Investigating of the Operation of a Railgun System with Laboratory Proportion

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Abstract

In this document it is addressed the basic principles underlying the function of the railgun focusing in the electrodynamic questions. It is intended to acquire familiarity with this kind of weapon through the critical study of his functional principles. At first glance, the basic principle of operation of a railgun may seem

simple in the light of the immediate application of the Lorenz force in a conductor driven by current. However, everything becomes more complicated in the case of a quick change of the involved parameters (transitional regime), which requires a more thorough analysis of current behavior, electric and magnetic fields, and all involved materials in the system.

This project also included the construction of two railguns, initially a smaller size one to gain familiarity with the system, and lastly a laboratory proportion one in which was performed and analyzed a number of tests with different materials and distinct projectile sizes. To better understand the process that involve the railgun process, an analysis in the time domain, of the spatial distribution of the electromagnetic field, electrical current and energy flow was performed. In the present paper, we describe the preliminary concepts about the studied weapon, the energy flow, complemented by a summary of the experimental work associated to the construction of the second railgun (in laboratory proportions) that allowed us to test distinct materials, forms and sizes.

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Notes

1. 1 $Mach$ is defined as the ratio between the speed of the object and the speed of sound.

2. Since during the discharge of capacitors, we have $I_0 = \frac{V_0}{R}$ and $I(t) = I_0 e^{-\frac{t}{RC}}$.

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