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Comprehensive Analysis of transmission line model for Vibration measurement based on electrostatic sensor

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ABSTRACT

This paper describes the vibration in transmission line. In this paper we included that the what is reason behind the vibration occurring in transmission line with these effects on the transmission line, And their vibration diagnosis technique. The main purpose of this paper is a novel measurement technique based on the electrostatic sensing to analyse the vibration of transmission line in an on-line, non-contact manner. The measurement system works on the principle that variations in the distance between a strip-shaped electrode and the electrified conductor of transmission line give rise to a fluctuating current output. A closer distance between the electrode and the conductor makes higher order vibration modes identifiable, but also leads to severer signal distortion that produces higher order harmonics in the signal.

Keywords– transmission line conductor, vibration analyser, electrostatic sensor, element modelling, etc.

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I. INTRODUCTION

In the recent years and in the context of competitiveness there is an increasing demand of electricity. The power transmission of electricity from one place to another place is done by the transmission line. Whenever the electricity transmits by transmission lines there is some failures occurs in over-head transmission line. Because of this efficiency of transmission of electricity becomes less. there are various causes for transmission line becomes less efficient and line becomes failure. Vibration is one of the most important problems in transmission lines because it represents the major cause of fatigue failure of transmission line conductor. Wind-induced vibration or Aeolian vibration of transmission line conductors is a common phenomenon under smooth wind conditions. The cause of vibration is that the vortexes shed alternatively from the top and bottom of the conductor at the leeward side of the conductor. The vortex shedding action creates an alternating pressure imbalance, inducing the conductor to move up and down at right angles to the direction of airflow. The conductor vibration results in cyclic bending of the conductor.

The objective of this research was to develop a novel measurement technique based on electrostatic sensing for on-line and non-contact monitoring of transmission line vibration. Recent studies have found that a power transmission line conductor moving both axially and transversely generates a fluctuating electric field that can be detected using an electrostatic sensor. It is concluding that the vibration can be measured using the electrostatic sensing technique. Because of this analysis of transmission line vibration measurement, we perform predictive maintenance of transmission line.

II. REASON OF VIBRATION IN TRANSMISSION LINE

Due to wind there is vibration in transmission line this vibration causes oscillation in transmission line. In winter season due to snow fall there is ice collect on conductor, because of this ice loading weight of the conductor increases and vibration occurs. When the requirement of electricity changes, this causes load is suddenly increase or decrease, because of this magnetization is produces in between lines and then transmission line is vibrated. When the insulator of transmission line is damaged there is difference occurs in two towers insulators because of that conductor line is oscillate and vibration in transmission line occurred. Due to vibration life on transmission line conductor is reduces.

III. EFFECT OF VIBRATION ON TRANSMISSION LINE

A. Proximity effect – In transmission line due to vibration the line conductors are comes near to each other because of that the one conductor effects on second hence the proximity effect occurs.
B. Ferranti effect – In the transmission line because of vibration capacitance increases because of that receiving end voltage is increases than the sending end voltage.
C. Corona effect - due to vibration corona also occurs in transmission line.
D. Sag increases.
E. Conductor and insulator may be damage.
F. Efficiency reduces.
G. Effect on load side i.e. voltage fluctuation.

IV. MEASUREMENT METHOD

A. Measurement Principles

As early as the 1970s, it had been found that static charges could build up on the surface. The static charges undergo a combined axial and transverse motion, creating a fluctuating electric field in space. An insulated metal electrode placed adjacent to the conductor generates an induced current signal in response to the passage of nearby charges. By converting the current signal into a proportional voltage signal using an I-V converter illustrates the principle of the electrostatic sensor. The feedback resistor in the I-V converter determines the trans impedance gain, while the feedback capacitor ensures stability through phase compensation. the amount of charge generated on the conductor depends on a variety of factors including voltage, material property of the conductor, temperature and atmospheric humidity. For fixed operating and environmental conditions, the density of charge is mainly determined by surface roughness of the transmission line conductor, suggesting that the charges are randomly distributed. the fluctuation of the random electrostatic signal could reflect the variation of the surface roughness. But in practice, the conductor vibrates transversely and the non-uniformity of surface roughness along the conductor is very small. It is therefore deduced that the fluctuation of the sensor signal is dominated by the variation in the distance between the conductor and the electrode. The above supposition, which constitutes the physical foundation of the measurement technique.

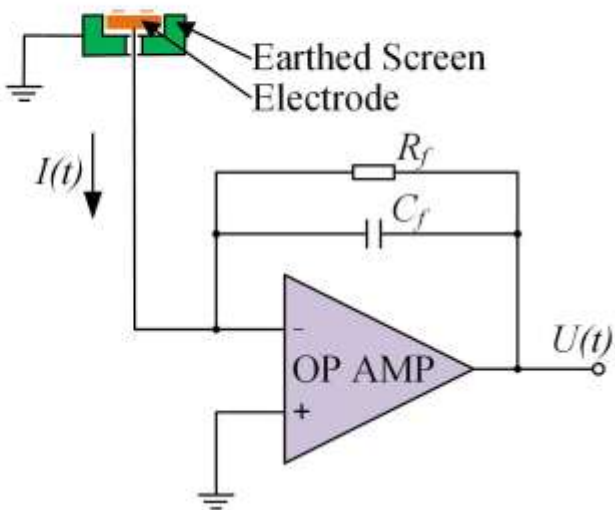

Fig.1 Principal of electrostatic sensor

B. Experimental Setup

The physical instantiation of the electrostatic sensor is a two-layer printed circuit board with the electrode residing on the bottom layer as a long pad. On the top layer is the signal conditioning circuit consisting of five consecutive stages built with wideband rail-to-rail operational amplifiers of AD8604 and AD8601. The first stage is the I-V converter that outputs a small voltage signal. The second stage amplifies the signal using a non-inverting amplifier. A Salley-Key low-pass filter at the third stage eliminates high frequency noises. The signal is further amplified at the fourth stage and then level shifted from a bipolar signal to a unipolar signal at the final stage for subsequent sampling. Fig shows the electrostatic sensor with the dimensions labelled.

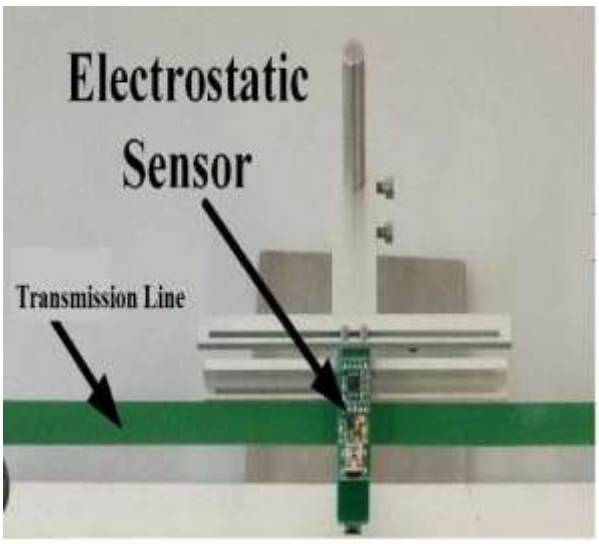

Fig.2 Test figure.

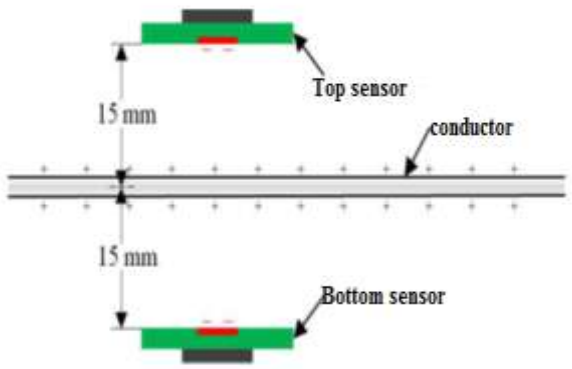

Fig.3 Sensing Arrangement

Experiments with the electrostatic sensor were undertake non a purpose-built Fig.2 test fig, as shown in The electrostatic sensor is mounted on a supporting frame that allows distance between the electrode and conductor to be adjusted. A DSP board performs sampling and on-line processing of the sensor signal, and measures the motor rotational speed using a photoelectric rotary encoder as well. Fig. 3 shows the sensing arrangement, in which the belt runs between two electrodes separated by 30 mm. the distance between the electrode and the conductor affects the performance of the system, i.e. the distance between electrode increases the absolute vibration analysis is reduced.

V. ADVANTAGES

1) For condition monitoring of transmission line.
2) Non-contact measurement.
3) Simple in construction.
4) Suitable for harsh environment.
5) Low cost.

VI. DISADVANTAGES

1) Unable to measure absolute vibration.
2) Low response.

VII. APPLICATION

1) In transmission line for analysis of vibration of transmission line conductor.
2) Electrostatic sensor is also useful for the belt drive machines vibration measurement.

VIII. CONCLUSION

According to the literature survey carried out for collecting the data and also from the comprehensive analysis it is observed that measurement of vibration parameters is based on various techniques. The electrostatic sensor measurement is the most economical, simple, non-contact manner vibration measurement for transmission line. The electrostatic signals collected from sensors on both sides of the conductor have validated that the signal fluctuations are dominated by the line conductor vibration.

Because of this transmission line vibration diagnosis technique, the predictive line maintenance is done according to this vibration measurement. It also gives on line vibration analysis of power transmission line. By using of this measurement of line we do maintenance also we reduce the transmission line vibration on the basis of this vibration analysis. Because of this non-contact measurement, it not harmful for line conductor.

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