0.0521i	**1E-07**
76:77	0.0102+0.0040i	0.0102+0.0040i	**1E-06**
77:78	0.0102+0.0040i	0.0102+0.0040i	**2E-06**
78:79	0.0305+0.0122i	0.0305+0.0122i	**1E-06**
79:80	0.0267+0.0107i	0.0267+0.0107i	**0.1384**

Table I. Cable impedances input to load flow program and output from algorithm.

From: to	Cable admittance input to the load flow program	Cable admittance output from the algorithm	[illegible]
	Y (S)	Y (S)	%
NBS15:76	2.40E-05	2.40E-05	**1.20E-05**
76:77	1.90E-06	1.90E-06	**0.002**
77:78	1.90E-06	1.90E-06	**0.0006**
78:79	5.70E-06	5.70E-06	**0.0013**
79:80	5.00E-06	5.00E-06	**0.0009**

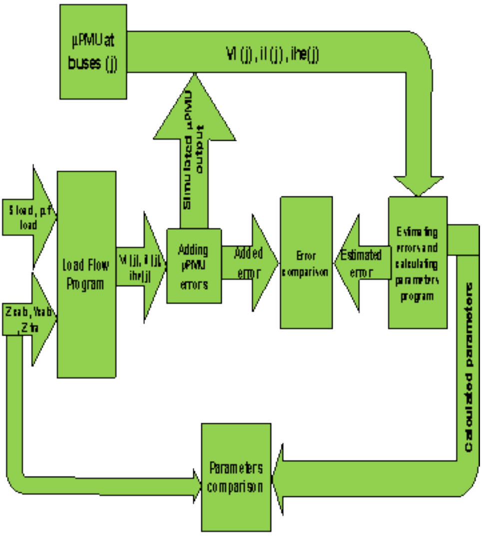
Table II. Cable impedances input to load flow program and output from algorithm.

error	added errors		Estimated error	
	a	Ø	a	**Ø**
µPMU1	0.03	0.01	0.03	**0.01**
µPMU2	0.02	0.03	0.02	**0.03**
µPMU3	0.04	0.02	0.04	**0.02**

Table III. added error to µPMU measurements and estimated errors from algorithm at NBS 15.

Discussion

- To check the validity of the proposed algorithm, a simulated testing process is presented.
- The outputs of µPMUs with certain errors are simulated from outputs of power flow program.
- The outputs of energy monitoring devices with certain defined errors and outputs of µPMUs with certain errors are simulated from outputs of power flow program.
- The testing process shows the high ability of the proposed algorithm to calibrate the errors in the µPMU measurements.



FIG(4) . Block diagram of the simulating testing process.

Conclusion

- This paper presents an accurate method for calibrating the error of µPMU measurements and calculation of balanced radial distribution grid cables parameters
- The testing process to test the accuracy of the proposed algorithm is applied to different sub-feeders. We conclude the following from the cases studied and the results obtained:
- The proposed algorithm proves high accuracy for detecting the measurements errors of µPMU in the different studied cases.
- The proposed algorithm proves high accuracy for MV cable impedance and admittance calculation in the different studied cases.
- The proposed algorithm will be crucial in the development of DMS for radial distribution grids.