Simulation of resonances in the homopolar generator

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Abstract

The homopolar generator or Faraday disk has been considered as a candidate device for producing energy from spacetime. With very few exceptions, no successful practical designs are reported. The machine has been subject of theoretical studies of the AIAS institute where three types of possible resonances have been found. One of them is studied in detail in this paper. Simulations of device dynamics show that indeed a giant resonance is possible, inferred by a negative effective resistance.

Keywords: Homopolar generator, Faraday disk, N-machine, electrodynamics simulation

1 Introduction

The homopolar generator or Faraday disk is the oldest electric motor or generator and has been discovered by Michael Faraday in 1831. Machines of this kind were in use until about 1900 but were replaced by modern induction motors and generators. Nevertheless the machine has preserved a nimbus of mystery because it works on the principle of the Lorentz force which keeps a life of its own in engineering since this law is not directly contained in Maxwell's equations, the basis of electrodynamics. However, the Lorentz force is nothing else than the relativistic transformation law which Maxwell's equations are based on, so nothing cryptic is contained in the principle of homopolar induction.

In recent years some engineeres argued that a homopolar machine can produce unusual effects and "resonances" which are not explainable by classical electrical engineering, even transfer of energy "from the vacuum" should be possible. This hint was picked up by the AIAS research group and they gave an explanation of the machine in the context of Einstein Cartan Evans (ECE) theory [1]- [2]. Three possible types of resonances were found in connection with a variable rotational speed [3]. Two of them can only be explained by ECE

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theory. The third can be understood on a more classical level and seems to be the one being most accessible to engineering. Therefore we give a deeper description of it in this article and report on simulations which corroborate that a giant resonance exists and can probably be used for extracting energy from spacetime. In the next section we describe this resonance theory in detail and in the third part we report on simulation results of the dynamics of the machine.

2 Principle of resonance in the Homopolar Generator

The Homopolar generator or N-machine consists of a spun conducting disk in a static magnetic field. An electric field builds up between the shaft and the rim of the disk. The voltage provided by the electric field produces a current through the connectors which have to be locally fixed with respect to the lab. Relative motion between the connectors and the disk is required for the machine to work. This all has been discussed in great detail in the literature, see for example [4]-[5].

In paper 107 of the UFT series of AIAS [3] the third type of resonance was derived from a dynamic effect. In conventional view a Faraday disk is considered to have a constant magnetic field which pervades the disk. In the design presented in [3] the single disk with a static magnetic field is replaced by a twin disk. In this special design we use one conventional permanent magnet for one disk and an electromagnetic coil for the other, see Fig. 1. The current produced by the machine flows through the electromagnet and provides a positive feedback effect. The higher the current, the higher the magnetic field and the higher the current again. Although this is a simple design, nobody seems to have considered this before. The machine can be analysed in a static and dynamic way. A static analysis was given in [3] and leads to resonance-like enhancements of the current for certain rotation speeds. We will derive the dynamic behaviour first and then reduce the result to the static case.

According the Kirchhoff rule, the sum of voltages in the circuit of Fig. 1 is [1]

$$U_L + U_R = U_H \tag{1}$$

where the voltages of the inductor coil and the resistance are

$$U_L = L\dot{I}, \tag{2}$$

$$U_R = RI. \tag{3}$$

The dot denotes the time derivative of the current I. The voltage of both parts of the homopolar is [3]

$$U_H = \frac{1}{2}\omega r^2 (B_m + B_I) \tag{4}$$

where ω is the angular rotation speed, r is the radius of the disk, B_m is the magnetic field of the permanent magnet and B_I is the dynamic magnetic field

[1] The term U_H can also be placed on the left hand side in the canonical way by changing the sign definition of angular velocity.

given by

$$B_I = \mu_0 \mu_r \frac{N}{l}\ I. \tag{5}$$

The inductor parameters are the number of windings N, the relative permeability of the material μ_r and the length of coil l. With these definitions Eq.(1) reads

$$L\dot{I} + RI = \frac{1}{2}\omega r^2 (B_m + B_I). \tag{6}$$

Inserting expression (5) we find

$$L\dot{I} + I\left(R - \frac{1}{2}\omega r^2 \mu_0 \mu_r \frac{N}{l}\right) - \frac{1}{2}\omega r^2 B_m = 0. \tag{7}$$

The parenthesis next to I is an effective Ohmic resistance which we define by

$$R_{eff} := R - \frac{1}{2}\omega r^2 \mu_0 \mu_r \frac{N}{l}. \tag{8}$$

Obviously this term can become zero and even negative. Later we will see that resonance appears at $R_{\text{eff}} = 0$. This condition defines the resonance frequency

$$\omega_{res} := 2\ R\ \frac{l}{r^2 \mu_0 \mu_r N}. \tag{9}$$

To complete the theoretical analysis, we consider the static case. This is defined by

$$\dot{I} = 0 \tag{10}$$

and by means of Eq.(7) leads to the static current

$$I_{static} := \frac{1}{2}\ \frac{\omega r^2 B_m}{R - \frac{1}{2}\omega r^2 \mu_0 \mu_r \frac{N}{l}} = \frac{1}{2}\ \frac{\omega r^2 B_m}{R_{eff}}. \tag{11}$$

For simulating the time behaviour the time dependence of ω has to be defined. We assume that the disk is driven by an external motor with a constant torque α. Then the angular velocity follows from the rotational Newtonian law

$$J\dot{\omega} = \alpha \tag{12}$$

where J is the moment of inertia of the rotating parts. Eqs.(7) and (12) together define a set of two equations for two unknowns I and ω. This coupled set of equations has to be solved by simulation.

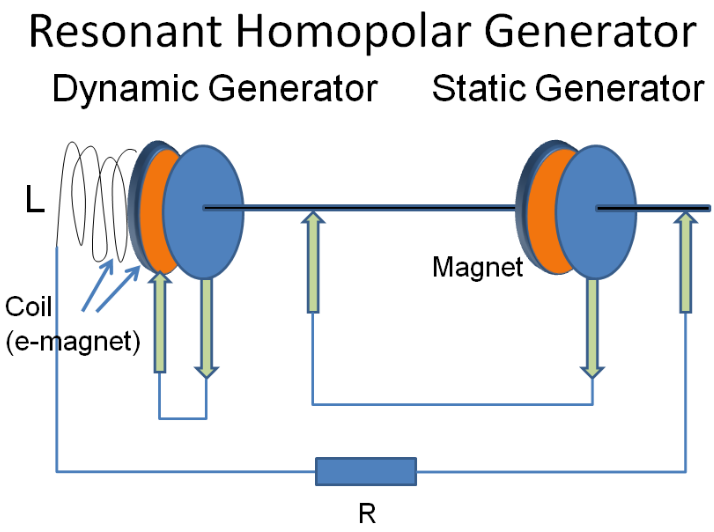

Figure 1: Design of the resonant homopolar generator.

3 Simulation results

The simulation package OpenModelica [6] was used to solve the time dependent equations. The following parameters were defined (in SI units):

$$
\begin{aligned}
R &= 0.3 \\
L &= 0.001 \\
N &= 800 \\
l &= 0.05 \\
r &= 0.1 \\
\mu_0 &= 4\pi 10^{-7} \\
\mu_r &= 100 \\
B_m &= 0.1 \\
J &= 0.01 \\
\alpha &= 1.0
\end{aligned}
$$

As the driving torque is constant, ω increases linearly as can be seen from Fig. 2. For $\omega = 30$ the angular velocity reaches the resonant value defined by Eq.(9). As can be seen from Fig. 3, R_{eff} becomes negative above this point of time of about 0.3 s. According to the results of the earlier paper [3], a pole in the static current appears here. Exactly this can be seen from Fig. 4 (the upper part of the pole is not visible due to restrictions of time axis resolution). Howerver the dynamic current is not affected at this point. The increase of current is retarded due to the inductivity. Only for times grater than about 0.4 s the effect of the negative effective resistance becomes fully visible and drives the current to infinity. This

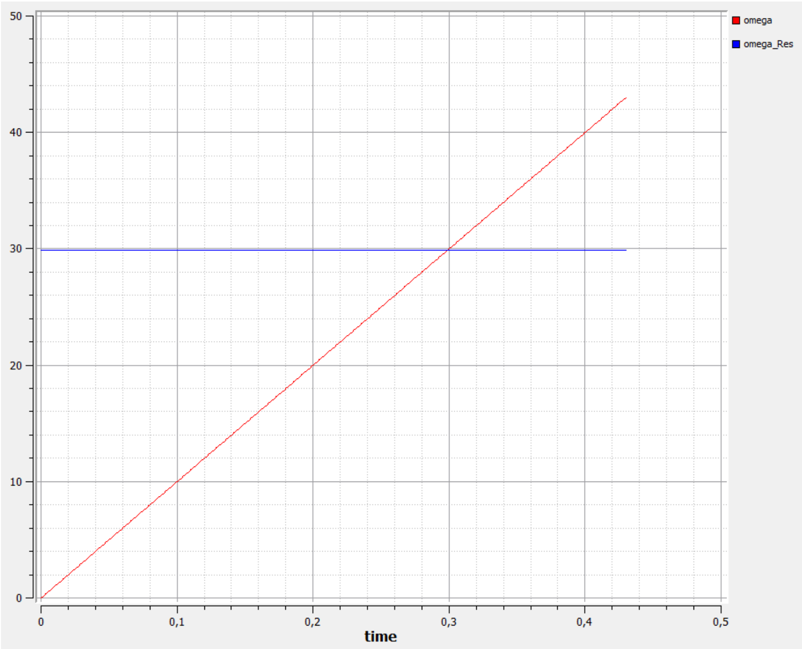

Figure 2: Time dependence of ω and $\omega_{\rm res}$.

is a pure dynamic effect. Mathematical analysis shows that a negative resistance leads to an exponential growth of the current. However the magnetic field (the negative part of the resistance) additionally increases with the current. This gives a hyper-exponential growth. Correspondingly the total energy approaches minus inifinity (Fig. 5). The minus sign appears since the dominating voltage U_H is negative at resonance. The negative resistance leads to the interpretation that energy is sucked up by the system instead of dissipated. This energy can only come from the surrounding or spacetime.

An interesting effect shows up when the homopolar disk is not spun from zero velocity but is brought into a state of $\omega > \omega_{\rm res}$ before the curcuit is connected. Then the system is brought into the negative resistance region but with a current starting from zero. The disk is decelerated below the critical speed (Fig. 6). The effective resistance then starts at negative values but becomes positive later on (Fig. 7). The current raises to a maximum (Fig. 8) and falls down afterwards, not going to infinity. The hight of the maximum is strongly determined by the initial angular velocity. This means, the more time the system has to utilize the negative resistance, the higher the peak in Fig. 8 is. The current maximum obviously coincides with the pole of the current from static analysis, in contrast to the case considered before. Finally the total energy goes down to zero because ω reaches zero according to Fig. 9. This takes place in the range where $R_{\rm eff}$ is positive, the system behaves ordinary after having reached the zero crossing of $R_{\rm eff}$.

Another point to consider is the effect of the static magnetic field B_m. Without this, Eq.(7) becomes a homogeneous equation without a driving term. As a result the current stays at zero if it is zero initially. The value of B_m needs not to be very high. Lower values lead to a slight flattening of the resonance so

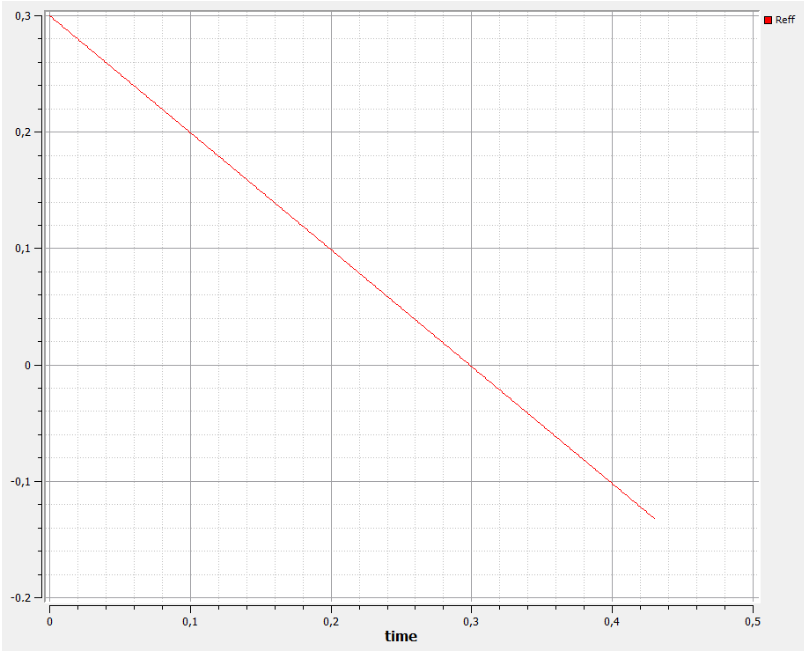

Figure 3: Time dependence of R_{eff}.

this would even alleviate the desing of a control mechanism. Negative values of B_m lead to an inversion of the current direction. The position of the resonance is not affected by it.

We conclude that a double disk homopolar design of the specified kind is able to produce a "giant resonance" as has been observed by at least two experimenters (Walter Thurner [7] and Adam Trombly [8]). An experiment can be set up according to the parameters used in the simulation. It should be noted that the rotation frequency can be kept below 1000 min^{-1}. It could be reduced significantly by using a high magnetic field in the electromagent. We assumed an iron core with $\mu_r = 100$. Without this, rotation speed would have to be increased by a factor of hundred, rendering the design very ambitious.

What has to be designed carefully is a control mechanism for the device, for example by positive and negative feedback control as proposed in [3]. Because the resonance is very sharp, the mechanism must be very reactive and safe. Otherwise the machine disintegrates as one of the experimenters [7] has experienced personally. So be warned when realizing the design.

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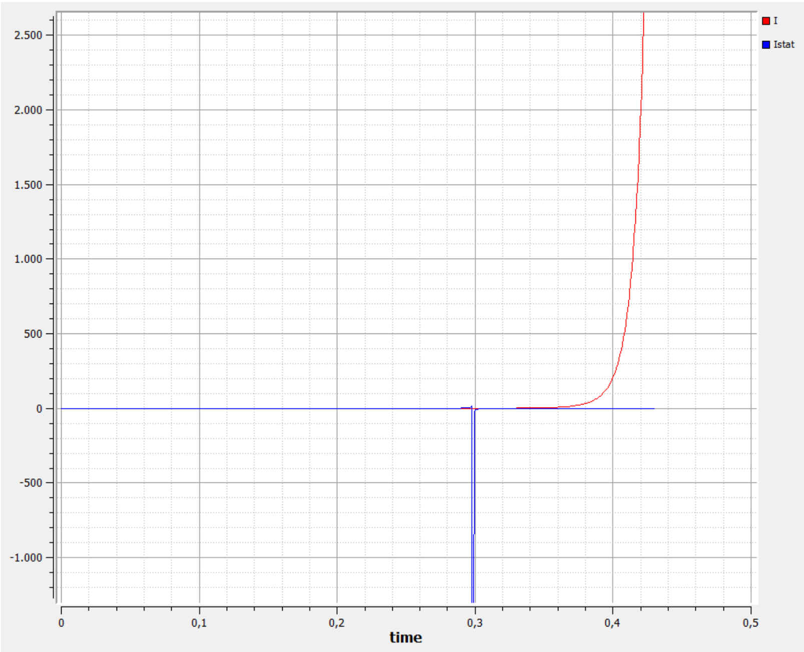

Figure 4: Time dependence of current and static current.

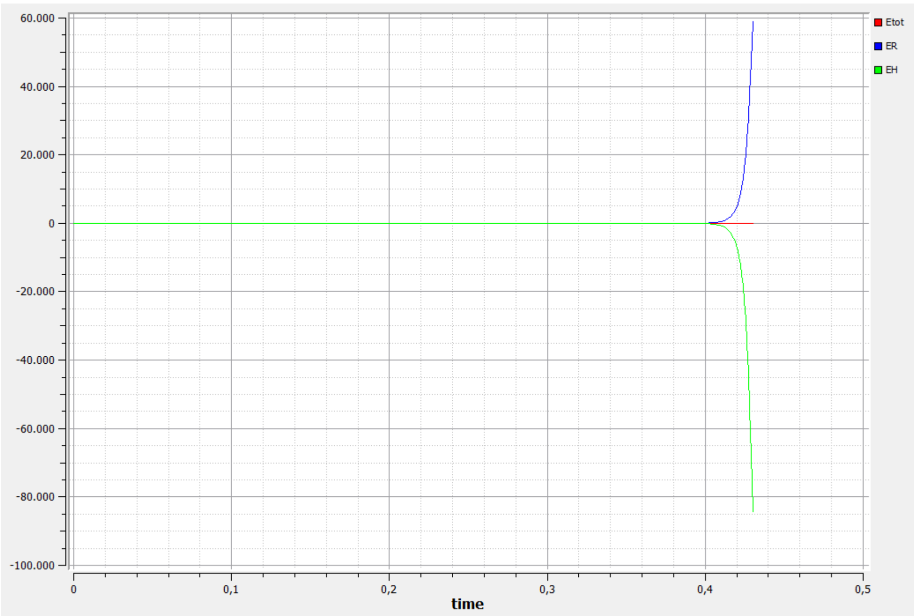

Figure 5: Time dependence of Ohmic dissipated energy and total energy.

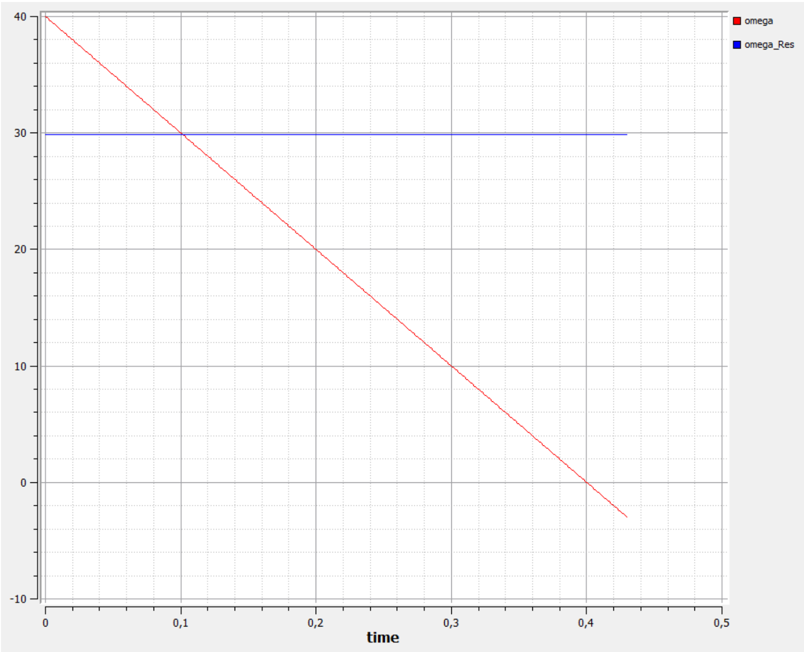

Figure 6: Time dependence of ω and ω_{res} in critical region.

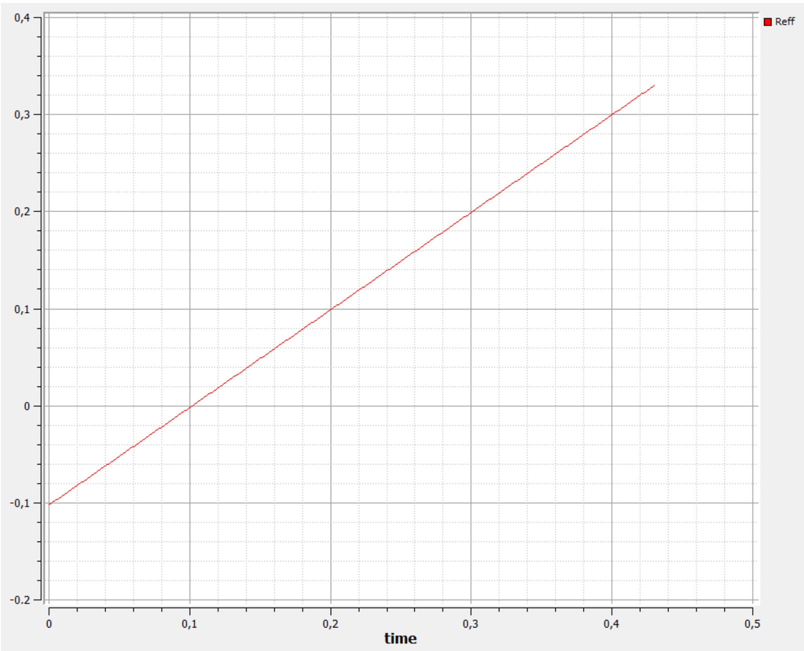

Figure 7: Time dependence of R_{eff} in critical region.

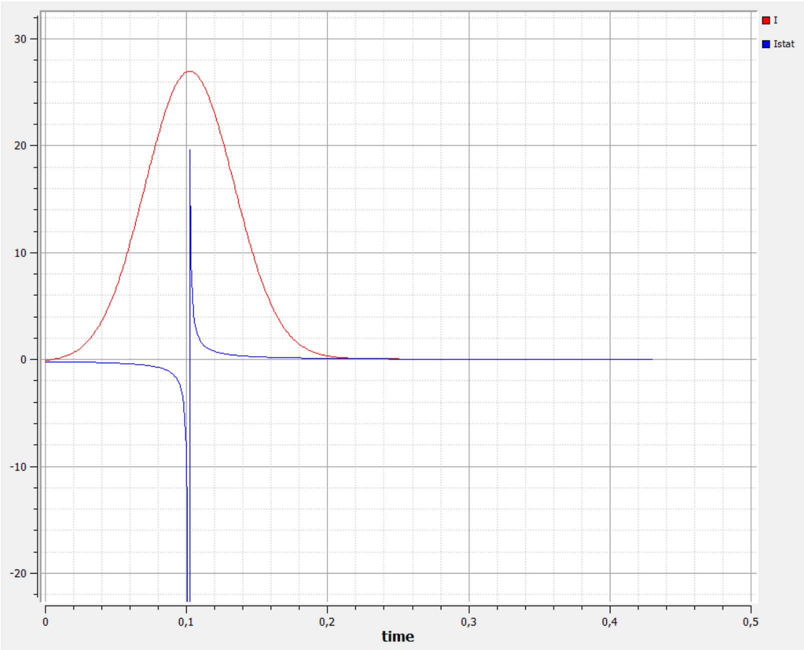

Figure 8: Time dependence of current and static current in critical region.

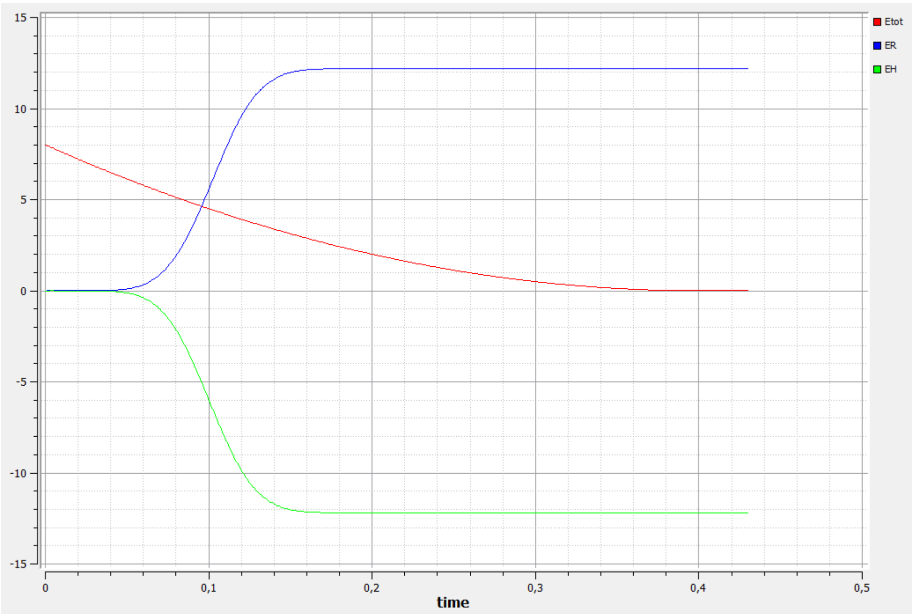

Figure 9: Time dependence of Ohmic dissipated energy and total energy in critical region.

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