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Fabrication of Maglev Assisted Take-Off System

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Abstract

In recent years, due to more population density, there is a need to decrease runway length in the future. Hence in this project, we are trying to reduce the runway length by using magnetic levitation technology. Due to reducing the friction between the runway and landing gear, it is possible to take-off an aircraft. In this project, instead of fabricating a large aircraft, we plan to fabricate a motor-powered propulsion mechanism with my landing gear. The use of conventional landing gear for this project aims to reduce the take-off and landing time.

Keywords - *Magnetic suspension, Permanent magnets, Magnetic array Landing gear, Aircraft performance.*

I. INTRODUCTION

The magnetic Levitation system uses a magnetic force to levitate the aircraft on a rail and accelerate it during take-off. When landing, this system can be utilized to decelerate the aircraft. If an aircraft is assisted with a magnetic levitation system during take-off and excessive landing, impact force, vibration, and shock will be produced. In a conventional system, hydraulic shock absorbers are used for this purpose, which nearly consumed 7% weight of the total aircraft, and a complex hydraulic mechanism is required.

Today and in the future, noise levels are regulated by local and aviation authorities. Because predefined noise levels cannot be exceeded, noise-constraints airports have difficulties expanding and are limited in the number of daily operations.

A magnetic assisted take-off system can be a manner for these airports to expand without violating the noise regulations due to the lower thrust setting required by the aircraft to take-off. Since the engine is a primary source of noise pollution during take-off, reducing the thrust directly translates to a reduction in EPNL (equivalent perceived noise level).

- Possible solution using the Magnetic levitation technology to assisting the aircraft take-off.
- This is a disruptive technology investigating by NASA, US NAVY, etc.
- This project evaluates the feasibility of the method of applying to civil air transport.

A. THEORY OF OPERATION

Maglev is defined as a "family of technologies in which a vehicle is suspended, guided, and propelled utilizing magnetic forces."

1. Propulsion System
2. Levitation System

The propulsion system used is known as a linear motor. Unlike a conventional motor, a linear motor creates linear motion instead of circular motion. As mentioned above, the major principle behind its operation is magnetic repulsion.

Maglev is short for magnetic levitation, in which trains float on a guideway using the principle of magnetic repulsion. Each magnet has two poles. However, instead of using permanent magnets, the principle of electromagnetism is used to create healthy and large temporary magnets. In Maglev's that levitate by magnetic attraction, the bottom of the train. Wraps around the guideway. Levitation magnets on the guideway's underside are positioned to attract the opposite poles of magnets on the Maglev's wraparound section.

B. STABILITY AND CONTROL

An aircraft is stable if it returns to its initial equilibrium flight conditions when it is perturbed.

There are two main types of aircrafts instability.

- An aircraft with static stability uniformly departs from an equilibrium condition.
- An aircraft with dynamic instability oscillates about the equilibrium condition with increasing amplitude.

There are two modes of aircraft control: One moves the aircraft between equilibrium states, the other takes the aircraft into a non-equilibrium (accelerating) state. Control is directly opposed to stability.

C. MAGLEV PROS AND CONS

Maglevs are cool and fast, sure, but as good as they sound, they are disadvantaged. On the page, we will take a look at the Maglev's goods and beds.

D. ADVANTAGES

- To reduced less friction in the float landing gear.
- To reduced fuel consumption in aircraft.
- Efficiency conventional rail is probably more efficient at a lower speed.

- Maglev aircraft experience no rolling resistance, leaving only air resistance and electromagnetic drag, potentially improving power efficiency.
- No noise.
- Quicker and efficient transport.
- Safe and cost-effective.
- Comfortable, smooth ride due to ver. Little friction.

E. DISADVANTAGES

- The Maglev's track is much more expensive than railroad tracks.
- Although Maglev is pretty quiet, noise ca Au disturbance still occurs. Airspeed by air disturbance still occurs.
- Maglev's use 30%less energy than normal trains.
- High Expensive.
- Complex control system.
- No overlap or junction can be done.

F. APPLICATION

- Magnetic levitation is used in train due to reducing undesirable noise
- The use of conventional landing gear may reduce conventional weight.
- There are used permanent magnets, conductors, and superconduction.

G. USES

- Maglev train for high-speed ground transportation maglev train is designed to take advantage of magnetic levitation.
- The contactless melting metal having high resistance can be levitated and melt in the magnetic field.

H. MAGNETIC LEVITATION IN AIRCRAFT

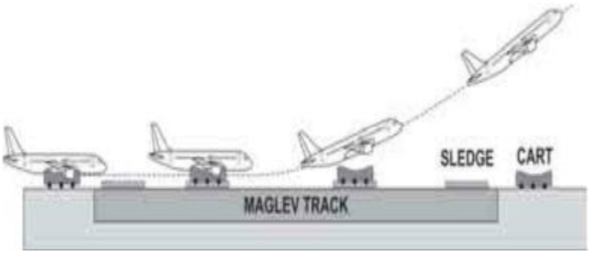

Fig 1: Maglev track

I. MAGLEV TRACK

The magnetic levitation track provides levitation and traction to the entire setup. The magnetic levitation induct track is constructed through the series of halfback arrays that can produce a flux density of more than 1T. At the sled's operation speed, the induct track's levitation force acts like a stiff spring.

Thus more than 2cm clearance between the sled and the track can be produced. Since no friction force is acting on the system, the sled can be accelerated to its maximum speed, which is the aircraft's required speed to produce lift. Hence lift produced by the wing takes off the aircraft, and the sled will be finally detached from the aircraft.

II.PROBLEM DEFINITION

The radically new solutions, technologies always meet serious problems and barriers impeding the applications, faster deployment. Especially in the case of "out of the box" projects, the stakeholders may create problems and barriers or be afraid of appearing problems. The diffusion of a new product depends on many factors, including the economic, technological, and social aspects. In some cases, the stakeholders are accepting the new products meets their needs (mobile phones) or/and have strong political support (as electric cars) in other cases when the original solutions or technologies are planned to implement to the part of the total systems (like developing the electromagnetic brake) the acceptation problems are reduced, too. In cases of developing new approaches to operator load measurements and management combining the new technologies with possible measurement of the operator's psychophysiological (mental) condition, the implementation meets the resistance of user operators as car drivers, aircraft pilots, and air traffic controllers.

A. SPECIAL TECHNICAL AND TECHNOLOGICAL PROBLEMS

The use of Maglev technology to support the aircraft take-off is such a radical concept that generates many technical, technological problems. This concept can be realized safely and cost-effectively even today by utilizing the available technologies. Several problems need further investigation and creating some solutions. The most important three problems are the following.

B. REQUIRED ENERGY SUPPORT-ENERGY BALANCE

The energy problem is generated by the cart-sledge system's weight that must be accelerated by the aircraft together.

The weight of the cart-sled system mass of which equals to 80% -135% of the accelerating aircraft mass. The required energy and power were determined for the 5 scenarios.

1. Applying the methods of aerodynamics and flight mechanics calculations and physical equations for operations of the magnetic tracks. The total drag is compost from the aerodynamic drag of airplane, undercarriage friction

The undercarriage friction appears at moving of cart-sledge at low velocity on rolling wheels because the selected electrodynamics levitation with permanent magnets in Halfback Arrays cannot work at low velocity.

2. The project had developed several ideas for possible improvements of the rendezvous control, like improving the sledge dynamics, increasing the effectiveness of the actuators systems by the wide use of distributors microsensors, applying the guest elimination technology, smacking control with feedforward and predictions, integrating the ground and onboard systems including sensing, etc.

It is developed a possible display system for the integrated ground-on-board rendezvous control system.

C. REAL ENVIRONMENT IMPACT

The environmental impact analysis that these users will reduce the fuel consumption up to 18%in cases of mid-size passenger aircraft, and considerably reduce the noise at airport regions and reduce the chemical emissions for 40%-60% calculated for ICAO take-off cycle after optimization of the climb and approached procedures.

The noise and chemical emission reductions are questionable because the airport size, namely runway length (including the decelerating the sledge aircraft after aircraft take-off), should be increased by another30%-60% or during the take-off, the aircraft engines must be used, too.

There was elaborated an unconventional take-off and climbing scenario developed to reach maximum noise and emission benefits.

D. PROBLEMS OF STAKEHOLDERS

The stakeholders like to operate the existing systems. Introducing new and especially new technologies and solutions always generates some extra problems for stakeholders.

They have many problems with deploying the Maglev assisted aircraft too. The policymakers, aircraft producers, and operators (airplane, airports) have problems associated with cost, safety, and security.

III.METHODOLOGY

A. TAKE-OFF GROUND RUN

The airplane starts from rest during the ground run and accelerates to the take-off speed (VT0 or V1). The flaps and engine(s) are adjusted for their take-off settings. In the case of an airplane with a tricycle type of landing gear, all three wheels remain in contact with the ground till a speed of about 85% of the VT0 is reached. This speed is called 'Nose wheel lift-off speed.'

At this speed, the pilot pulls the stick back and increases the airplane's angle of attack to attain a lift coefficient corresponding to take-off (CLT0). The nose wheel is off the ground at this stage, and the airplane's speed continues to increase. As the speed exceeds the take-off speed, the airplane gets airborne, and the main landing gear wheels also leave the ground. When the airplane has a tailwheel type of landing gear, the attack angle is high at the beginning of the take-off run.

However, the tail wheel is lifted off the ground as soon as some speed is gained, and the deflection of the elevator can rotate the airplane about the main wheels. This action reduces the angle of attack and, consequently, the airplane drag during most of the ground run. As the take-off speed is approached, the tail wheel is lowered to get the incidence corresponding to CLT0. When VT0 is exceeded, the airplane gets airborne. The point at which all the wheels have left the ground is called 'Unstuck point.'

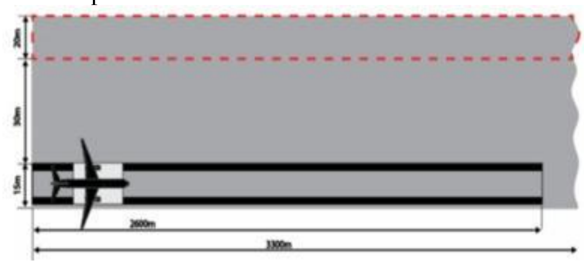

Fig 2: Runway

IV. FABRICATION OF MAGLEV SETUP

A. LATERAL GUIDANCE

The levitation coils facing each other are connected under the guideway, constituting a loop. When a running maglev vehicle that is a superconducting magnet displaces later, an electric current is induced in the loop, resulting in a repulsive force acting on the levitation coil of the side near the flight and an attractive force acting on the levitation coils of the side father apart from the flight. This, a running flight, is always located at the center of the guideway.

B. PROPULSION

A repulsive force and an attractive force induced between the magnets are used to propel the vehicle (superconducting magnet). The propulsion coils located on to sidewalls on both sides of the guideway are energized by a three-phase alternating current from a substation, creating a shifting magnetic field on the guide away. The onboard superconducting magnets are attracted and pushed by the shifting field, propelling the maglev vehicle.

C. FLOATATION

Due to the complexity and ramification of the current aircraft landing system, there are some limitations. For season consumes passengers' time, aircraft are forced to divert their flight paths. Due to unpredictable climatic changes, the runway's invisibility creates inconvenience to both passengers and crew members. This level of disruption costs airlines huge amounts of money, and it also causes passengers a great deal of inconvenience through missed connections and the extra time spent in the aircraft along time.

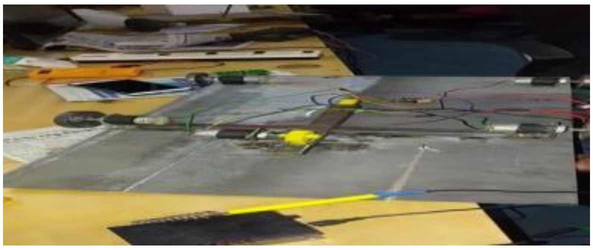

Fig 3: Fabricated model

D. FABRICATIONS OF TRACK

The first steam locomotive, named the rocket, could travel at a constant 39 km/hr (24mph). Since then, manufacturing technology has rapidly progressed, until today, where high-speed trains can travel at a speed of 574 km/hr (357mph) on the metal rail and 581km/hr (361mph) on magnetic-levitation track.

Environmental requirements include noise emissions, energy efficiency, carbon footprint, and recycling. Manufacturers are continuously are trying to improve initial and through-life cost, weight, aesthete tics, crashworthiness, and end-of-life reuse of material. These factors were addressed by innovative designs of the rail car structure and appropriate joining technologies and materials.

Engine-Out Take-off Case

Dictated by two scenarios

Continued take-off sub case

The actual distance to clear an imaginary 11 m (35 ft) obstacle D35 (with an engine-out) Aborted or rejected take-off sub case

Distance to accelerate and stop (DAS) Note: no correction is applied due to the rare nature of engine-out conditions in practice for turbofan/turbojet-powered aircraft.

Components

- Wood
- Battery
- Gear motor
- Steel plate
- Wires
- Beaconrack
- On-off switch
- Wheel
- Magnet

E. WOOD

Fig 4: Wood (runway track)

Wood is porous and fibrous structural tissue found in the stems and roots of trees and other woody plants. It is an organic material, a natural composite of cellulose fibers strong in tension and embedded in a matrix of lignin that resists compression.

Wood processing comprises forest products such as Pulp and Paper, construction materials, and tall oil. It is used to runway track and attached with magnet form rail track. It is used to maintain the balanced for aircraft performance with maglev technology.

F. GEAR MOTOR

A gear motor is a specific type of electrical motor designed to produce high torque while maintaining a low horse, or low speed, motor output.

The gear motor can be found in many different applications and is probably used in many devices in your home.

Fig 5: Gear motor

It should produce to be high to low power and speed efficiency. Gear A gear motor is commonly used in devices such as can openers, garage door openers motor is used in an application that requires lower shaft speed and higher torque output. This describes a wide range of applications and scenarios, including many of the machines and equipment we interact with daily.

G. WHEEL

Fig 6: Wheel

The wheel is a circular block of hard and durable material whose centers have been bored with a circular hole. It is placed an axle bearing about which rotates when a moment is applied by gravity or torque to the wheel about the axis.

A new manufacturing process has been developed to produce the next generation of lightweight alloy wheels. The most advanced technology combines a one-piece wheel casting technology called the spinning process. The new technology of casting and rim forming by the MAT.

H. BATTERY

Fig 7: Battery

A battery consists of one or more electrochemical cells with external connection provided to electrical power devices such as flashlight and electric b cars. When a battery is supplying electric power, its positive terminal is the cathode, and the negative terminal is the anode.

It contains high power and speed. It should be charged to connect the wire.

I. STEEL PLATE

Fig 8: Steel plate

The steel can be carbon, structural, stainless, ferrites, austenitic, and alloy types. These steel standards help guide metallurgical laboratories and refineries, product manufacturers, and other end-users of steel and variants in their proper processing and application procedures to ensure quality toward safe use.

The process starts in the center of the wheel with the three main iron ore ingredients in iron ore, coke, and lime fed into a blast furnace to produce molten iron.

J. WIRE

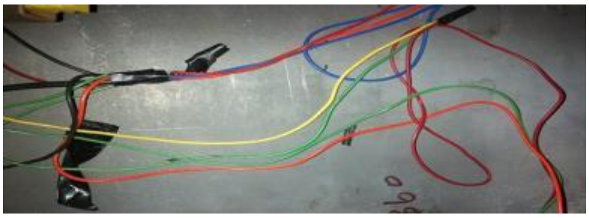

Fig 9: Wire

A wire is a single, usually cylindrical, flexible strand, or rods of metal wires are used to bear mechanical loads or electricity and telecommunication signals. The wire is commonly formed by drawing the metal through-hole a die.

The technical purpose, such as high-efficiency voice coils in the loudspeaker.

K. MAGNET

Fig 10: Magnet

If an object is suspended using the force of attraction applied from the top of the object, it is known as a magnetic suspension.

The area of attraction in magnetic levitation is a means of eliminating the friction of physical contact.

As a means of eliminating friction, magnetic levitation give its use in the magnetic bearing.

V. RESULT AND DISCUSSION

This method could increase aircraft fuel efficiency since take-off and landing are done through ground assisted power source, thus smaller engines can be used. Removal of conventional landing gear could reduce 7% weight of the aircraft, less noise production so that airports can be built nearer to the cities.

Finally, I conclude that more than more, this method is the most cost-effective because of the use of less hydraulic mechanism and can reduce runway length. This is the best alternative solution to the conventional TOL mechanism.

Nowadays, many works are being carried out whose aim is to improve air transport efficiency and reduce its negative influence on the environment. Among different ideas, a group of solutions can be separated, which stands out of the common schemes and can be an alternative way of development in the future. This group includes the following ideas: the ground aiding system of the aircraft take-off and landing using the phenomenon of magnetic levitation.

This is an advanced innovative idea; it is not schematic. Implementation of this idea requires a solution to a number of important and complex technical problems. However, the benefits that can be gained due to this system's implementation are worth the investment necessary to improve the system.

This analysis found that:

- A 4-5% decrease in the take-off weight is feasible if the take-off and landing processes are assisted with the GABRIEL concept, and thus the aircraft is not equipped with the traditional undercarriage.
- A 4-5% drag reduction under cruise conditions is feasible, which would reduce fuel consumption. This is achieved through the

Smaller aircraft weight (a smaller induced drag), the wing-fuselage center section's modification, and the engine nacelles' smaller dimensions.

Potential fuel consumption cut in the take-off phase and during the initial climb depends on the aircraft's lift-off speed.

VI. CONCLUSION

The presented work focuses on analyzing the change in weight and the emission of the transport aircraft in the take-off and landing phase using the system of magnetic levitation. Based on the obtained results, it can be noticed that the introduction of this system can be justified not only regarding ecological matters (decreased emission of harmful substances and noise pollution) but also regarding economic factors (less weight, transport efficiency improvement).

Public perceptions and acceptance of new transport technology will be critical to the success of the supporting ground system's project. The aircraft emissions have a large impact on nonattainment area, local and regional air quality, and as a consequence on public health. The supporting system has a significant impact on the greenhouse effect. A comparison of results obtained for traditional aircraft and aircraft using the supporting system allowed us to state that the new concept radically reduces emission and greenhouse effect for all considered LTO scenarios.

We can expect over 50% reduction of all dangerous products emitted from aircraft jet engines. The possibilities of noise reduction were shown thanks to the system's application supporting the aircraft during the take-off and landing phase. Different conditions of the take-off and landing give possibilities to shape the trajectory of the initial stage of the aircraft climb after the take-off and approach path to decrease the environment's negative influence. The use of the aiding system will bring many benefits; however, regarding its innovative character and the problems connected with it, the idea can have been realized in a couple of years or even decades.

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