

ELECTRICITY GENERATION BY EMPLOYING REPULSION MAGNETIC TECHNIQUE IN ROTATING MACHINES

T.Meenakshi¹, S.Sujithkumar², S.Suganya³

^{1,2}*Electrical and Electronics Engineering, Jansons institute of technology / Anna University, India)*

³*Electrical and Electronics Engineering, Sri Krishna college of engineering & technology / Anna university, India*

ABSTRACT:*The rotating machines are the heart of industries. This rotational energy along with driving a load can be used as a source for free energy power generation as a by- product. This paper proposes a novel technology to convert the rotational free energy available from rotating machines to electrical energy using repulsion magnet technique. The proposed technology employs the theory of magnetic repulsion to utilize the free energy. The system uses permanent magnets to produce repulsion and this repulsive force produces a torque which drives a DC generator. The repulsive magnet disc consists of two magnetic discs of which one is mounted in the rotating machine and the other is connected to the DC generator. During driving a load, the rotating machine on rotation rotates disc 1. The repulsion between the two magnets makes the disc 2 to rotate which forms the mechanical input for DC generator. Thus the free energy available is used for power generation by repulsion technique. The power output from the DC generator can be stored in batteries or used to drive any AC loads through an inverter. Thus the free energy can be effectively utilized at no cost.*

Keywords:*Batteries, DC generator, Free energy, Inverter, Machines, Magnetic repulsion.*

I. INTRODUCTION

The repulsive-type magnetic system has been employed so far in bearing and levitation systems alone. Due to the scarcity of power generation, much modern technique must be employed for power production in this world. This proposed work states the new invention of producing free energy from repulsive type magnetic system for power generation. The technique is very effective and cost enough [7]. This generated power can be used in all kind of applications, specifically in this paper the generated power is fed to UPS. The UPS is indispensable in the critical loads such as on-line system for banks, life-supporting system, etc. This proposed work UPS or VCVSIs are same. The input source of the Voltage controlled voltage source inverters (VCVSI) are widely used in power supplies, power quality controllers, renewable energy, marine and military applications [1]. They are at the heart of applications requiring an AC supply from a DC source. Therefore it is important that they are designed to be robust and efficient, especially in remote areas and renewable energy applications where inverter failure can cause inconvenience and the available energy is limited. The design of inverters can be improved using software packages suitable for this application such as Matlab Simulink [2] and PSIM [3]. This can provide insight into the inverter performance and allows for the analysis of the design before it is implemented in hardware and software, which can lead to improved performance and reduced development and production costs. In this paper, Matlab Simulink is used to model a 2kVA single-phase full-bridge VCVSI [4-6]. This software package is designed for modelling, simulating and analyzing dynamic systems. It supports linear and nonlinear systems modelled in continuous time, sampled time or a combination of both.

II. BLOCK DIAGRAM OF PROPOSED SYSTEM

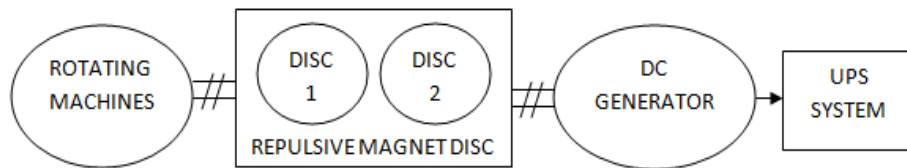


Figure 1. Block diagram

The machine drives any load this rotational energy can be used as a source of free energy for power generation as a by-product. For the generation of free energy a new technique known as repulsive magnetic technique is used. In repulsive magnetic disc the permanent magnet are placed in opposite poles which produce repulsive force. Here two discs, disc 1 is coupled with rotating machines and disc 2 is coupled with the DC generator. These two discs are separated by a small distance because; distance is inversely proportional to the repulsive force. The generated power from DC generator is fed to UPS system. The block diagram of proposed system is shown in figure 1.

I. Analysis of force calculation

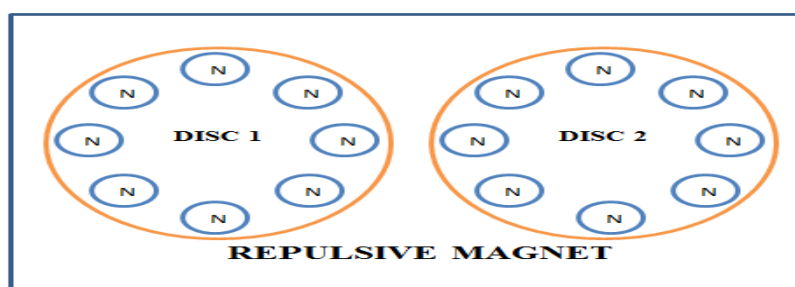


Figure 2. Model diagram

For two cylindrical magnets with radius R, and height h, with their magnetic dipole aligned and the distance between them greater than a certain limit, the force can be well approximated (even at distances of the order of h) by,

$$F(x) = \frac{3\pi B^2}{2\mu_0 x^2} R^4 h^2$$

Where, x is the distance between them. For small values of x, the results are erroneous as the force becomes large for close-to-zero distance [7]. The model diagram of proposed system is shown in figure 2. This force

calculated by using repelling magnet calculator, the results of repelling curve and also different size of magnet force is shown in below figure 3.

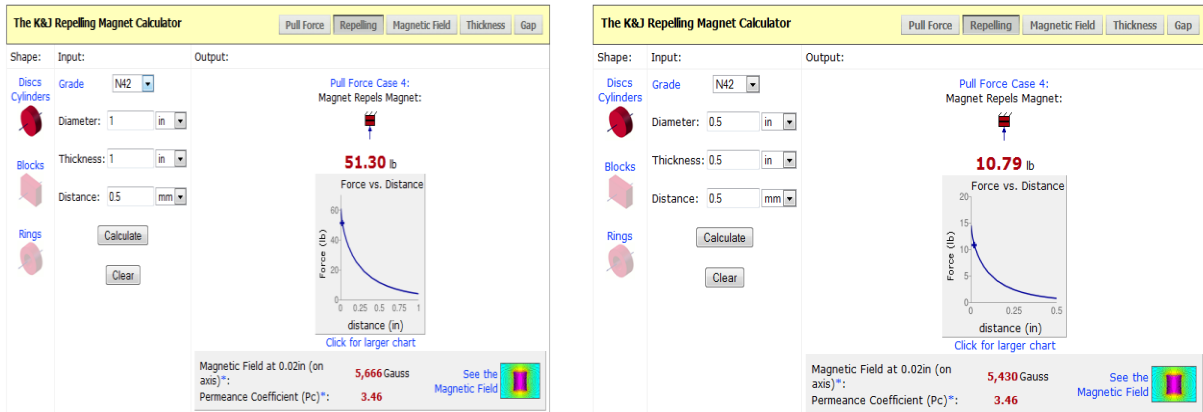


Figure 3. Force analysis of 1 inch and 0.5 inch magnet

Power is the rate of work done per unit time. The expression of mechanical work done derived in below,

$$Power = \frac{Work}{time}$$

$$Work = Force \times distance$$

$$Power = Torque \times Angular\ velocity$$

$$Power = \frac{2\pi \times Speed \times Torque}{60}$$

This mechanical power is applied to the generator. The magnetic circular disc2 coupled with DC generator its generated electricity. The power output from the DC generator can be stored in batteries or used to drive any AC loads through an inverter. This modelling of repulsive magnet technique generated 2kVA power.

III. MATLAB SIMULINK OF UNINTERRUPTABLE POWER SUPPLY

This model, developed using the Simulink power system block set, comprises of components such as power electronic devices (full bridge and rectifier) and elements such as inductors, capacitors and resistors. The DC model used comprises of the battery (V_{batt}) and its respective resistance and lead wire resistance (R_{batt}) as well as the filter capacitor (C_{dc}) and a DC bus current measurement resistor (I_{dc} measure), which is of the order of micro-ohms as it is only used for DC bus current measurement using a multi-meter block. The output from the full-bridge block (A and B) comprises of the filter inductor and its resistance (L_f, R_{Lf}) and filter capacitor with damping resistor (C_f, R_{Cf}). Also included is the step-up transformer (T_x) and a non-linear load used for

analysis. The resistor ‘R measure’ is of the order of micro-ohms and is only used for load current measurement the same as ‘I_{dc} measure’. Shown in Table 1 are the specifications for the Matlab Simulink inverter model.

Table 1. Specifications of the 2kVA inverter

Parameter	Label	Value	Unit
Rated Power	-	2	kVA
Rated output frequency	f _{Load}	50	Hz
Rated output voltage	V _{Load}	240	V
Battery voltage	V _{batt}	24	V
Battery and lead wire resistance	R _{batt}	30	mΩ
DC filter capacitance	C _{dc}	88000	μF
Inverter switching frequency	f _{sw}	10	kHz
Inverter output frequency	2x f _{sw}	20	kHz
Filter inductor	L _f	10	μH
Filter inductor resistance	R _{Lf}	1	mΩ
Transformer turns ratio	N	18	-
AC filter capacitor	C _f	4	μF
LC filter damping resistance	R _{cf}	10	Ω

The PWM signals for each of the power electronic devices in the full-bridge come from the PWM generator block. This block allows for the switching frequency and number of inverter legs to be selected with all PWM signal multiplexed on a single bus into the full-bridge block (pulses). The input to this block (signal(s)) is the sinusoidal reference for the inverter. The reference for this model is generated from a sinusoidal reference generator in Simulink with load voltage RMS feedback and open-loop (no feedback) control.

IV. SIMULATION AND EXPERIMENTAL RESULTS

Simulation results for the Matlab Simulink inverter model developed in Figure 5 experimental results for the 2kVA inverter. Open-loop control allowed for the inverter model accuracy to be investigated without any effects caused by closed loop control. The load voltage RMS feedback control allowed for the accuracy of the complete system (power system and standard Simulink block sets) to be investigated. For each of these two control methods, linear and non-linear loads were connected to the inverter to provide two cases to compare the model accuracy.

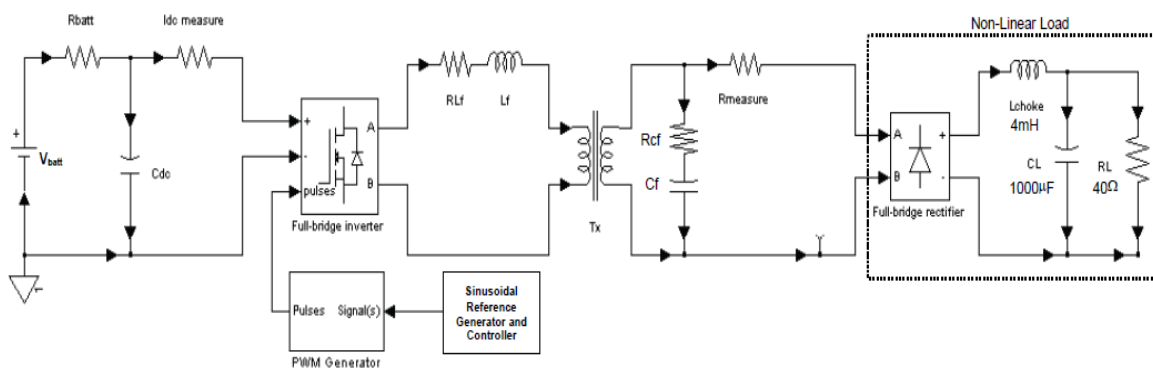


Figure 4. Matlab Simulink model of 2kVA Voltage Controlled Voltage Source Inverter with non-linear load

The non-linear load (considered a worst-case scenario) is shown connected to the inverter model in Figure 4 and comprised of a full-bridge rectifier, choke (L choke), filter capacitor (C_L) and load resistor (R_L). The choke or power factor correction (PFC) inductor was included as this is commonly used in power supplies to reduce the rate of change in load current (di load/dt), improving inverter performance. The DC ripple of the load was around 14%. The linear load comprised of only the load resistor (R_L) without the full-bridge rectifier, choke or capacitor. Signals measured were load voltage (V_{Load}), battery current (I_{batt}), filter inductor voltage (V_{Lf}) and current (I_{Lf}). The load current can be found from the filter inductor current as $I_{Load} = (I_{Lf}/N) - I_{Cf}$ and I_{Cf} is

generally much smaller than I_{Lf} , $I_{Load} \approx (I_{Lf}/N)$. For the experimental results only the DC bus voltage (V_{dc}) and battery current (I_{batt}) could be measured, and not the DC bus current (I_{dc}) as it was not accessible.

V. LOAD VOLTAGE OPEN-LOOP CONTROL

Open-loop control was used to compare the simulation and experimental results for the 2kVA inverter without the effect of the load voltage RMS feedback controller. For the Matlab Simulink model and 2kVA inverter, the modulation index was set to obtain 240V at no-load. The linear and non-linear loads were then connected to the inverter for comparison.

VI. LINEAR LOAD OPEN-LOOP CONTROL

Shown in Figure 5 (a) and (b) are experimental and simulation results respectively of the VCVSI with open loop control and the 2kW linear load ($RL=28.8\Omega$). For both results it can be seen that the load voltage has reduced from 240V to around 199V (83%), resulting in a reduced load power of around 1375W ($P_{Load} = V_{Load}^2/RL=199^2/28.8$). This can also be confirmed by equation (1) as given at the top left corner of Figure 5 (a) and (b). From the experimental results in Figure 5 (a) it can be seen that there is some distortion in the load voltage waveform at the zero crossing point. This is due to hardware dead-time used to provide a small time delay between the turning off of one switch and turning on of the other switch in the same full-bridge leg.

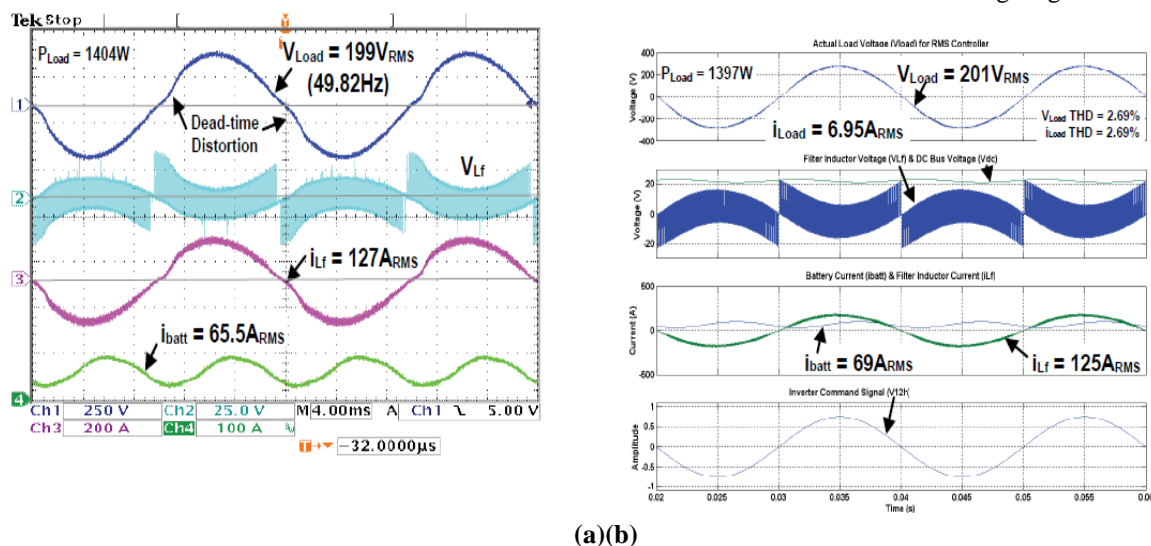


Figure 5. Single-phase VCVSI with open-loop control and 2kW linear load (a) experimental (b) simulation

VII. CONCLUSION

The proposed technology employs the theory of magnetic repulsion to utilize the free energy. The system uses permanent magnets to produce repulsion and this repulsive force produces a torque which drives a DC generator and Matlab Simulink model of a single-phase 2kVA UPS system based Voltage Controlled Voltage Source Inverter with load voltage control is modelled. The inverter model was developed with the Matlab power systems blockset while the load voltage controller was developed with the standard Simulink blockset. Open-loop control was used to show the accuracy of the model developed without the closed loop feedback. Matlab Simulink was shown to be a powerful tool for the development of a single-phase VCVSI and load voltage controller. Future scope of this work is to implement in industry to generate electricity.

REFERENCES

- [1] [1] N. Mohan, T. M. Undeland, and W. P. Robbins, *Power Electronics - Converters, Applications, and Design*, 2nd ed: John Wiley & Sons, Inc., 1995.
- [2] [2] "Matlab 6, Release 12.1." Natick, Massachusetts: The MathWorks (www.mathworks.com), 2006.
- [3] [3] "PSIM Version 7.0." Woburn, MA: Powersim Inc. (www.powersimtech.com), 2006.
- [4] [4] M. Trigg, "Digital Sinusoidal PWM Generation using a Low-cost Micro-controller Based Single-Phase Inverter," presented at ETFA 2005, Catania, Italy, 2005.
- [5] [5] M. C. Trigg, H. Dehbonei, and C. V. Nayar, "Digital Sinusoidal PWMs for a Microcontroller based Single-Phase Inverter. Part 1: Principles of digital sinusoidal PWM generation," *IJE Power electronics and instrumentation hardware*, 2005.
- [6] [6] H. Dehbonei, M. Trigg, and C. Nayar, "A Novel Sine wave Inverter for Harsh Environment," presented at AUPEC 2005, Hobart, Tasmania, Australia, 2005.
- [7] S. C. Mukhopadhyay, *Senior Member, IEEE*, J. Donaldson, G. Sengupta, *Member, IEEE*, S. Yamada, *Member, IEEE*, C. Chakraborty, *Senior Member, IEEE*, and D. Kacprzak, *Member, IEEE*, "Fabrication of a Repulsive-Type Magnetic Bearing Using a Novel Arrangement of Permanent Magnets for Vertical-Rotor Suspension" *IEEE TRANSACTIONS ON MAGNETICS*, VOL. 39, NO. 5, SEPTEMBER 2003.