Volume 18, Issue 3, 182444 (1-11)

Majlesi Journal of Electrical Engineering (MJEE)

https://dx.doi.org/10.57647/j.mjee.2024.180344

Robust Kalman Filtering technique and adaptive change of impedance-based power swing and fault detection scheme

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Original Research

Received:
23 March 2024
Revised:
11 April 2024
Accepted:
7 June 2024
Published online:
3 September 2024

Abstract:

With the incorporation of the various DG sources in the power system, numerous changes appear and have serious effects on the protective scheme. Knowledge of the impact of these energy sources on the dynamics of the power system is utmost necessary. Also, the performance of the protection system under these circumferences needs to be analyzed. Under the penetration of Renewable Energy Sources, it is desired to develop a new technique that can identify the Power Swing conditions and Fault conditions. It is also required to discriminate between stable or balanced power swing and unstable or unbalanced power swing conditions as an unstable swing may result in cascading of the system. Sometimes, the impedance trajectory falls into the tripping zone of the Mho relay used for line protection during stable swing conditions. This situation is unnecessary because the system has a chance to return to its normal state. Hence, it is necessary to identify the proper system conditions and prevent the maloperation of protective devices in such a situation. The technique suggested here can also able to differentiate between Stable Power Swings and Unstable Power Swing, the latter sometimes leads to maloperation of the system. The Suggested method uses Kalman Filtering due to its adaptability to deal with noisy data, which makes it a valuable and robust tool in the Power System. Considering the rate of change of impedance in real-time, the scheme can correctly identify the stable, unstable power swing and fault situations.

Keywords: Transmission line; Protective relaying; Kalman filtering; Power swing; Faults; Impedance calculation

1. Introduction

In evolving power systems, the integration of renewable energy sources is unavoidable. Due to the demand for increasing use of renewable energy sources, power system dynamics have also been changing. Now, it is required to focus more on this changing power system and the performance of conventional protection systems in this scenario. The main objective of the protection system is to identify and disconnect the faulty part from the healthy one by employing different protective devices like relays, circuit breakers potential transformers, current transformers, etc. Conventional Protection System comprises distance protection and over-current protection. But nowadays complex power system consists number of generators, transformers, and transmission lines and make an interconnected system. The protection of this complex system is necessary for uninterrupted power supply, and many researchers have given different methods for the purpose and improvement of the protection system. Guidelines are given internationally for providing transmission line protection by the IEEE relaying committee for the betterment of the researchers and technical person's in-depth analysis [1, 2].

Nowadays, there are many techniques applied with algorithms based on the Discrete Fourier Transform (DFT) to verify the authenticity of the relay performance different Full Cycle Discrete Fourier Transform (FCDFT) techniques are widely used in the power system field from a protection point of view as a sliding window technique. Different scenarios are changed to validate the algorithm by researchers based on the Discrete Fourier Transform (DFT) [3–5]. Modified DFT is used in the field of power systems to avoid unwanted frequency and noise signals which can cause misoperation of protective schemes [6, 7].
Different challenges arise due to inverter-based resources in protection algorithms that have been reviewed by researchers [8]. The incorporation of DGs and renewable sources in the power system demands relevant change to provide advancement in protective schemes. Required changes and improvements are discussed in detail thoroughly in the manuscript [9]. Suggested techniques provide a very low burden and quick response. To identify different symmetrical faults with indemnity under power swing conditions with higher accuracy [10]. To detect the symmetrical fault here one index is defined for the transient monitoring based on current sampling difference. These differences in the actual and dynamic current also provide information and decisions regarding power swing conditions. One threshold is defined to detect the power swing for the analysis [11]. Here current phasor angle is obtained by the FCDFT algorithm. The differential phase angle of superimposed currents is designated, and it is calculated for each phase [12]. The primary method used in this scheme is to extract features for fault detection based on the cumulative current covariance procedure. As per the suggestion to identify the fault under the power swing conditions here researcher imposes the current cumulative techniques [13].
Travelling wave-based techniques are advised by researchers under a DG-based power system to resolve the issues generated during transmission and distribution line protection [14]. Finding fault with its location shows its importance in the distribution system. Numerical relays based on Ethernet switches can define the fault and its location sharply [15]. A digital smart meter is also able to locate faults accurately with the detection and classification of the fault [16]. A series compensated transmission line incorporated in the power structure it is very tough to find the shunt fault. The value of the instantaneous voltage & current based on the DFT algorithm and Artificial Neural Network (ANN) techniques can precisely classify various faults [17]. Sequence component-based techniques are used in the protective scheme successfully in transmission lines [18] and also in power transformers [19, 20].
The damping power in the power structure is called the power system oscillation. The effect of these oscillations in the power system is a verse in some cases and it also causes the disoperation of the transmission line protection. Such cases are involved based on DG techniques like the incorporation of the wind farm in the power system to resolve these types of oscillations or damping of the power system effectively [21]. DGs are also most effective on the system parameters and they also generate special effects in the different protective schemes based on their parameter changes in those conditions [22]. PV systems have a static nature and wind farms have a dynamic nature. This means there are different natures of generations are connected when there are different DGs connected. So, different challenges are incorporated in designing the power system protection. This means, there are some special considerations are required during the protective system design as per equipment and system [23].
Nowadays scenarios are changing due to the interconnection of various DG systems in power systems. Even due to the plug-in of the electrical vehicles, there is complexity twisted in the system [24]. Active and reactive power components are varied and they also sometimes affect the system reliability. As far as concern with reliability, it is precisely required in these developing stages of the country. Compensation of reactive power in power systems with different techniques is also encountered in the protective system in the transmission line protection as per example of series compensated transmission line protection gives maximum complexity rather than another simple transmission system [25, 26]. Protection of the double circuit transmission line also faces very complexity and requires more concentration, however, some special concentration is required under that circumstance for the power swing conditions [27]. Phasor-accounted techniques are also preferred for transmission line protection belonging to double circuits [28] considering power swing.
There are more compatible filtering theorems available than the DFT filtration techniques like the KALMAN filtration technique [29]. Due to the various advantages of the KALMAN filtering techniques, these filtering techniques are preferable in research [29–31]. These articles present the proposed technique based on Robust Kalman Filtering (RKF) techniques. RKF is used here as the computation of the magnitude and phasor values of the given current and voltage signal captured by the Current Transformer (CT) & Potential Transformer (PT) in the proposed power system. Most of all the test conditions are validated and tested successfully by changing the diverse parameters of the transmission line, like the Fault Resistance (F_R), Fault Inception Angle (FIA), CT secondary burden, load angle, and sudden change of load, with different faults. The proposed system is designed in the PSCAD^{TM} simulation and signals are apprehended via the CT & PT simulation block in the PSCAD software. These data are migrated for further analysis in MATLAB based on the KALMAN filtration techniques to obtain the phasor and magnitude value. The advantage of the KALMAN filter circuit over the conventional DFT filter circuit is also elaborated in detail in this manuscript.
Article outlines are covered here with 6 sections. The first section introduces the schemes used in the ground for the protection of power systems shortly. From the introduction section, further modifications and required suggestions are given here as the problem description in section 2. Problem solutions with proposed techniques are elaborated in section 3. The validation flow is arranged here in the manner of a flowchart. The proposed algorithm is shown in the term of flow chart in section 4. Based on the flow chart

and proposed system diagram result validation is exposed in section 5. Here different parameters are changed in the proposed system and take different contingencies for accounting and authentication of the scheme. In the end, the whole article is concluded followed by the references.

2. Problem definaion/evalution

Perturbations in the complex power scheme not be avoided. Faults, switching, loss of load, etc. cause deviation in the rotor angle of the synchronous machine resulting in tripping of the system. During fault in line, the impedance calculated by the distance protection scheme is comparatively lower than the predetermined set value of the tripping circuit. Thus, the relay gives a tripping command to the Circuit Breaker (CB) when the protection zone undergoes faulty conditions. But under some specific perturbations like power swing, it is not necessary to execute the trip command as in the case of stable swing. The swing conditions are not considered a fault in the power system however under these types of circumstances impedance trajectory falls in the adjusted relay impedance characteristics and malfunctioning occurs. Also, it is required as the robust protective scheme, under the stable power swing condition must be discriminated with the faulty conditions. The system may recover as the locus comes back to the non-operating boundary. So, under this situation, proper discrimination between faulty conditions and PS conditions is required. Conventionally, the blocking of Power Swing (PSB) is provided in a protection zone within a certain time depending upon system dynamics. If the locus falls back within this threshold value it is considered as a Power Swing condition otherwise as faulty one.

PSB function is necessary to discriminate between PS and a fault. Also, through unstable PS, it is necessary to trip the system as the system cannot recover to its normal state. This condition can result in a cascade operation of the whole or part of the power system. So, it is desirable to distinguish between faults and PS as well as between stable and unstable PS. Due to system dynamics, it is very difficult to decide threshold values to distinguish between such conditions. Also, under the addition of renewable energy sources system dynamics are changing. Hence it is required to develop such an algorithm that utilises system dynamic parameters rather than prefix values of the system. The above discrimination plays an important role in maintaining power system stability.

3. Proposed technique

Transmission lines are the main connecting part of the power system which connects generating stations to the far end load centers. The generated power has to be supplied at the higher voltage level to increase the efficiency of the transmission which results in the high insulation cost as well as other necessary equipment. This results in the increased cost of the transmission system. Hence protection of the transmission line is of utmost importance. Different protection techniques have been applied to protect transmission lines. It is required to use the emerging technologies for protecting the system. Also, the load on the transmission line can be increased with an increase in the demand. At this instant, it is necessary to have a detailed knowledge of the different available relays for generators, transformers, etc. In the case of transmission lines, it is required to know about distance relays which play an important role in transmission line protection. Different characteristics are available for distance relays. Numerical relays are the latest version of relays which have been utilized for the protection of the system. As per the requirement of the system, the user can define the characteristics of the relay. Perturbations in the power system arise because of sudden variations in load, load switching & heavy faults, etc., which change the generator rotor angle. In some perturbations, it is not required to isolate the system because the system may turn back to its normal state. While in some perturbations it is necessary to isolate the system without any delay. The suggested method works on the real-time calculation of the parameters. A single machine connected to a large power system is under consideration and 3-zone protection is provided for fault detection and discrimination between fault and power swings. After acquiring the system parameters they can be analyzed by Robust Extended Kalman Filtering (REKF) technique. This method uses the current state estimate of the signal model by linearizing and to predict the next estimate uses a linear Kalman filter. The advantages offered by Kalman Filtering over other signal processing methods can be expressed below:

- Due effectiveness in filtering noise signals from received data results in more accurate system state estimation.
- It is not limited to a particular frequency and handles noise signals effectively at any frequency. This results in the consistency in the system model.
- Due to its adaptability, it is more intelligent than other filters. Adjusting its gain upon actual measurement tends to optimal solution.
- Even, if the precision of the instrument used for taking data is low due to error compensation it gives more accurate results.
- It depends on the system model, if the system model and measurements model are good, it will provide the best estimation.
- The ability to minimize estimation error of variance makes it practically effective.

$$y_{k+1} = \theta_k y_k + w_k \tag{1}$$

Equation (1) stands for the Kalman filtering process state model, where $y-k$ stands for state vector in transition matrix for time t_k, θ_k. w_k stands for vector sequence uncorrelated with the structure of co-variance

$$\begin{aligned} \mathrm{V}_{abc}(y,\, s) &= A\mathrm{V}_{012}(y,\, s) \\ \mathrm{I}_{abc}(y,\, s) &= A\mathrm{I}_{012}(y,\, s) \end{aligned} \tag{2}$$

here

$$A = \begin{bmatrix} 1 & 1 & 1 \\ 1 & \alpha^2 & \alpha \\ 1 & \alpha & \alpha^2 \end{bmatrix}, \ \alpha\angle 120^{\circ}$$

$$\begin{bmatrix} V_{SR} \\ V_{SY} \\ V_{SB} \\ I_{SR} \\ I_{SY} \\ I_{SB} \end{bmatrix} = [K] \begin{bmatrix} V_{RR} \\ V_{RY} \\ V_{RB} \\ I_{RR} \\ I_{RY} \\ I_{RB} \end{bmatrix} \tag{3}$$

which represents the sending end and receiving end voltage equation combined with a complex frequency domain. Here, S and R represent the sending end and receiving end voltage respectively, R, Y, and B are phase sequences and K is transferred resistance.

$$\begin{bmatrix} Vs_{012} \\ Is_{012} \end{bmatrix} = \begin{bmatrix} U & -Z_T(s) \\ 0 & U \end{bmatrix} \begin{bmatrix} Vr_{012} \\ Ir_{012} \end{bmatrix} \tag{4}$$

where zero, positive, and negative sequence components are represented by 0, 1, and 2.
Process of inversion

$$f(t) = \frac{1}{2\pi} \int_{-\beta}^{\beta} F(\alpha + j\omega)(\sigma(\omega) \exp((\alpha + j\omega)t) dw \tag{5}$$

with discrete samples at

$$S = \alpha \pm j\frac{\Delta\omega}{2}, \quad \alpha = \alpha \pm j\frac{3}{2}\Delta\omega, \text{ etc} \cdots,$$

and sigma factor

$$\sigma(\omega) = \frac{\sin(\frac{\omega\pi}{2})}{\frac{\omega\pi}{2}}$$

where α, ω, $\Delta\omega$, and β are convergence parameters, step, step length, and range respectively.

Under fault conditions, impedance change concerning time is considered for the identification of fault. A simplified system is shown in Figure 1 (a). Voltage drop in line as well as relay voltage during fault in line is shown in Figure 1 (b).
The suggested method uses real-time parameters to calculate the impedance and its cyclic variation considering a single machine connected to a large turbo generator.
An offset mho relay characteristic has been taken into consideration as shown in Figure 2. Here Mho relay characteristic radius is predefined based on the attention of the half-length of a transmission line. The PSB zone is estimated taking into account the 400% of the line from the location of the relay.
Equation (6) gives the value of the changes in impedance concerning time as follows in the suggested scheme,

$$\frac{dZ}{dt} = \frac{d\left[\frac{V_{base} - V_{realy}}{I_{relay}}\right]}{dt} \tag{6}$$

3.1 Relay setting

The distance relay zones are shown in Figure 3. The characteristics shown in Figure 2 have been derived from the zone protection shown in Figure 3.
Nowadays, three zones of the protection schemes are very public in transmission line protection. However, as per requirement, we can add an extra layer of protection.
Generally, 80% to 85% impedance reach is taken for Zone-I with no time delay. The left margin kept is due to the inexactness of the CT & PT measurements. Zone -II covers the remaining part of the line to be protected and around 50% of the shortest adjacent line. Zone-III provides 100% at the remote end and 50% protection of the Zone-II.

4. Flowchart

The flowchart of the suggested method is represented in Figure 4. The required constraints from the power scheme are collected with the measuring devices. Then the measured parameters have been evaluated by the Robust Extended Kalman Filtering (REKF) technique. The estimation has been carried out by REKF for voltage and current magnitudes. Due to the ability of REKF samples are taken at

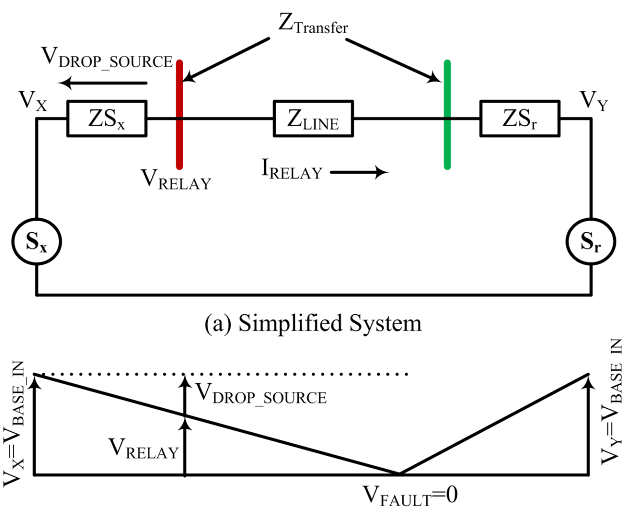

Figure 1. The idea for the impedance calculations based on the profile of voltage imposed under the fault.

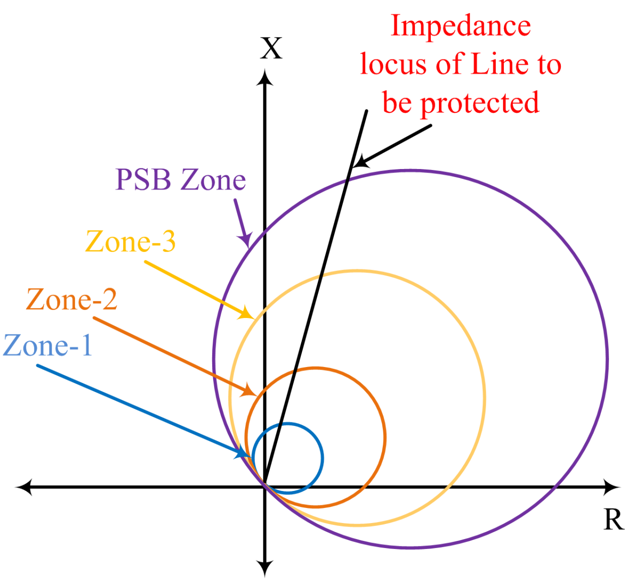

Figure 2. Suggested algorithm based on different Blinder features.

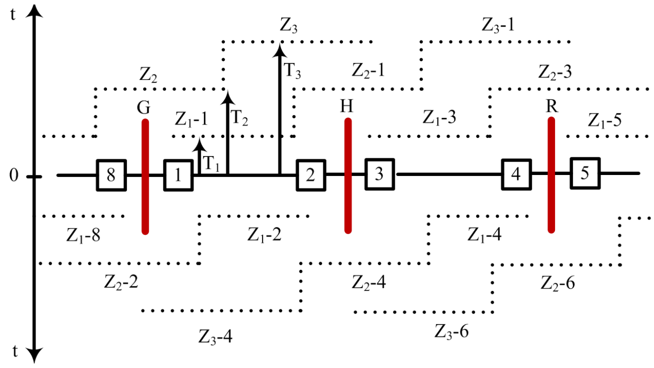

Figure 3. Different protection zones for the distance relay.

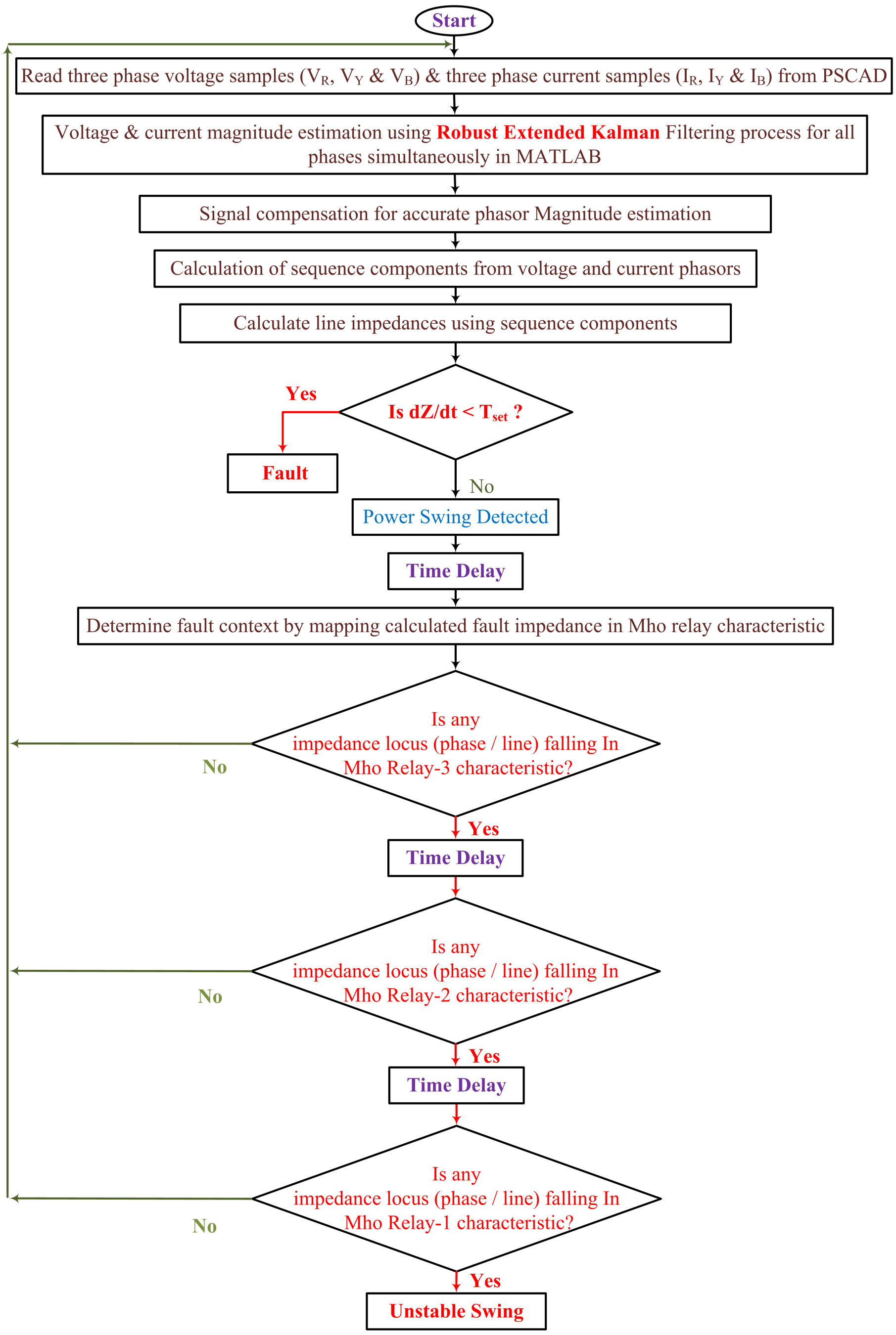

Figure 4. Proposed flowchart.

regular intervals and are based on sliding window technique. The REKF can process the last read data and accurate estimation has been provided. Its ability to process in any noisy dataset makes it more practical for use. The correct estimation is compared with the current data at regular intervals to identify the change in the impedance. The change of impedance concerning time has been identified by the technique. Signal compensation is done by REKF to provide accurate phasor estimation. The sequence components have been calculated after the phasor estimation and these are utilized to calculate line impedance. If the impedance change with concern to time is upper than the prefix rate then in this case it is accounted as a faulty condition. If the impedance change with concern to time is less than the threshold entity then it is measured as a power swing. In the case of power swing conditions, it is required to check whether the system falls back to its normal state or not. This is considered as a discrimination between stable & unstable PS. The time delay is provided to check whether the impedance trajectory stays in the relay characteristic zone or comes back to the normal operating condition. If the locus does not lie in the characteristics zone then the system turns back to a normal state. But if the locus remains in the characteristic zone then again it is required to check the location of the locus of the impedance. For the condition of unstable power swing due to severe disturbance, finally locus resides in the first zone of relay characteristic. At this time, the trip signal is originated and sent to the assigned CB for successful isolation during severe disturbance.

5. System diagram

A renewed power system of an Indian transmission line is considered to authenticate the proposed algorithm. Two parallel transmission lines are considered to connect buses operating at different rotor angles and load variations. On one side, a generator of 120 MVA is connected to a power transformer of 13.8/220 kV, 150 MVA, 50 Hz. All parameters are considered here based on IEEE standards. As per the suggestion of IEEE standards, four breaker systems are connected. Among them, breaker B_1 is considered here as a specimen breaker to validate the proposed algorithm. A turbo generator of suitable capacity equivalent to the infinite bus is connected to the receiving end bus (REB). On the middle bus, a three-phase variable $P + jQ$ load is connected to make the effect of load variation in the considered power system. A transmission line of 120 km is taken with circuit breakers at the sending end and receiving end as B_1 and B_2 respectively. Parallel line with same distance with circuit breakers B_3 and B_4 at sending end and receiving end respectively. Different faults have been created on the transmission lines L_1, L_2 and L_3 at different distances starting from 1 km to 120 km and beyond. Also, the power swing situations are simulated by fluctuating the load level as well as by alerting the rotor angle of the far end source. Various symmetrical and asymmetrical faults have been created in the presence of Power Swing conditions.

6. Result analysis

To validate the proposed scheme system diagram is taken as revealed in Figure 5. Under no-fault conditions & PS, conditions have been created to check the validation of the proposed method. Out of this, a few cases have been discussed below.

6.1 LL fault

To validate the proposed method different faults and swing conditions have been created. For this case in the considered system, an LL fault is created in the transmission line-1 (Fig. 5). The fault is created at time 0.7 s. From the results, it can be observed that impedance characteristics are followed and enters the relay zone. Even though the simultaneous rate of the impedance change concerning time is also very fast for the predefined value the said conditions are marked as the fault condition. Under these types of circumstances, the concerned CB gets the trip signal from the protective scheme. Figure 6 shows the waveform of current and voltage as well as the relay characteristics with impedance trajectory path. From Figure 6 (b) it can be seen that the algorithm performs as required and identifies the fault condition. The trip command is initiated and in Figure 6 (b) current is zero after the tripping command. It can be seen in Figure 6 (c) that the impedance falls into the zone II characteristic. The magnified view of Figure 6 (c) has been depicted in 6 (c').

6.2 Stable swing

PS condition has been created in the PSCADTM software model with different constraint adjustments. The PS is created by increasing the rapid change in load on the considered system. Here in the power system simulation B_5

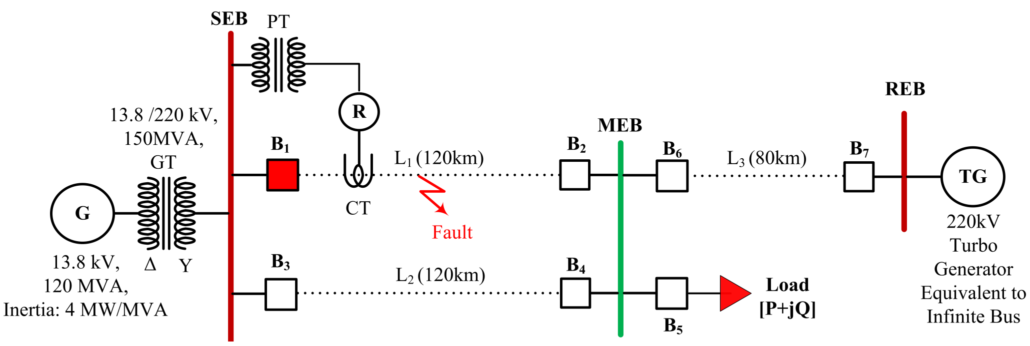

Figure 5. System diagram.

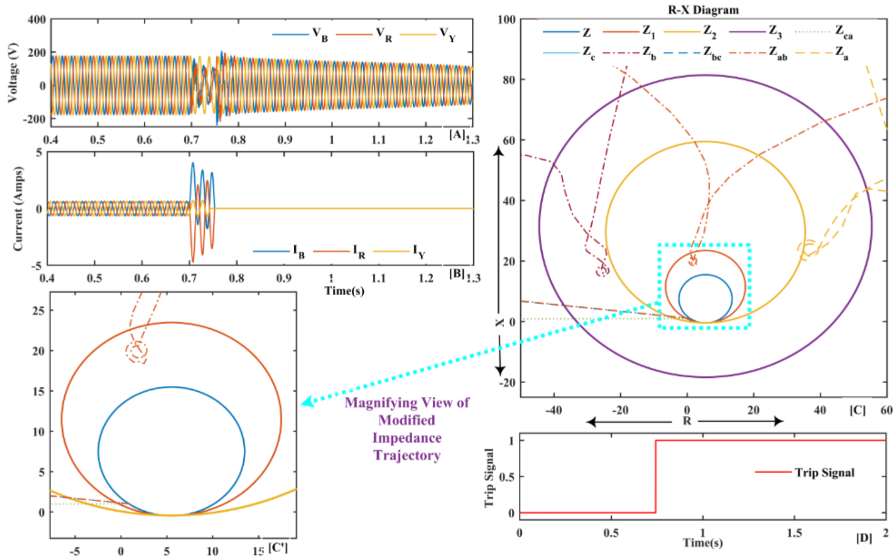

Figure 6. L-L fault (a) Voltage waveforms (b) Current waveforms (c) Proposed impedance trajectories with fault impedance trajectories (c') Magnifying view of the proposed impedance characteristics (d) Trip signal.

Circuit Breaker is suddenly closed at 0.5 seconds, so the heavy load is injected into the transmission line. All the said stable power swings are also generated in the system by changing the different load angles on the receiving end bus system. Said power system under the power swing is elaborated here in Figure 7.

It is visible from Figure 7 (a) & (b) that the voltage and current signal are stable. Simultaneously, the rate at which impedance change time is much lower as suggested in the algorithm t_{set} so a time delay is provided in the relaying circuit. Hence the impedance trajectory followed in the Z_1 relay is not getting a trip signal. At $t = 0.5$ sec CB opening, Figure 7 (a) demonstrates voltage signals in the power system. The second window, Figure 7 (b) represents the waveform of the phase current. The power swing situation is simulated by the sudden connection of a large load in the system. Under this situation, the concern time for dZ/dt is smaller than the set value (t_{set}), hence relay does not operate due to time delay. No initiation of Trip signals in the system presented in Figure 7 (d) due to the features described in Figure 7 (c). It can be easily seen in the magnified view of Figure 7 (c') that the estimated impedance during power swing disturbance remains well outside the modified relay characteristics.

6.3 Unstable or unbalanced PS

Power swing is normally generated in PSCADTM simulation by the sudden change in load angle or sudden injection of the heavy load. Here, at $t = 0.5$ second, a sudden load is injected as well as load angle is simultaneously changed

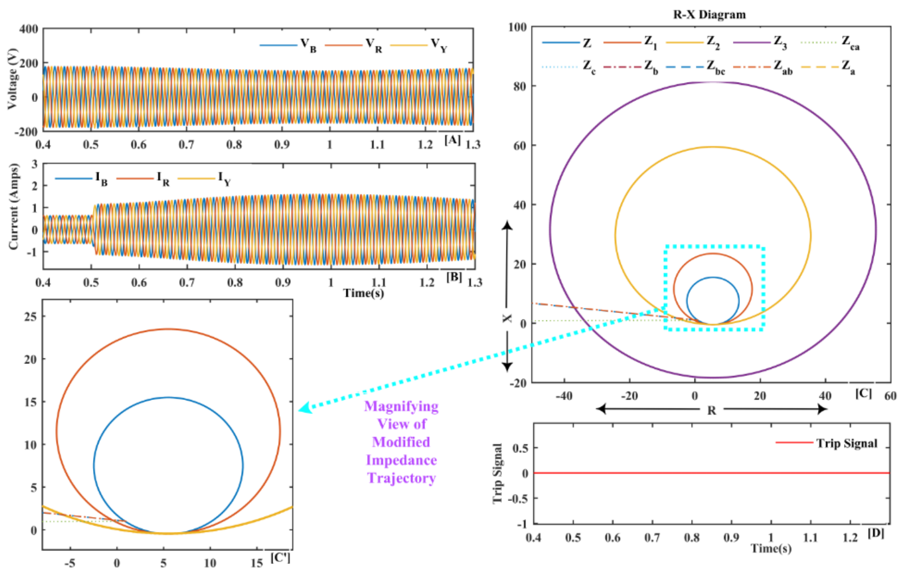

Figure 7. Steady power swing (a) Voltage waveforms (b) Current waveforms (c) Proposed impedance trajectories with fault impedance trajectories (c') Magnifying view of the proposed impedance characteristics (d) Trip signal.

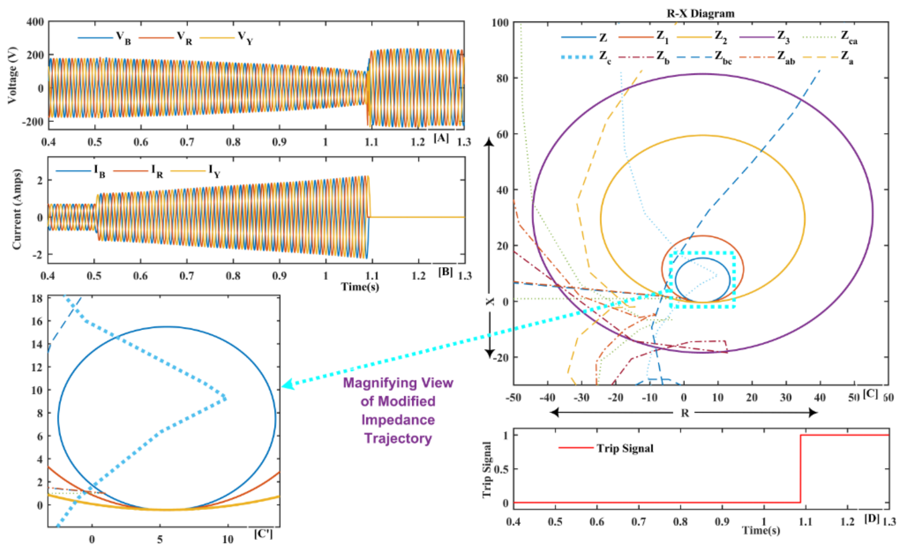

Figure 8. Unstable power swing (a) Voltage waveforms (b) Current waveforms (c) Proposed impedance trajectories with fault impedance trajectories (c') Magnifying view of the proposed impedance characteristics (d) Trip signal.

suddenly on the generator connected to the receiving end bus. Due to both the changes in load angle and injection of load drastic swing is caused in the considered system. Due to unstable swing, the impedance trajectory enters into zone- 3, 2, and 1 also. However, due to the dZ/dt being very lesser concerning the set value, delay is provided by the algorithm for zones- 3 and 2, trip signal is not issued by the relay. However, when the dZ/dt trajectory enters the relay zone- 1, considering unstable power swing, a trip signal is issued by the algorithm to the CB. Figure 8 depicts all the parameter variations under the situation of unbalanced PS. Figures 8 (a) and (b) depict voltage and current waveforms, respectively, and indicate the PS created after 0.5 seconds. Figure 8 (d) shows the tripping signal is initiated at $t = 1.08$ s unmistakably.

All the required condition has to be verified and it has been seen that after the locus falls into the relay characteristic zone- I, the trip command is initiated. The magnifying view of locus falls into the zone- I relay characteristic has been depicted as per Figure 8 (c').

6.4 LLL fault trailed by swing

Following the PS condition, other faults are generated to test the algorithm's functionality. The triple line (LLL) short-circuit is imposed in the presence of PS. To generate the PS condition here the circuit breaker B_5 closed at $t = 0.5$ so that a sudden load is imposed in the system. The three-phase voltage and current signals are visible in Figure 9 (a) and (b). At time $t = 1.18$ sec LLL fault is imparted in the line in the presence of a swing situation. This means during the power swing conditions fault is generated here artificially and that all incidents can be seen clearly from

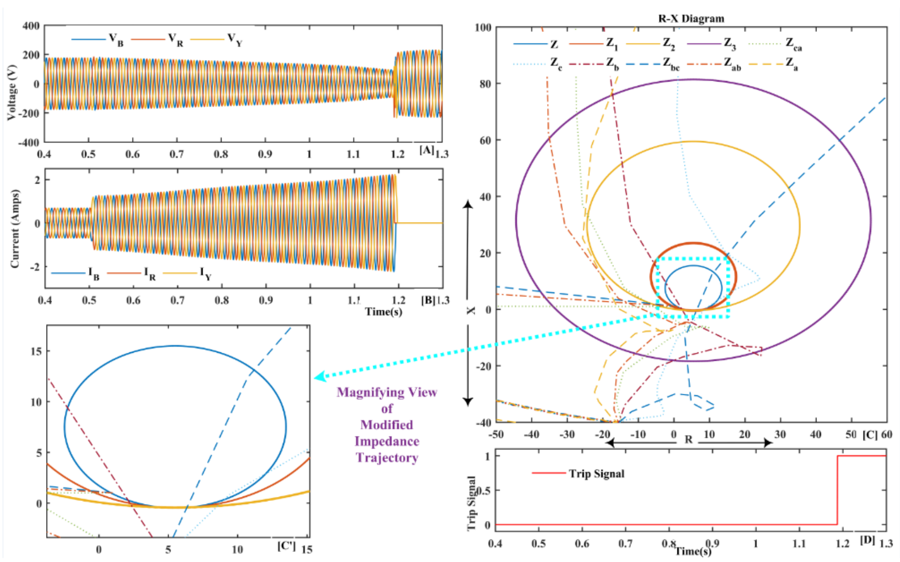

Figure 9. LLL fault trailed by swing (a) Voltage waveforms (b) Current waveforms (c) Proposed impedance trajectories with fault impedance trajectories (c') Magnifying view of the proposed impedance characteristics (d) Trip signal.

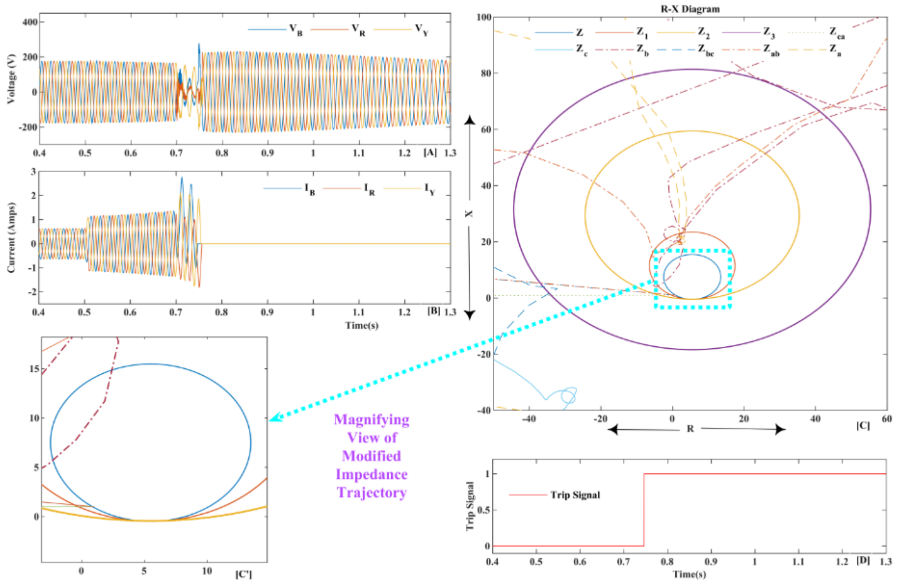

Figure 10. LL fault trailed by swing (a) Voltage waveforms (b) Current waveforms (c) Proposed impedance trajectories with fault impedance trajectories (c’) Magnifying view of the proposed impedance characteristics (d) Trip signal.

the current and the voltage signal given in Figure 9 (a) & Figure 9 (b). Figure 9 (d) clearly shows the trip signal generation at the exact fault that persists in the system. Up to the swing appearing in the power system, there is no trip signal generated for the CB. This means, it clearly shows the algorithm perfectly scrutinizes the power swing from the fault conditions. Even under the fault conditions CB trip signal is generated perfectly as per Figure 9 (d). Figure 9 (c) depicts the impedance locus trajectory traveling into the protection zone characteristic. The magnifying view is also depicted in Figure 9 (c’).

6.5 LL fault trailed by power swing

Numerous abnormal conditions are simulated on the considered power system for the testing of the suggested protection algorithm. One of them is the LL fault trailed by the power swing generated in the power simulation. This means swing is generated at $t = 0.5$ sec and then the fault is created in the presence of the swing situation. For all studies, the voltage signal is depicted in Figure 10 (a), the current signal is shown in Figure 10 (b), and generations of trip signal are exposed in Figure 10 (d). Figure 10 (c) represents the time-dependent impedance trajectory and Figure 10 (c’) shows a magnifying view of this trajectory. As per the algorithm, the relay gets the trip signal properly and accurately under the fault conditions and sharply discriminates the power swing conditions with the fault.

7. Conclusion

The proposed scheme with a novel idea perfectly discriminates between normal swing, fault, and unstable swing conditions. Even these schemes also discriminate the power swing followed by fault under different types of changes in circuit parameters. By introducing a variety of faults and different PS conditions into the system, it is discovered that the aforementioned algorithm successfully identifies and classifies faults and PS conditions. It also distinguishes between stable and unstable PS circumstances. The technique is validated using the REKF technique, which allows for noise discrimination and little data consumption. As a result, the algorithms turn out to be simpler and offer quicker processes in a lesser quantity of time.

According to the study of the preceding scenarios, if only PS is presented in the system, the protective system can readily determine whether the power swing is unstable and return the system to a normal state. However, if the system is unable to return to its normal state, it is classified as a UPS, and the nonstandard part must be isolated from the system. As a result, the suggested algorithm identifies this as a UPS and sends a trip instruction to its safety devices. Furthermore, when PS and faults occur simultaneously, the aforesaid approach efficiently detects fault problems during the PS. In this depicted situation, the trip command is initiated.

Authors contributions
All authors have contributed equally to prepare the paper.

Availability of data and materials
The data that support the findings of this study are available from the corresponding author upon reasonable request.

Conflict of interests
The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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