A REVIEW ON 3 PHASE LINEAR INDUCTION MOTOR AND PERFOMANCE ANALYSIS

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Abstract : This paper explores the design of linear induction motor. The linear induction motor can be give many sharp merits over mechanical systems such a very high and very low speed, highly acceleration, near to zero maintenance cause of the no one the contacting parts and high accuracy without backlash. Achieving linear motion with motor need no coupling, gears, pulley, shaft. By using a linear encoder, position is directly measured at the load for increased accuracy of the load position. These linear induction motors produce more force than ironless design. In this paper the skewing can reduce cogging force

Keywords - Linear induction motor(LIM),Design, performance analysis, end effect, air gap

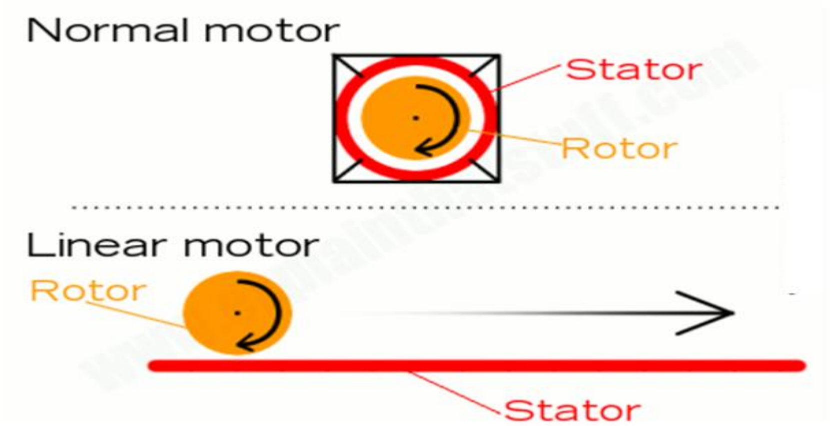
I. INTRODUCTION

The history of linear induction motors extends as long back as the 19th century. Although these machines have been practically forgotten for the last 30 or 40 years, the reappears to be a genuine revival of interest in them. The fascinating history of these "unrolled" motors and their theory of operation are discussed in this report. The idea of the linear induction motor is probably contemporary with the invention of the rotating field machine by Tesla, Dolivo-Doborovolsky, and Ferrari sometime after 1885. However, some authors give other dates for the discovery. The idea of a linear electric motor is almost as old as that of a rotary electric motor. The first linear motor was a reluctance machine built by Charles Wheatstone in 1845, to be closely followed by a similar machine by Henry Fox Talbert. Nicola Tesla invented the induction motor in 1888. The first patent in linear induction motors was obtained by the mayor of Pittsburgh in 1895. The first electromagnetic gun was undoubtedly Birkeland's cannon of1918, again a reluctance device, but possibly the first tubular motor using a row of simple coils energized in sequence with DC. In 1946, Westinghouse built a full-scale aircraft launcher, the "Electroplate", which was an induction motor with a moving primary. It was this machine that inspired E.R.Laithwaite to begin his own work on linear motors in the 1950's, since when there have been rapid advances in linear induction machines for 2producing standstill forces, for propelling high-speed vehicles and as accelerators for producing kinetic energy.

Recently linear induction motor have been a new premium look by different users they required a locomotive force, LIM have found the widest prospects for application in locomotive system. Starting with this system like a electrical sliding door, robots, conveyor etc.. But that time uses in locomotive for passengers and material supply. Fresh motivate for worldwide research in LIM locomotive system come from high speed maglev system on account of the need develop for only less contact levitation system, but also contact free propulsion system. This is something different then friction high speed locomotive and monorails are just a new and more design using linear motor. Linear induction motor capable to direct work without any translation energy, this us main advantage for locomotive system This motor is low maintain, high speed, high acceleration and braking force for locomotive system. As customary for rotating machines, a distinction is made between dc and multiphase ac linear-driven types. The three-phase ac linear variety is in turn classified into induction and synchronous machines.

How linear motors work?

A linear induction motor in stator has been cut open and unwrapped is laid out in the use for track of coil. This coil is made from copper wire wound and this part is primary of a linear motor and rotor is moving part for track coil platform is secondary part of motor. When the supply is apply in primary and then magnetic field is produce and then rotor is rotated for linear motion. This linear motor design, the force is produce by linear motion and magnetic field acting on conductors in the field. Any conductor be a loop a coil, or simply wound in plate metal, that is placed in this field will have eddy current induce in it by creating an opposing magnetic field in accordance with Lenz low The two opposing fields will back each other, creating motion as the magnetic field sweeps through the metal.



II. Problem Identification of linear LIM

In the linear motor the main problem occur by the its construction. A good construction can give a better efficiency in this machine but the defect construction can reduce efficiency, power factor etc. The main point in the linear induction motor is the air gap which can helps to fluxing between stator and rotor in air gap position. As the air gap is high the distance is high between the stator and rotor thus the linkage flux need to spread long distance the incising air gap or distance between stator and rotor. Same the minimum air gap give better result than large number of air gap. due to also need more power. The old linear induction motor must have to need the magnets. They magnets are permanent magnets which are heavy due to used in old induction motor the motor will be bulky. Also the magnetizing effect is high and power factor low also reduces efficiency.

III. Types of LIM

1. Single side linear induction motor
2. Double side linear induction motor
   - If the LIM has only one primary, it is called as single sided LIM.
   - If a LIM has two primaries face to face, a double sided LIM is obtained.

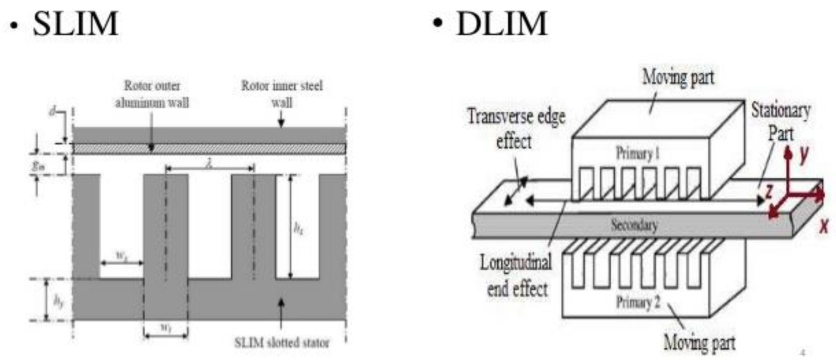


Figure 1 Types of LIM

IV. Effect in linear induction motor

End effect

Travelling magnetic field cannot join up on itself, and end effect in liner induction motor. It produce a non uniform flux density distribution along the length of the motor. Increasing no of poles end effects are reduced Unlike a circular induction motor, a linear induction motor shows 'end effects'. These end effects include losses in performance and efficiency that are believed to be caused by magnetic energy being carried away and lost at the end of the primary by the relative movement of the primary and secondary. With a short secondary, the behavior is almost identical to a rotary machine, provided it is at least two poles long but with a short primary reduction in thrust that occurs at low slip (below about 0.3) until it is eight poles or longer. However, because of end effects, linear motors cannot 'run light' -- normal induction motors are able to run the motor with a near synchronous field under low load conditions. In contrast, end effects create much more significant losses with linear motors.

Gap effect

Conventional induction motors have a very small air gap of the order 2mm or less. In case of LIM, air gap is of the order 5cm for traction purposes. Due to large air gap, motor has high reluctance and losses. Therefore, efficiency is low in comparison of the conventional motors.

Levitation of a linear motor

In addition, unlike a rotary motor, an electrodynamics levitation force is shown, this is zero at zero slip, and gives a roughly constant amount of force/gap as slip increases in either direction. This occurs in single sided motors, and levitation will not usually occur when an iron backing plate is used on the secondary, since this causes an attraction that overwhelms the lifting force. [4]

V. Force in linear induction motor

The main forces involved with the LIM are thrust, normal force, and lateral force, as shown in Fig 3-4. This project is interested in thrust and its relation to other variable parameters. The normal force is perpendicular to the stator in the z-direction. Lateral forces are undesirable forces which are developed in a SLIM because of the orientation of the stator. Fig 4. Forces in a LIM

Normal Forces In a double-sided linear induction machine (DLIM) configuration, the reaction plate is centrally located between the two primary stators. The normal force between one stator and the reaction plate is ideally equal and opposite to that of the second stator and
hence the resultant normal force is zero. Therefore, a net normal force will only occur if the reaction plate (secondary) is placed asymmetrically between the two stators. This force tends to center the reaction plate. In a SLIM configuration, there is a rather large net normal force between the primary and secondary because of the fundamental asymmetrical topology. At
Synchronous speed, the force is attractive and its magnitude is reduced as the speed is reduced. At certain speeds the force will become repulsive, especially at high-frequency Operation.

1. **Lateral Forces**

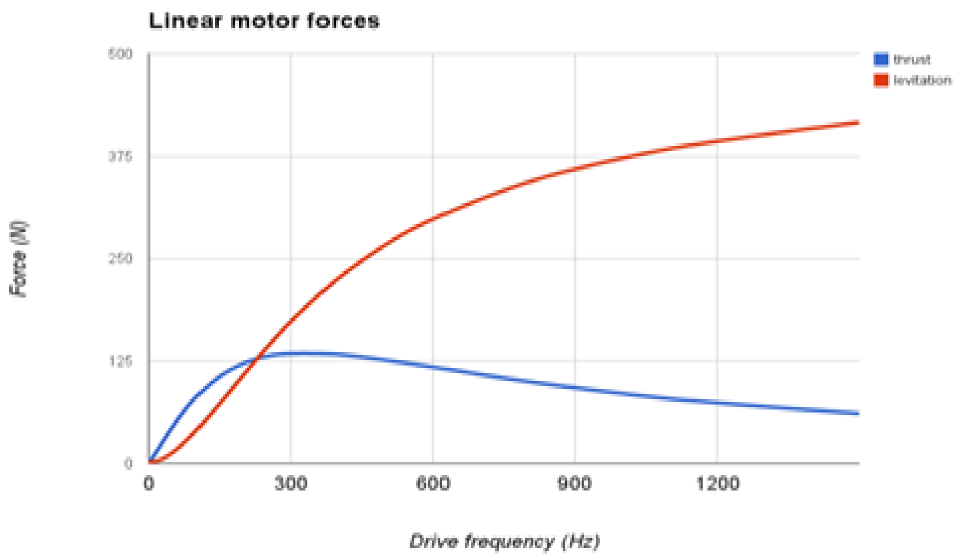
As shown in Fig 3.4, lateral forces act in the y- direction, perpendicular to the movement of the rotor. Lateral forces make the system unstable. These occur due to the asymmetric positioning of the stator in a LIM. Generally, small displacements will only 24result in very small lateral forces. These forces are a matter of concern in high frequency operation (>>60Hz) where they increase in magnitude. A set of guided mechanical wheel tracks is sufficient to eliminate a small lateral force.

2. **Thrust**

Under normal operations, the LIM develops a thrust proportional to the square of the applied voltage, and this reduces as slip is reduced similarly to that of an induction motor with a high rotor resistance. From (3.13), the amount of thrust produced by a LIM is as follows: 23

$$Fs = \frac{Po}{Vc}$$

Where Po is the mechanical power transmitted to the rotor or the output power and Vc is the linear speed of the rotor



VI. Literature Survey

In the Paper [1]: ERIC R. laithwhite explains the operation of various types of linear motors used in maglev systems, discusses and compares their suitability, and describes the scope of worldwide maglev developments.

In the paper [2]:M. S. MANNA, S. MARWAHA, A. MARWAHA provides the eddy current and core flux density distribution analysis in linear induction motor. Magnetic flux in the air gap of the linear induction motor (LIM) is reduced to various losses such as end effects, fringes, effect, skin effects etc. The finite element based software package COMSOL Multiphysics Inc. USA is used to get the reliable and accurate computational results for optimization the performance of LIM**.** The geometrical characteristics of LIM are varied to find the optimal point of thrust and minimum flux leakage during static and dynamic conditions.

In the Paper[3]:Chan-Bae Park*, Hyung-Woo Lee** and Ju Lee† explains the power requirements necessary for the traction motor to maintain balanced speed in the high-speed traction system. From this, we determined the design criteria for the development of a high-speed traction system for use in the deep-underground GTX. Finally, we designed a linear induction motor (LIM) for a propulsion system, and we used the finite element method (FEM) to analyze its performance as it travelled through deep-underground tunnels.

In the Paper[4]: Abhay Kumarl, M.A.Hasan, Md. Junaid Akhta,S.K.Parida, RK.Behera explains objective function of the optimization problem discussed in this paper includes efficiency, output thrust and machine weight. Various machine design parameters have been used as constraint variables. Optimization done with Quasi Newton process shows significant improvement in machine efficiency and output torque compared to the results reported in literature.

In the Paper[4]: Ch. V. N. Raja and K. Rama explains a novel Harmony Search optimization algorithm is proposed to meet required efficiency and power factor in the design of a Linear Induction Motor. Finite Element Method is adopted to analyze the flux density in LIM with the parameters obtained using HAS

VII. Conclusion

In this research the linear motor is not base in the magneto linear induction motor this is the pure electrical linear induction motor. This is only work on a electrical input the we can say that electrical energy using linear induction motor. In our induction motor the no use of magnets. The air gap will be very narrow. The efficiency, power factor high and the reduce the losses. Here the only use the electrical supply so the motor will not bulky. The losses like cogging carolling is negligible the purpose of this motor the uses in industrial purpose. It can get maximum load on it so the product is however bulky its not to need carry but only sliding on it so the work is such a simple. In the airport the conveyer belts will be replace by electrical linear induction motor. This motor will be reliable and low cost to maintenance cause the maintenance is near about to zero. For the analysis and design of a Linear induction motor having negligible end-effects, the performances to be determined are thrust and efficiency.

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