Regeneration of Energy

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Abstract

In this project, we developed a system where it can regenerate energy and transform AC Voltage to DC Voltage and then charge a Battery. It is only possible to do that by programming a code where it says the motor 1 to run at certain speed and by connecting the first motor to another motor by using couplings , the first motor makes the second one run by its own rotation and through that we can regenerate energy in the other end, where it will output an AC Voltage and then transforming it into DC Voltage and then being able to charge the battery and then being able to determine how reliable this system is and checking if the results would increase or decrease based on the different capabilities of different sets of electrical motors and capacitors. And by plugging an Oscilloscope in the end of each step of the transformation we can see the transformation of the Wave in Ac to a Wave in DC.

Introduction

Nowadays, there are a lot of discussion about switching from Vehicles moved by fuel to electric vehicles. In first two months of Joe Biden as President, he started to talk about the ideas of until the end of his presidential time, he would try to make the companies to produce more and more Electrical Vehicles, which at one point is good, because it would make pollution decrease a lot in our country, but is it that reliable? How much effective is the restoration of energy process used in their vehicles? Is it worthy? Those questions that we are answering by doing my own Energy Restoration Process and seeing how the whole process works and how effective it can be.

When we received this project to do in partnership with E-Circuit Motors, the project was nothing of what it ended up becoming. In the beginning the plan was to see if we could figure out a way in which we would be able to increase to 50% the efficiency of a Motor Controller from a company called RoboTeq. Once we received this controller, we notice that the controller itself already had the feature of Regenerative Braking on it, so we wouldn't understand anything about the whole process of Regenerating Energy by using BLDC(Electrical) Motors if it was already built in the controller.

So, after we discovered that and also because there wasn't too much background or information that we were able to find from this specific controller, we decided to change our gears from increasing the effectiveness of the Regenerative Braking process in the system and instead focus only on the Regeneration of Energy process, and it was then that our Project really started, when we decided to understand and look into piece by piece of this process in order to build our own system to regenerate energy in order to fully charge a battery, know how long it would take to do it and how reliable it is and compare the results that we would have with different sets of components.

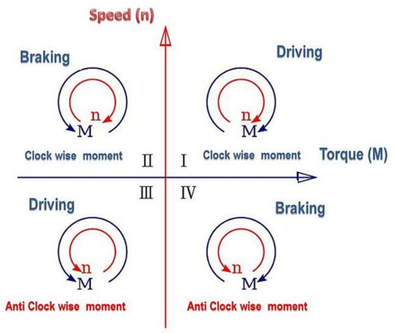


Fig. 1: Regenerative Braking Chart

Methods and Materials

The materials used for this experiment consisted of BLDC Motors, Arduino, RoboTeq, Schottky DIodes, V/I Regulator, ESCs, LiPo Batteries, and a Multimeter. Other materials included a DeWALT Drill, Resistor, Capacitors and Couplings of different diameter sizes to match the size of the motors.

The main method used for this project was the implementation of the Regenerative Braking Process method into BLDC Motors. This method consists of recycling the kinetic energy that would normally be lost when you brake the motor. With this process, however, the energy is sent back to the battery, and with that, resulting in a minimal loss in terms of energy when compared to braking a vehicle using a Brushed DC Motor[5]. However, in order to implement this method, we first needed to implement a rectifier so that the AC Voltage could be converted to DC Voltage. Said rectifier is made by connecting two Schottky Diodes of determined voltage and current, and then having it connected to one of the phases of the motor. Once the BLDC Motors reach those three phases, the process must be repeated three times. Once that is done, we connected all the GND and Power of each 2-Diode Connection together, so we could then connect those ends to the Battery which we want to charge through the system.

Once the rectifier is finished, it can now convert the AC Voltage that comes out of the BLDC Motor into DC Voltage. Once, connected to the Rectifier, the output of it passes through a Capacitor, to increase the amount of Voltage, then passes through a Voltage/Current Regulator where the values of Voltage and Current are step up to 15 Volts due to the fact that you can only charge a battery if there is more voltage than the battery have and once the battery we are using have 15V 1.5A, then the voltage and current coming out of the V/I Regulator needs to be equal or greater than those values in order to charge the battery, and also in order to not overcharge the battery, we also need a charging circuit in the end before connecting to the battery and being able to charge it. The two pictures below represent the Schematic and Physical Version of the circuit.

Fig. 2 - Schematic of the Regeneration of Energy System

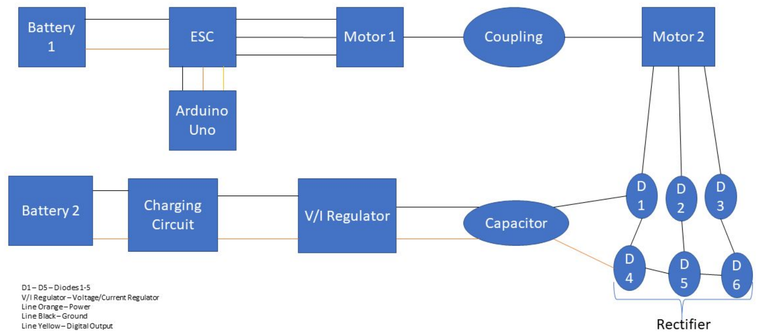
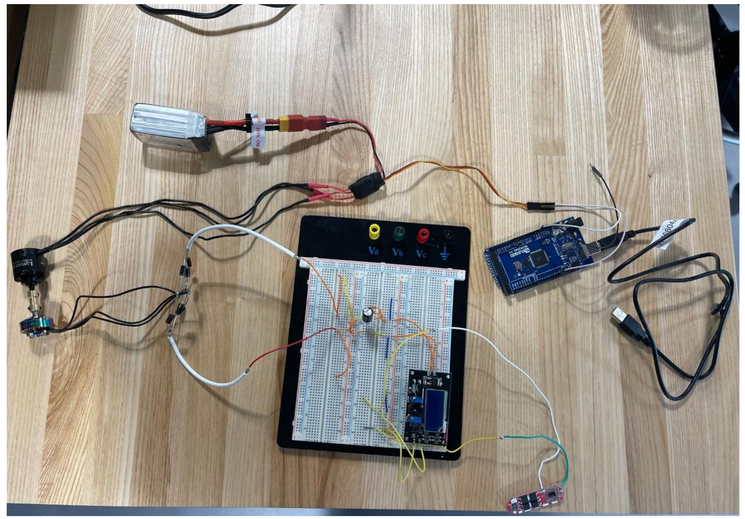


Fig. 3 - Physical form of the Energy Regeneration System



Results

By doing this entire process to regenerate energy through electrical motors, we were able to see that it is not as reliable as we thought, once the maximum results that we were able to have was a regeneration of energy from 10% up to 20% of the original power, which is normal for the size of the motors that we were using. Even though, it wasn't the perfect 50% that we would love to have, it is already something to be proud of. Throughout this study, we were able to find out how the energy regeneration process works and how it is done by doing it by our own from scratch by using two BLDC Drone Motors and two motors given to us by E-Circuit Motors, comparing the two motors and see that have huge differences between the two of about 10% of difference which means a lot. Also, I was able to design a whole base for the two sets of motor by my own way in my first time using a CAD Design Software. So, the results is not what we wanted in the beginning which was to hit the mark of 50%, but there is a feeling of fulfillment in the end.

Conclusions

In conclusion, this study was able to show to us that the reliability of the Regeneration of Energy in electric motors is not that reliable and that this area still has so much time to advance in order for people to fully switch from vehicles moved by fuel to fully electrical vehicles, even though the results gathered from this application are promising, there is still a huge amount of power being lost in this process and because of that, we don't see people making long travels with their electrical vehicles for reasons like the battery not being charged for too long, accessibility of charging areas in the driveways and much others. This project was an amazing learning experience in the sense of learning and understanding the area, seeing the background of it, and trying to see how could we transfor what we have in a Regeneration of Energy setup, also with some assistance of my Advisors from Sacred Heart University and from the E-Circuit Motors company, I was able to complete this study about the Energy Regeneration Process.

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