Magnetic Levitation System for Take-off and Landing Airplane - Project GABRIEL

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Abstract

Introduction
The project Gabriel proposes new conception of take-off and landing. There is eliminated the classical gear with wheel from construction of airplane. The airplane moves to the magnetic runway on a cart before take-off. The cart docks to the magnetic sledge. The sledge has got system of magnetic suspension and linear electric drive. There is eliminated mechanical contact between runway and sledge.

In this paper is presented analysis construction of passive magnetic suspension system for small airplane runway. There is used the passive magnetic suspension system to suspend the sledge over runway. This system was designed for mass of small airplane about 2 kg and total mass of take-off system about 8 kg (sledge, cart, equipment and airplane). The magnetic suspension system with superconductor was selected for levitation system of sledge. This system was built from two magnetic railways and boxes with superconductor's bulks. The bulks were drowned in the liquid nitrogen.

Use of COMSOL Multiphysics®
COMSOL Multiphysics® was used to model magnetic suspension system with superconductors. There will be presented 3D model of magnetic suspension and estimation levitation forces between superconductor and magnets of railway. The simulation was used to obtain optimal configuration array of magnets mounted at rails. There was tested two configuration array. The study was made as a magnetic field no current.

Results
On the figure 2 is presented two configurations of arrays. The red color presents positive direction of vector of magnetization and blue shows negative direction. The configuration from fig. 2.a is a very difficult to make. There is generated strong repulsive force between magnets from two layers. The configuration from fig. 2.b is easy to make and generates strong magnetic field. This configuration is seems effectually. The model of magnetic rail and cylinder shaped superconductor bulk was modeled in the COMSOL Multiphysics® and magnetic forces were obtained for air gaps and different position superconductor towards lengthways magnetic rail. The simulation was made for full scaled model and physical parameter of magnetic materials. On the picture 3 and 4 is presented distribution magnetic force for air gap 3 mm and lengthways of the magnetic railway. The magnetic force generated by array from figure 2.a shows figure 3 and

magnetic force generated by array from figure 2.b shows figure 4.

Conclusion
The magnetic array of railway from figure 2.b seems most effectively then from figure 2.b. However if the superconductor bulk moves under rail the magnetic force is changed with constants frequency. There is generated wavelength about length of magnet (there is equal 15 mm). The magnetic force changes about 2 N. This construction of magnetic rail doesn't meet expectation of system of take - off and landing. The configuration from figure 2.a was chosen for realization UAV take-off and landing system. The COMSOL Multiphysics® was turned out to be good for verification construction of rail.

Figures used in the abstract

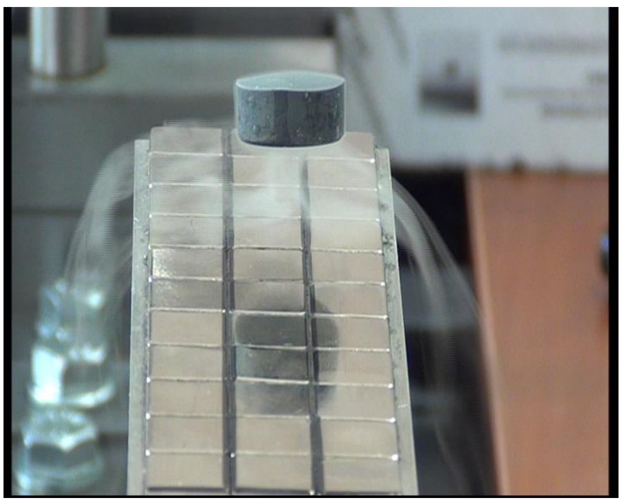

Figure 1: Test stand for measure levitation forces of sledge.

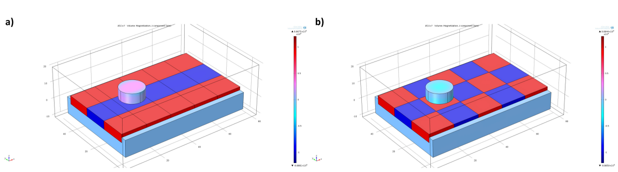

Figure 2: Configuration of magnetic rail.

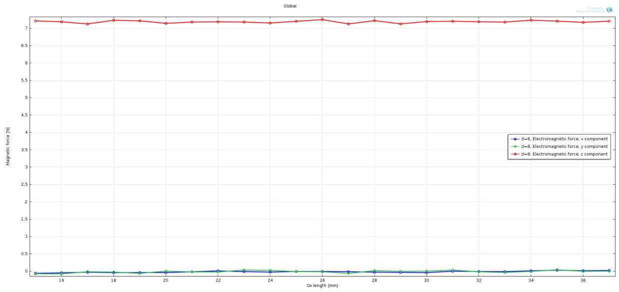

Figure 3: Magnetic force for configuration of array from fig.2.a.

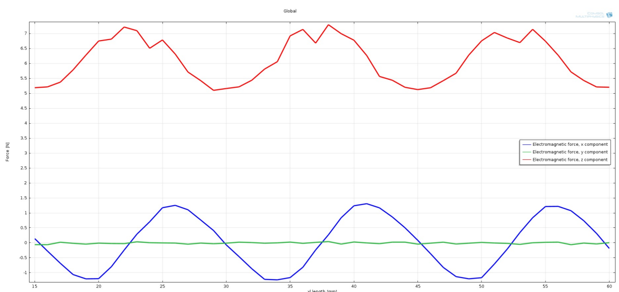

Figure 4: Magnetic force for configuration of array from fig.2.b.