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MICROPROCESSOR BASED IMPROVED DIGITAL PROTECTION OF TRANSMISSION LINE

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ABSTRACT

The main objective of this research work presented in this paper is to search for a new algorithm to improve the design performance of protective relays without filtering the sample voltage and current and develop around Intel 8086 microprocessor for transmission line protection. In order to improve the performance of protective scheme of transmission line with connected equipments in complex power system, it is required to have faster, accurate and computationally simple algorithm. The microprocessor based digital relays using the proposed algorithm can easily fulfill the present requirement of modern protective relays. In the present work, the algorithm used is based on the solution of differential equation representing n- model transmission line for line parameter estimation and is the fastest, simplest and suitable algorithm for microprocessor implementation of distance relays.

KEYWORDS: Transmission, Microprocessor, digital, protection, parameter.

INTRODUCTION

With increasing size and complexity of modern power system fast, accurate, reliable and compact digital protective schemes are required for its protection. Now-a-days, more economical, powerful and sophisticated microprocessors are available due to advancement in the VLSI -technology. So, their applications to the power system have been the interest of the present power protection engineers.

In order to improve the performance of protective schemes for transmission line and also the system stability with connected equipments in complex power system, faster, reliable, accurate and flexible relays are required. A microprocessor based digital relay using fast, accurate, and computationally simple algorithm can achieve improved performance and can easily fulfill the present requirements of modern protective relays.

A number of algorithms for the measurement of transmission line parameters have been proposed during last three decades for protective relaying. An overview of previous algorithm [1-52] reveals that the algorithm based on numerical solution of the differential equation representing the transmission line model by series R-L circuit is the fastest and the most suitable algorithm in implementing the protective relay scheme based on microprocessor [1,2,37,41,50]. In differential equation solution based on series impedance transmission line model Shunt capacitive effect is ignored, obviously algorithm is not accurate, hence, system stability is affected. Therefore, to improve the stability of the system particularly for medium and long transmission line, it is necessary to measure and consider the shunt capacitance of transmission line for more accurate protective relaying design. For this very purpose, a transmission line represented as nominal n-model is preferred.

The algorithm based on single 7c-section model of transmission line to evaluate **R&L** [42] suggested by W.J. Smolensk needs six times more computational requirement than that of an algorithm based on series R-L transmission line model. Thus, algorithm suggested [2] is not very suitable for

microprocessor implementation as protective relaying hence, to achieve better relaying following scheme is proposed.

The transmission line model as a-network can be characterized by the following equations.

At the sending end,

$$V_s = Ri_L + L\frac{di_L}{dt} \qquad -(i)$$

$$i_S = \frac{C}{2}\left(\frac{dv_s}{dt}\right) + \frac{V_s}{Z_L} \qquad -(ii)$$

$$\text{When } \frac{dV_S}{dt} = 0,\ Z_L = \left(\frac{V_S}{i_S}\right)$$

Equations (i) & (ii) hold both steady state and transient conditions. The occurrence of fault represents the transient conditions. Therefore, the value of transmission line parameters (R,L & C) under transient or fault conditions are required to be known for protective relaying in order to determine whether the fault point lies in the protective zone or not?

In the light of future trends, the microprocessor technology opens the way to greater compactness and flexibility. So that, systematic research is needed to improve performance, stability and reliability of the system in order to meet the requirements of the modern complex power network in near future.

Following is the proposed algorithm:

The solution for R & L from equation- (i) can be obtained taking boundary condition under consideration

$$\text{When } i_L = 0,\ L = \left[\frac{V_s}{\frac{di_L}{dt}}\right] \qquad -(iii)$$

$$\text{And} \qquad X_L = 2\pi fL \qquad -(iv)$$

$$\text{When } \left(\frac{di_L}{dt}\right) = 0,\ R = \left[\frac{V_s}{i_L}\right] \qquad -(v)$$

Now in the proposed scheme, C can be evaluated under boundary condition from equation — (ii)

$$\text{When } V_S = 0,\ C = 2\left[\frac{i_S}{\frac{dV_S}{dt}}\right] \qquad -(vi)$$

$$\text{So, } X_c = \frac{1}{2\pi fC} \qquad -(vii)$$

Further, in the view of above algorithm, it is proposed to develop a microprocessor based system for realization of different operating characteristics of distance relays suitable for protection of transmission line using the above algorithm for measurement of line parameters. For this purpose, a data acquisition system will be fabricated and interfaced to the microprocessor.

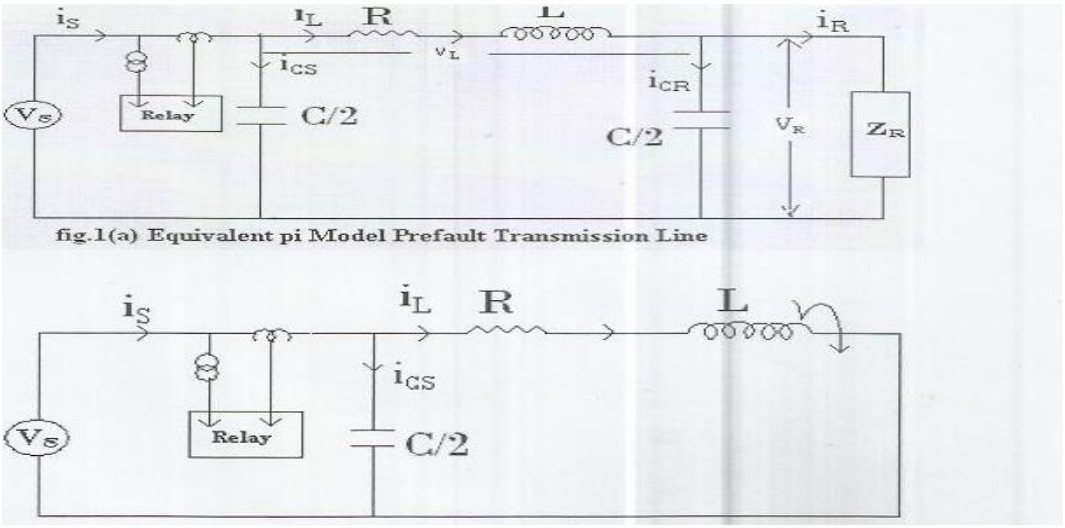

fig.1(a) Equivalent pi Model Prefault Transmission Line

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fig-1

(i) MEASUREMENT OF X

The reactance of a circuit is given by the expression

$$R = Z.\cos\varphi$$

$$= \frac{V_{r.m.s}}{I_{r.m.s}}\cos\varphi$$

$$= \frac{K_1 V_m}{K_2 I_{d.c.}}\cos\varphi$$

$$= K\frac{V_m}{I_{d.c.}}\cos\varphi \qquad \ldots\ldots\ldots (2.1)$$

Where K_1, K_2 and K are constants.

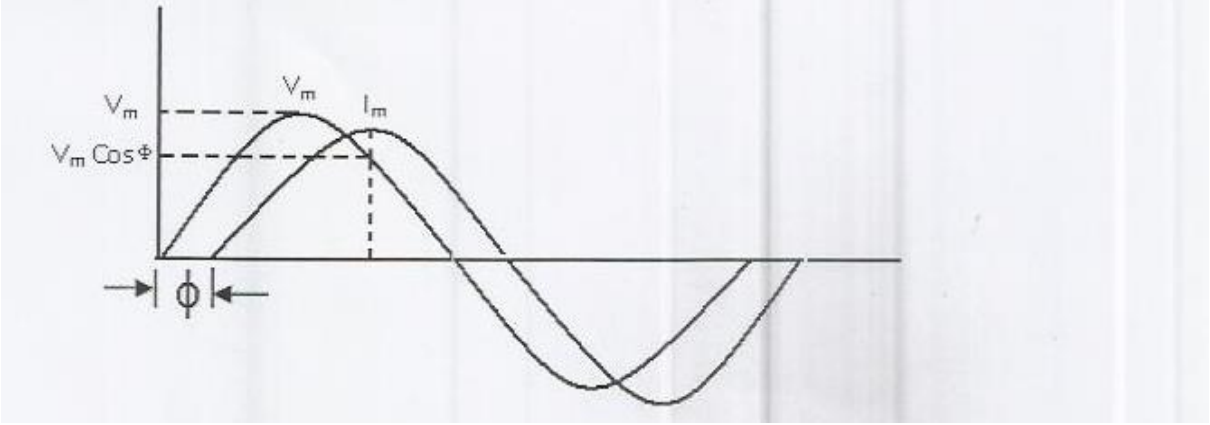

Fig 2

CONCLUSION

The main objective of this research work presented in this paper is to search for a new algorithm to improve the design performance of protective relays without filtering the sample voltage and current and develop around Intel 8086 microprocessor for transmission line protection. In order to improve the performance of protective scheme of transmission line with connected equipments in complex power system, it is required to have faster, accurate and computationally simple algorithm. The microprocessor based digital relays using the proposed algorithm can easily fulfill the present requirement of modern protective relays. In the present work, the algorithm used is based on the solution of differential equation representing n- model transmission line for line parameter estimation and is the fastest, simplest and suitable algorithm for microprocessor implementation of distance relays.

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