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Direct Control of Instantaneous Torque of Switched Reluctance Motor using ANFIS Controller in Generating mode and Motoring mode

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ABSTRACT

A flexible combination of vehicle modes and modified collision-brake vehicles can be used to control the quality of equipment and various processes. This type of SRM electric drive is very different from traditional electric drives in both construction and control. The paper looks at the design features of the SRD brake control system. According to it is proposed a novel algorithm for direct control of rapid torque. Analysis of the dynamics of electric and mechanical driving during the transition of adjacent sections is analyzed. The effectiveness of the proposed control method is proven by the simulation model. In addition, factors affecting the accuracy of the high-speed control system are analyzed.

Keywords: *Torque control in generating mode , SRD torque control, Using ANFIS controller, Controlling torque by current and flux rating*

CHAPTER-1
INTRODUCTION

Movement control of most production modes, vehicles, etc. It requires a flexible combination of the purpose and operation of electric brakes as part of their electric drive. Sloping motors (SRMs) have long attracted the interest of many professionals due to their constructive simplicity and comprehensive control tools [1]. But the concept of basic drive control (SRD) is very different from that of traditional electrical equipment. The basis of their theory is the mathematical interpretation of a standard (two-phase) electric motor with different currents according to the parallel axes d (to create a recreational flow) and q (to create torque), which rotates harmoniously to provide frequency. Using this model in the control system allows you to determine the amount of constant torque, that is not depending on the location of the rotor, in the sinusoidal phase currents in the static coordinate system (α, β).

The SRD operation consists of a series of phase rotations in specific rotor parts of the pool in a BLDC vehicle. But phase currents do not correspond in different directions, depending on the volume used, rotor speed, control angles, stator position and rotor tooth, and many other factors. As a result SRD without the use of special control methods has large pulsations of rapid torque. In extreme cases the amplitude of these pulsations can reach 100% of the normal value. At high speeds this does not make a special impact on the performance of the drive due to the moment of inertia. In this case the internal line of regulation can be the control of central torque. To get good performance at low speeds (such as servo drive) it is necessary to control rapid torque. Over the years significant progress has been made in setting up the SRD motive performance mode. Basically, a variety of architectural options and algorithms to compensate for the torque power are suitable. It is set that direct torque control has excellent features from the response time view, eliminating the use of power supply and regulation accuracy.

Very few texts are provided in SRD operating mode. In this case the main attention is paid to the purpose of power generation and the provision of other customers. The generated mode of operation is usually long-lasting and its important indicators are given power and electrical power and efficiency of power conversion. In the execution of the required performance measurement in this mode the appropriate frameworks and control algorithms are used [7 - 8]. From a strong point of view SRD brake operating mode is also a productive method, but it is usually shorter and more focused on control is similar to the motive mode - support for a set amount of electrical torque. In the case of base control algorithms, as well as the motive mode, the elevated torque height is also a SRD brake operating mode. Therefore, in comparison with the motive mode, it may be considered one of the best ways to reduce their direct control of torque, but its use in production mode has certain features as it needs to be considered. The purpose of this article is to develop a new SRD precise torque control algorithm in brake operating mode considering the performance-enhancing features.

CHAPTER-2
LITERATURE SURVEY

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CHAPTER-3
SWITCHED RELUCTANCE MOTOR

The concept of popular modified cars was invented in 1838 but the car could not see its full potential until the modern era of electric power and a computer that helps shape the power of electricity. SRM's are electrically powered AC machines and are known to be a flexible vehicle as read by Lawrenson et al (1980). They are more than a fast-paced, fast-paced magnetic field. It includes many of the desirable features of Induction-motor drive, DC commutator motor drive, and Permanent Magnet (PM) systems that do not hit DC. SRM is impressive and easy to build and economically compared to a compatible car and import car. They are known to have high torque-to-inertia ratios and the mechanical rotor structure is well suited for speed use.

Switched reluctance motor (SRM) is a type of motor that is doubled by phase coils attached to stator poles that are very opposite. There are no permanent windings or magnets on the Rotor. The rotor is actually a piece of metal (attached) and its structure forms important poles. The stator has coils. Switched (SRM) sloping motors have a simple and powerful structure, so they are generally suitable for speed use. High-speed motors take advantage of high power, which is an important problem for traction motors in electric vehicles (EV). Therefore, high-speed SRM seems to be promising the choice of this application.

CONSTRUCTION OF LIVING MOTOR LIVING MOTOR

The idle motor used has both important features of the pole stator and rotor, such as the flexible flexible motor (Nazar 1969), but is designed for different applications, therefore, it has different operating requirements. The slow-moving car is designed to make it suitable for open loop and speed control for low-end applications, where efficiency is not a factor. On the other hand a used anti-rotating car is used on flexible drives and is naturally designed to work well in a variety of speed and torque and requires a sense of rotor position.

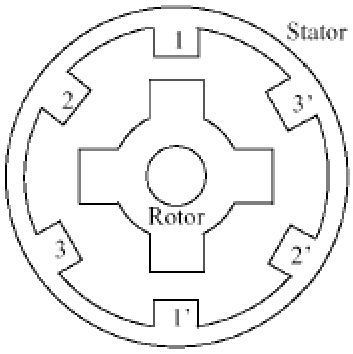


Fig 3.1 Switched Reluctance Motor

Here, the stator pole windings facing completely different are connected to the series and form a single phase. Thus, the six stator poles form three phases. When the rotor poles are aligned with the stator columns of a particular section, the section is said to be in parallel position. Similarly, if the axis in the center of the rotor is aligned with the stator columns of a particular phase, the phase is said to be in an unbalanced state.

SRM SYSTEM OF PERFORMANCE

SRM differs in the number of secure sections in the stator. Each of them has a certain number of suitable combinations of stator and rotor poles. A standard SRM Phase with a stator / four rotor pole suspension. The SRM Rotor is said to be in a relative position in relation to the specified phase if the current doubts are of low value (Corda et al 1979); and the rotor is said to be in an unbalanced position relative to the fixed phase when the current doubts reach its maximum magnitude. The car is happy with the sequence of current pulses used in each section. Each section is excited, forcing the car to spin. The current pulses should be applied in the correct phase in the rotor area directly in relation to the positive phase. When any of the rotor poles are exactly aligned with the stator poles of the selected phase, the phase is said to be in parallel position; that is, the rotor is in a state of high stator inductance.

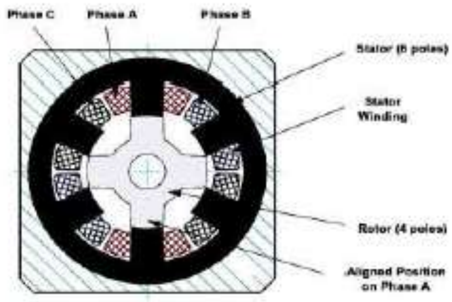


Fig 3.2 Three Phase SRM

CHAPTER-4

DC-DC converter

A DC-to-DC converter is a device that accepts DC input voltage and generates DC output power. The output output frequency is at a different level of power than input. In addition, DC-to-DC converters are used to provide noise, control of electric buses, etc. This is a summary of some of the popular DC-to-DC conversion features. The DC / DC booster converter is tested according to new concepts and the system model is lowered to various operating conditions considering the inductor resistance of the circuit. The region is efficient and the results obtained show the actual performance under the various operating modes. The main purpose of switching the DC / DC converter is to provide a DC-controlled voltage to the DC load in addition to a reduction in the size of the input converter where the input is the AC source. The technology to transform DC / DC rapid growth and mathematical study, which is incomplete reveals its existence about five hundred circuits of DC / DC converters.

Buck, Boost, Buck-Boost, and Cuk are the older types of DC-DC converters.
The old Buck - Boost converter can work to step up and down the DCDC converter, but it is important to note that the converter operates in a third-quadrant operating mode.

PLANNING

Depending on the separation between the input and output side, bidirectional converters are divided into two types. That's right
1. Indivisible Type
2. One type

UNBELIEVABLE DC-DC CHANGES WILL PASS

An undivided basic converter can be found in the ambiguity do not convert using bi-directional switches. Basic changes of buck and enhancements do not allow power flow on one side due to the presence of incompatible diodes devices. This problem can be solved using MOSFET or an anti-parallel IGBT diode that allows current to flow in both directions.

Mutable DC-DC variable variables
1. Multilevel converter
2. Replaced capacitor converter
3. Cuk / Cuk type
Sepic / Zeta type
5. Buck-Boost converter
6. Integrated inductor converter
7. Three-level converter

CHANGES IN INNER DEMONS
The remote type converter can operate at a wide range of power .the power is achieved through a power transmission in the circuit .but the converter only operates on AC supply.A AC connector in the region increases the complexity of the circuit.
Depending on the configuration, separated DC-DC converters can be divided into two categories:
1. A stand-alone current converter for bid -ctional DC-DC
2. A separate DC-DC power converter

The most common variables are:
1. Reverse converter
2. Transfer the reverse converter

3. Half bridge converter
4.Full bridge converter

BUCK Converter IS A STEP-TO-CONVERSION
In this circuit the rotation of the transistor will place the Vin voltage on the other side of the inductor. This voltage will usually cause the current inductor to rise. When the transistor is CLOSED, it will currently continue to flow through the inductor but will now flow to the diode. Initially we assume that the current through the inductor does not reach zero, so the voltage at Vx will now only be the voltage across the entire diode running at full OFF time. The medium voltage at Vx will depend on the medium time of the transistor as long as the current inductor continues.

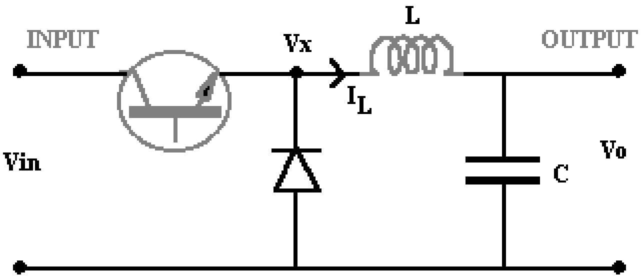


Fig 4.1 Buck Converter

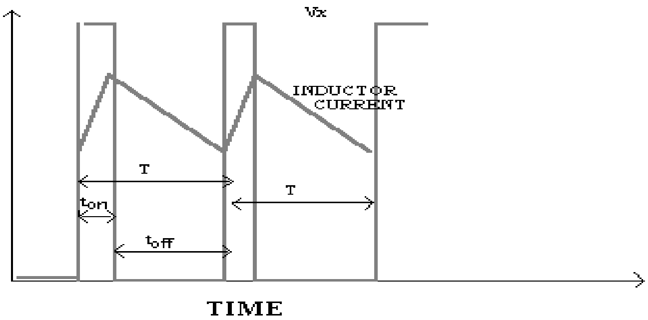


Fig. 4.2 Voltage and current changes

To analyze the volume of this circuit let us consider the current inductor change in more than one cycle. From a relationship

$$V_x - V_o = L\frac{di}{dt} \quad \text{.................. (1)}$$

the current change is satisfactory

$$di = \int_{ON}(V_x - V_o)dt + \int_{OFF}(V_x - V_o)dt \quad \text{.......... (2)}$$

With the current stable state function at the beginning and end of the period the T will not change. Finding a simple relationship between voltages does not take a voltage drop across the transistor or diode while on and changes the complete switch. So during ON Vx = Vin and OFF Vx = 0. Therefore

$$0 = di = \int_0^{t_{on}}(Vin - Vo)dt + \int_{t_{on}}^{t_{on}+t_{off}}(-Vo)dt \quad \text{...................... (3)}$$

This makes it easier

$$(Vin - Vo)t_{on} - Vo\ t_{off} = 0 \quad \text{............... (4)}$$

or

$$\frac{Vo}{Vin} = \frac{t_{on}}{T} \quad \text{............... (5)}$$

and defining a “performance measure” as

$$D = \frac{t_{on}}{T} \quad \text{.......... (6)}$$

The power relationship becomes Vo = D Vin As the circuit is cashless and the input and output power must be the same as the normal Vo * Io = Vin * Iin. The current input and output value must therefore satisfy Iin = D Io This relationship is based on the assumption that the current inductor does not reach zero.

The transition between continuity and non-continuity
Where current in inductor L remains constant it is likely that transistor T1 or diode D1 should operate. With continuous operation the Vx voltage can be Vin or 0. If the current inductor has reached zero then the output power will not be forced into any of these conditions. At this point the current transition reaches zero as shown in Figure (buck booster boundery). During ON Vin-Vout is across the inductor that way

$$I_L(peak) = (Vin - Vout) \cdot \frac{t_{on}}{L} \quad (7)$$

The current medium that should match the current output time is satisfactory

$$I_L(average\ at\ transition) = \frac{I_L(peak)}{2} = (Vin - Vout)\frac{dT}{2L} = Iout(transition) \quad (8)$$

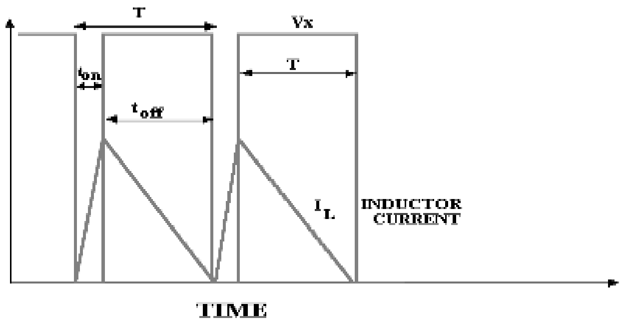


Figure 4.3 Buck Converter Border

If the input voltage does not change the current output in the transition area is satisfactory

$$Iout(transition) = Vin\frac{(1-d)d}{2L}T \quad (9)$$

Buck Converter Voltage Ratio (Stop Mode)
For the continuous analysis analysis we use the fact that the electrical conductivity in the inductor is not zero in the T-switching cycle. The transistor OFF time is now divided into components of diode conduction ddT and zero conduction doT. The medium inductor power provides so

(Vin - Vo) DT + (-Vo) □dT = 0 (10)

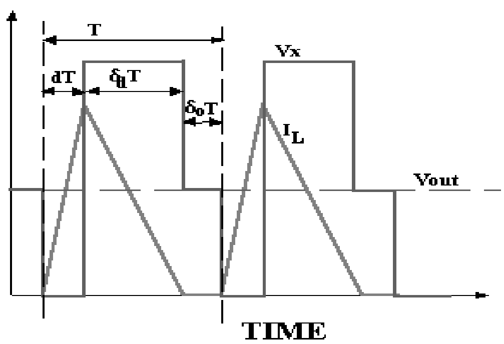


Figure 4.4 Buck Converter - Discontinued Processing

$$\therefore \frac{Vout}{Vin} = \frac{d}{d + \delta_d} \quad (11)$$

of the case. Resolve the value of the current output consideration which is part of the maximum value when in the middle of the operating times

$$Iout = \frac{I_L(peak)}{2} d + \delta_d \quad (12)$$

If you look at the current change during diode operation

$$I_L(peak) = \frac{V_0(\delta_d T)}{L} \quad (13)$$

So from (6) and (7) we can find you

$$I_{out} = \frac{V_0 \delta_d T \cdot (d + \delta_d)}{2L} \quad (14)$$

using the relationship in (5)

$$Iout = \frac{Vin\, d\, \delta_d T}{2L} \quad (15)$$

and resolving diode processing

$$\delta_d = \frac{2L\, Iout}{Vin\, d\, T} \quad (16)$$

The output power is thus provided as

$$\frac{Vout}{Vin} = \frac{d^2}{d^2 + (\frac{2L\, Iout}{Vin\, T})} \quad (17)$$

Explaining k * = 2L / (Vin T), we can see the current stop effect on the converter power.

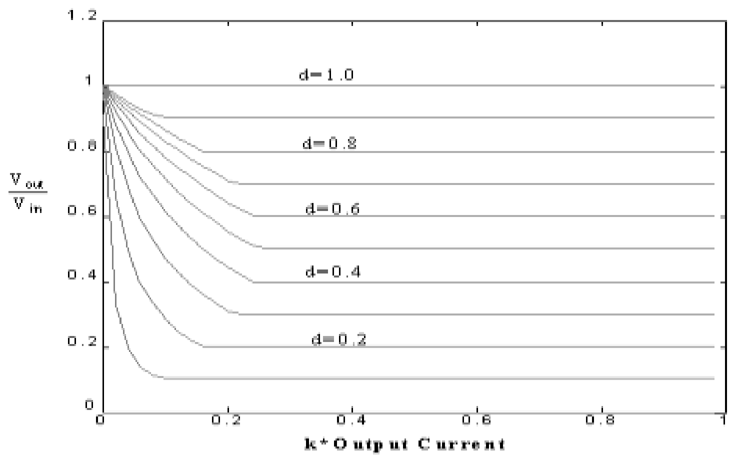


Figure 4.5 output current Voltage vs Output

As seen in the figure, if the output current is high enough, the power output depends only on the "d" function ratio. On low-end radios the suspension performance often increases the output power of the converter toward Vin.

THE FIRST STORE CHANGE

The scheme in Fig. 6 shows the basic converter converter. This circuit is used when higher power output is required than input.

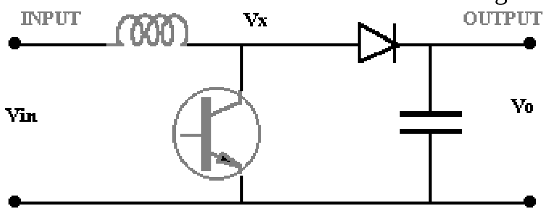


Fig. 4.6 Boost Converter Circuit

While the transistor is on V V = = Vin, and OFF means that the current inductor flows through a diode supplying Vx = Vo. In this analysis it is assumed that the current inductor remains constant (continuous conduction). The volume power across the inductor is shown in Fig. 7 and the ratio must be zero so that the current ratio remains stable

$$Vin\, t_{on} + (Vin - Vo)t_{off} = 0 \quad \text{………… (18)}$$

This can be rearranged as

$$\frac{Vo}{Vin} = \frac{T}{t_{off}} = \frac{1}{(1-D)} \quad \text{………. (19)}$$

and in a non-losing cycle the balance of power ensures

$$\frac{Io}{Iin} = (1-D) \quad \text{……… .. (20)}$$

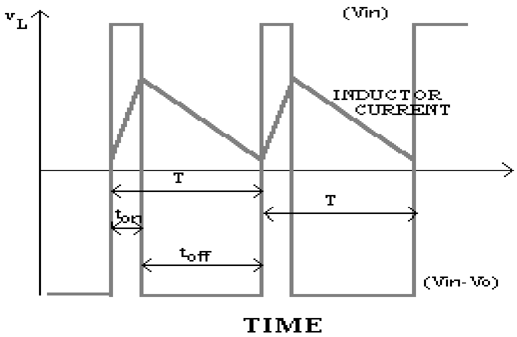


Fig 4.7 Voltage and current waveforms (Boost Converter)

Since the work value "D" is between 0 and 1 the output power must remain higher than the input power intensity. A bad sign indicates a change in the concept of a power output.

The old Buck-boost converter has a big problem: it is impossible to get the output voltage of the same input voltage, low output voltage and high output current (with widespread requirements for computer equipment and industrial applications) is not available, good output voltage at the same time not available, low power transfer gain, connection between input and output, and single quadrant operating mode. The region is analyzed for various operational and related approaches the required formulas are reduced. Converter test is also introduced according to new concepts based on circuit power analysis. The design of the converter is also presented in this paper. The transforming region is made and used almost.

In a DC-DC converter, the dc output power level must be controlled to match the desired level, using the input and output voltage may vary. In a DC-DC converter with a given input power, the central output power is controlled by controlling the turn on and off. One of the output power control methods uses a constant frequency change and adjusting the duration of the control time to control the output power medium. In this method, called pulse width modulation (PWM) switching, the function of D, which is defined as the measurement of time and time of change, varies. Variation in switching frequency makes it difficult to filter ripple material into wave input and output methods converter.

In the PWM switch mode, the switch control signal, which controls the switching condition, is made by comparing the voltage level control voltage with a recurring waveform. The frequency of the dynamic form of the dynamic is always higher, establishing the frequency of the change. This frequency is maintained without PWM control and is selected to be within a few kilohertz to a few hundred kilohertz range. The comparison effect is high where the recurring signal is greater than the control signal other than the output is zero.

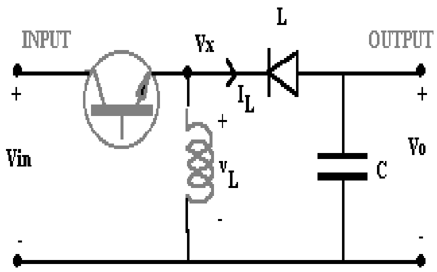


Figure 4.8 Buck-boost converter

With continuous operation of the Buck-Boost converter Vx = Vin when the transistor is turned on and Vx = Vo when the transistor is OFF. With the current change of zero net at some point the average voltage across the inductor is zero.

$$Vin\, t_{ON} + Vo\, t_{OFF} = 0 \quad \text{………… .. (21)}$$

providing a measure of electrical energy

$$\frac{Vo}{Vin} = -\frac{D}{(1-D)} \quad \ldots\ldots\ldots\ldots (22)$$

and the corresponding current tense

$$\frac{Io}{Iin} = -\frac{(1-D)}{D} \quad \ldots\ldots\ldots .. (23)$$

Since the "D" function ratio is between 0 and 1 the output power may vary between lower or higher than the input power in size. The negative sign indicates a change in the concept of output power.

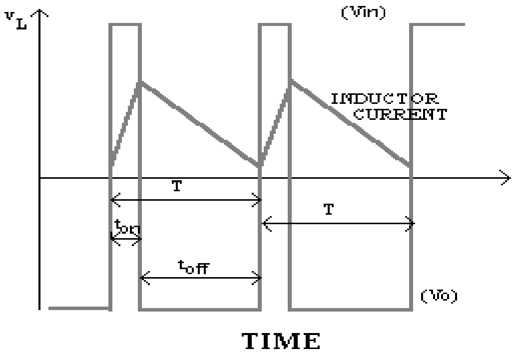


Fig. 4.9 Waveforms buck-boost converter

CHAPTER-5
PULSE WIDTH MODULATION
Pulse Width Modulation (PWM) is the most effective way to achieve power battery charging by switching solar power control devices. In the PWM regulation, the current output from the same solar panels according to the battery status and refill requirements Consider the shape of the waves as follows: it is a voltage change between 0v and 12v. It is quite clear that, since the voltage is at 12v as long as it is at 0v, then the 'appropriate device' connected to its output will detect the average voltage and assume that it is supplied to 6v - exactly half of 12v. So with a wide range of good pulse widths - we can vary in 'medium' power.

Similarly, if the switches keep the voltage at 12 to 3 times the length of 0v, the ratio will be 3/4 of 12v - or 9v, as shown below and if the 12v output voltage remains only by 25% of the time, then the rate says

By rotation - or ‘modeling’ - the time when the output is 12v (e.g. positive pulse width) can change the central voltage. So we do ‘pulse width fluctuations’. I said earlier that the output should feed the 'right tool'. The radio wouldn't work on this: the radio would see 12v and then 0v, and it might not work properly. However a car-like tool will respond in moderation, so PWM is inherently automated.

PULSE WIDTH MODULATOR
So, how do we produce a type of PWM waveform? In fact it is much simpler, than the circuits found on the TEC site. First it produces a triangular wave format as shown in the diagram below. You compare this to a dc voltage, which you change to control the closing rate and the time you need. When the triangle is above the 'required' power, the effect goes up. When the triangle is below the required electrical power, the When demand is accelerated in (A) you get out of 50:50, like black. Half time output is high and half time is low. Fortunately, there is an IC (integrated circuit) called a comparison: these usually come in four parts in one package. One can be used as an oscillator to produce a triangular form and the other to make comparisons, so a complete oscillator and modulator can be made with part of the IC and perhaps another 7 pieces.

The triangular waveform, with equal mountains of rising and falling, is one of the most widely used, but you can also use a saw tooth (where the voltage drops quickly and washes off a bit). You can use other waveforms and direct linearity (how good the ups and downs are) is not very important. Electronic solenoid driver for direct control, which is the application of the results in a complete square area. (Figure 5.1)

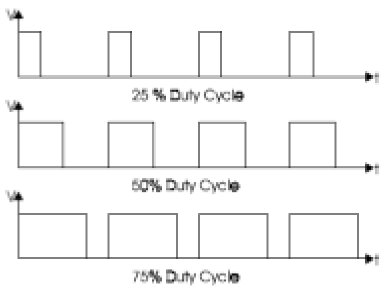


Figure 5.1

The solenoid length of the wire wound on the coil. As a result of this adjustment, the solenoid has, in addition to its resistance, R, a certain inductance, L. When a voltage, V, is applied to all idle, current, I, produced in that element does not jump to its fixed value, but it gradually rises to its peak at a time called the resurrection time (Figure 5.2). On the other hand, I do not disappear immediately, even if the V is suddenly removed, but decreases back to zero at the same time as the wake-up time.

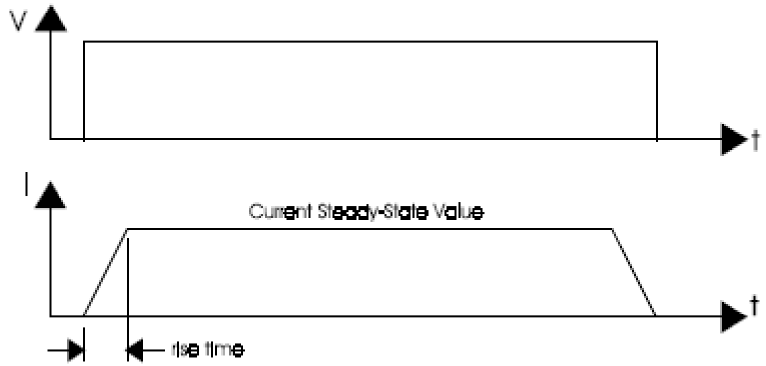


Figure 5.2

Therefore, when a low-volume PWM voltage is applied to the solenoid, the current in it will increase and decrease as the V turns on or off. If D is shorter than the rise time, I will never find its maximum value, and I will stop because it will return to zero by the end of V (Figure 5.3). Conversely, if the D is greater than the time to rise, I will never go back to zero, so it will continue, and I will have a normal DC value. For now it won't always be, but there will be a problem.

In high wavelengths, the V turns on and off very quickly, except for D, as the current does not have time to go down too far before the power is turned on again. Currently emerging with solenoid is considered static. By adjusting the D, the current output value can be controlled. With a small D, the current will not have much time to rise before the high frequency PWM starts to work and the current remains constant. With a large D, the current will be able to rise to the top before it remains constant.

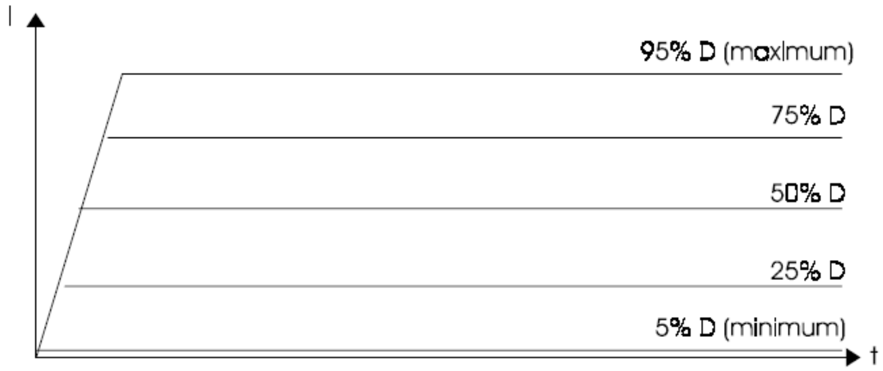


Figure 5.3

WHY PWM VALUATION IS IMPORTANT:

PWM is a large digital amplitude signal that switches from one extreme voltage to another. Also, this wide range of power fluctuations takes a lot of filter to smooth out. When the frequency of PWM is close to the frequency of the wave form you produce, then any PWM filter will also improve your generated wave form and significantly reduce its magnitude. Therefore, a good sixth rule is to keep the PWM frequency much higher than the frequency of any type of wave you are building.

Finally, filtering the edges is not just about the frequency of the heartbeat but also about the cycle of activity and how much energy is in the soul. The same filter will perform better on the pulse of the low or high activity cycle compared to the pulse cycle of 50%. Because broader heartbeat has more time to combine with stable filtering power and less heartbeat with less time to distract you was an application to control the speed of a good gasoline pump to move. The pump was limited to allow the full power of the engine amplified above 600 Hp.

In an idle cruise or highway cruise, this same engine requires very little fuel but the pump still delivers the same amount of fuel. As a result, the fuel is returned to the fuel tank, which burns the fuel unnecessarily. This PWM control circuit is designed to move the pump at low speed during low power and allow full pump speed when required at high engine power levels.

PWM DIRECTOR RESULTS:

This controller provides the basic setting of “Hi Speed” and “Low Speed” and has the option to use the “Progressive” acceleration between Low and Hi speeds. The low speed is set by the reduction pot inside the control box. Usually when you enter the control

SINUSOIDAL PULSE WIDTH MEASUREMENT:

In many industrial applications, Sinusoidal Pulse Width Modulation (SPWM), also called Sine coded Pulse Width Modulation, is used to control the inverter output voltage. SPWM maintains good drive performance throughout the operating range between zero and 78 percent of the value that can be achieved with square operation. If the volatility indicator exceeds this value, the linear relationship between the volatility indicator and the output power is not maintained and override methods are required

VECTOR PULSE WIDTH MODULATION:
The SPWM alternative is based on the vector representation of power space in plane d, q. The elements d, q are found in Park transform, where total power, and impedance, remain unchanged.

Fig: a vector of space indicates 8 space carriers according to the 8 inverter switch positions, V * is the phase-to-center voltage obtained by carefully selecting the nearest vectors V1 and V2.

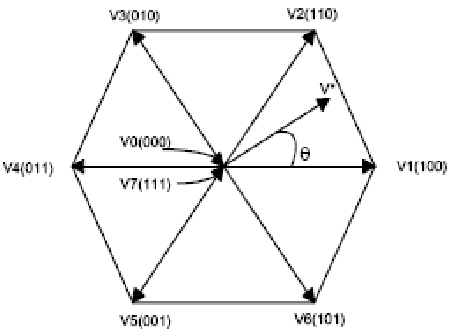


Figure 5.4 to extract the voltage space vector space

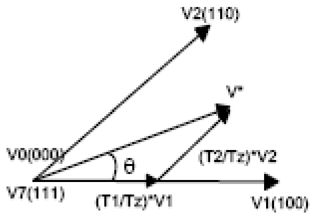


Figure 5.5 Determining the turnaround times

The vector space vector V * is given by Equation (1), where T1, T2 are intervals for the use of vector V1 and V2 respectively, and zero vectors V0 and V7 are selected for T0.

$$V * Tz = V1 * T1 + V2 * T2 + V0 * (T0 / 2) + V7 * (T0 / 2) \ldots\ldots\ldots .. (4)$$

SPACE VECTOR PULSE WIDTH CERTIFICATE (CONTINUED)
The diagram below shows that the inverter status of the inverter T1 for vector V1 and vector V2, resulting in changing the patterns of each inverter phase. Pulse pattern of space vector PWM.

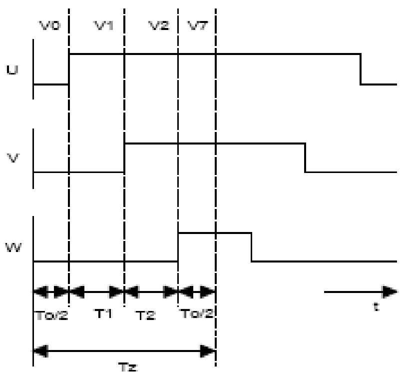
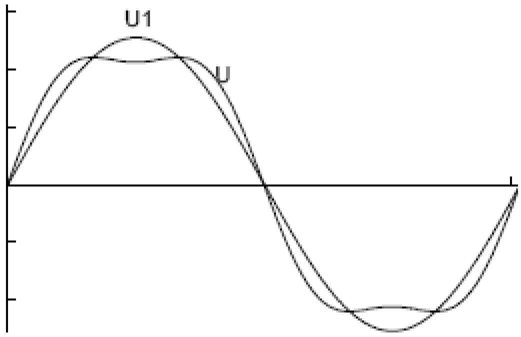


Figure 5.6 for Inverter switching for (a) V1, (b) V2



Pattern Fig 5.7 Pulse of Space vector PWM

COMPARISON

In Fig: - for comparison, U is a central phase power component consisting of three-order harmonics produced by the space vector PWM, and U1 is a sinusoidal reference voltage. But the harmonics of the three orders do not appear in phase-to-phase electricity either. This leads to a higher exchange rate compared to SPWM.

COMPARISON OF SPWM AND SPACE VECTOR PWM

As mentioned above, SPWM achieves only 78 percent of square wave performance, but the maximum voltage is 90 percent of the wavelength in the case of the PWM vector. High phase-to-center strength with sinusoidal and space vector
PWM respectively

Vmax = Vdc / 2: Sinusoidal PWM

Vmax = Vdc / -3: Space Vector PWM

There, Vdc is DC-Link.

This means that the Space Vector PWM can produce about 15 percent more Sinusoidal PWM in output power.

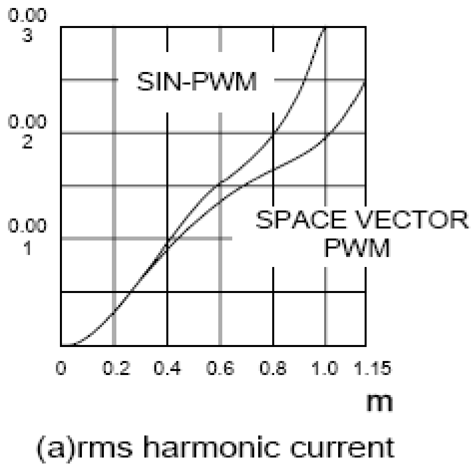


Fig 5.8 Rms is a harmonic current

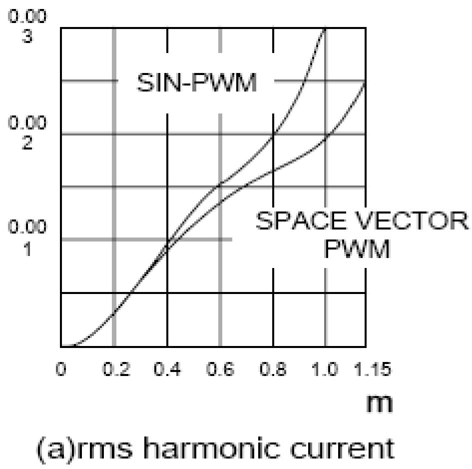


Figure 5.9 of torque harmonics

SVM PWM TECHNIQUE:

The Pulse Width fluctuation process allows for the detection of third-phase voltages, which can be used in a controlled output. The Space Vector Modulation (SVM) system differs from other PWM processes in that all three inverter drive signals will be built simultaneously. Implementing the SVM process in digital systems requires less operating time and less system memory.

The SVM algorithm is based on the principle of space vector u *, which describes all three output values of ua, ub and uc:

u * = 2/3. (ua + a. ub + a2. uc) ……… (5)

When a - 1/2 + j. v3 / 2 We can divide six categories determined by different vectors u 0 u7 (fig: - inverter output voltage space vector), corresponding to 23 = 8 conditions that can change the inverter power converter.

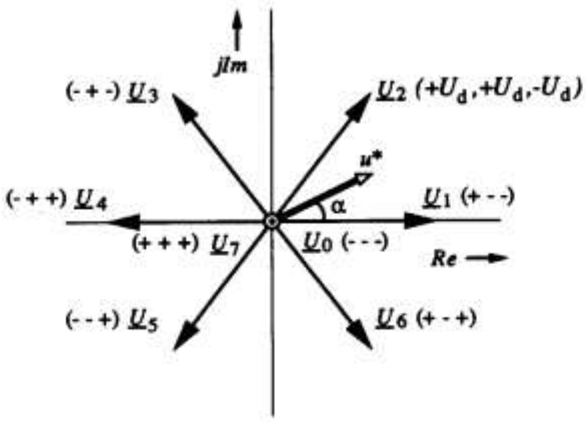


Figure 5.10 Vertical spacing

The width of u0 and u7 is equal to 0. Some 1… 6 vectors have the same amplitude and are rotated by 60 degrees.

By changing the corresponding time to change the Tc of different vectors, vector u * and the output effects of ua, ub and uc can vary and are defined as:

$$Ua = Re (u *)$$

$$ub = Re (u *. a-1)$$

$$uc = Re (u *. a-2) \ldots\ldots\ldots\ldots (6)$$

When changing the Tc and considering for example the first field, the vectors 0, 1 and u2 will be opened differently.

Fig. 5.11 Description of the Space vector

Depending on the t0, t1 and t2 change times the vector u * space is defined as:

$$u * = 1 / Tc. (t0. u0 + t1. u1 + t2. u2)$$

$$u * = t0. u0 + t1. u1 + t2. u2$$

$$u * = t1. U1 + t2. U2 \ldots\ldots\ldots\ldots .. (7)$$

Where

$$T0 + t1 + t2 = TC \text{ again}$$

$$t0 + t1 + t2 = 1$$

t0, t1 and t2 are related values of the transition times.

They are described as: $t1 = m. \cos (a + p / 6)$

$$t2 = m. \sin a$$

$$t0 = 1 - t1 - t2$$

Their values are used in the variance table m = 1. After that it will be easy to calculate the vector u * and the output values of the ua, ub and uc. Voltage vector u * can be provided directly by the rules that govern vector w1, vsa and vsb. In order to generate the phase values au, ub and uc corresponding to the voltage vector you want a high SVM strategy is proposed.

Category Shifted Multi-carrier Pulse Width Modulation Phase Shifted Pulse Width Modulation (PSPWM) is one of the flexibility schemes based on network or multilevel inverters. In PSPWM, triangular carriers have the same frequency and the same size but the phase is moved by an angle. No. of triangular carriers requires five inverter levels provided

$$N = (m-1)$$

The phase shift between any nearby carrier waves is provided by

$$\phi_{cr} = \frac{360°}{(m-1)}$$

The most prominent harmonic frequency in inverter output power

$$f_{sw,inv} = 4m_f * f_m$$

Determines the variable frequency of the inverter fsw inv In the five levels of CHB switching, the main harmonics in the phase and line lines are distributed at about 4mf. The word mf means indicator of frequency fluctuations (network signal frequency (fcr) basic signal frequency (fm). Inverter frequency frequency is given by

The inverter requires a small filter of output. A large amount of the current current flows through the inverter switch when the inverters are asked to generate a signal.

CHAPTER-6
EXISTING SYSTEM

Features of SRD production method

We will look at specific features of the productive mode on the basis of SRD test oscillograms for dental adjustment ZS / ZR = 8/6 and simplified power scheme versions of one phase. We will start by selecting the same function as the external UDC source

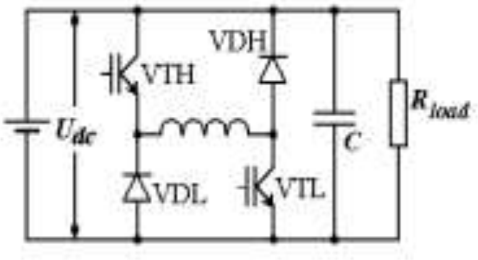


Figure 6.1. One SRD power scheme works similarly to an external UDC.

An oscillogram of SRD performance in mode construction, showing the most common occurrence of the various types of transistors switching is given in Fig. 2. Displays current Ia, Ib, Ic, and Id current signal signals, Idc_a between DC and phase A connector, voltage Udc, voltage phase phase A.

The conditions provided are: rotational speed n = 188 RPM, current limit setting in motive mode IMOT_LIM = 7 A, current limit setting in productive mode IGEN_LIM = 10 A, Rload = 50 Ohms. The 30% difference in the current settings of the transmission control limit and the low speed allows to view all 5 stages in the current Ia phase. The entertainment phase begins at the angular rotor θON = θON + U, which is controlled by the commutator phase. In space (t0… t1) both transistors are illuminated, a positive voltage is applied to phase A and there is excitement. This process is similar to the stage entertainment phase in the SRD motivational mode of operation, but occurs with a much larger number of phase interventions. The increase in current due to a decrease in power is maintained in the DC condenser connector C. This is reflected in the reduction of UDC. The current increase can also be stimulated by the circulating EMF, if the incremental phase can be made in the reduction phase of the reduction phase.

When point t1 Ia current reaches the IMOT_LIM value causing a single switch off, for example VTH. Ia is short of constant VTL switch and a suitable VDL diode diode, transmitting power supply. The stage turns into a short state, which lasts a lasting connection. The rise of Ia continues due to a decrease in phase induction, which is caused by the reduction of the scattered teeth in the area around the rotor. Over time t2 current Ia reaches the value of IGEN_LIM resulting in a second shutdown of VTL. Ia flows through VDH and VDL as opposed to a power source. Apply to the section Uph <0 causing a drop in Ia, forcing the current controller

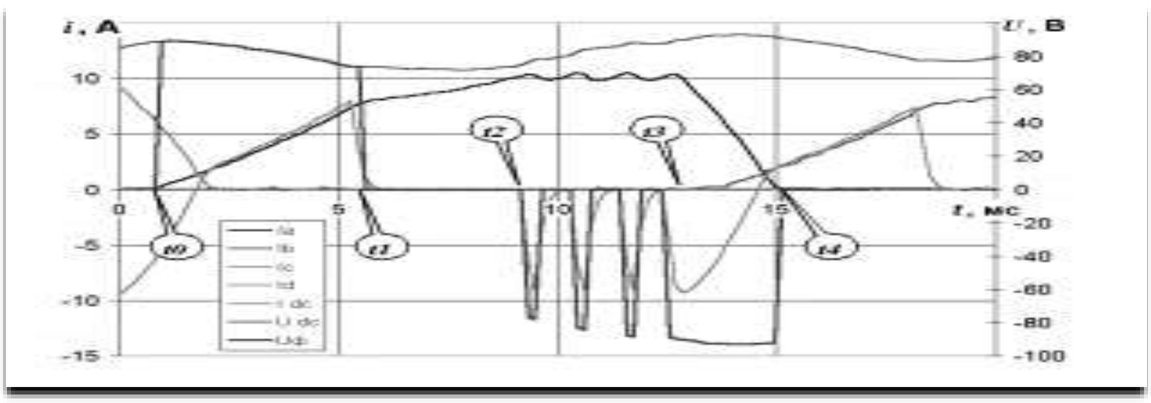


Figure 6.2. Section Switch cycle

repeatedly change the VTL, and disconnect the section on the DC link, then repeat it. Ia begins to increase again. The current adjustment process at IGEN_LIM = 10 A level is followed by an increase in Udc, which indicates the conversion of magnetic field to electrical energy. The current control function is operated in time zone t3, when both phase A switches are turned off and both phase B switches are turned on. In space (t3… t4) the current Ia flows through the VDH and VDL link to DC, which increases the UDC to the current Ia under the current load load and the current opening phase. At current t4 Ia = 0 until a new phase A is opened by the passenger

To evaluate the efficiency of the phase power conversion cycle it is easy to apply Ψ (i) image phase. Current flow phase connection values are calculated in the formula

$$\Psi(i) = \int_0^t U_{PHASE}(t)dt \qquad (1)$$

The point of detection of production mode is clockwise in direction 0-B-C-D-0 and the area of the closed number SOBCD is equal to the total value of the machine | WMECH | transformed one phase of the switching cycle. The curvilinear triangle position of the SOAB is equal to the WECIT energy consumed in the DC link in the entertainment phase - the time interval (t0… t1). Sum SOBCD + SOAB is the power supply back to DC connector.

We define the coefficient of electromechanical transformation of energy for the generating mode as the ratio of transformed mechanical energy towards the recuperated energy energy.

Work like an unlimited power network

We begin to explore possible ways in which SRD work is considered in conjunction with the unlimited power network, which is compatible with the Fig. System. 1 and UDC status = const. In this case the intermediate power of PGEN or WGEN power, generated by the generator, does not depend on the load resistance as its deficit or excess associated

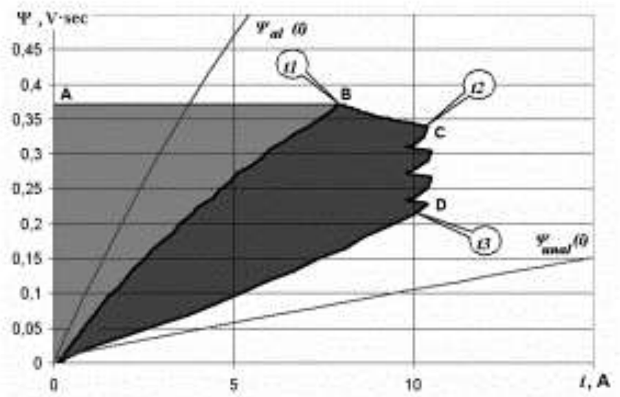


Figure 6.3 The picture section of the section A of the switch circle

Power Upload, used for uploading, is always compensated by an external source (accumulator battery). In contrast to the trigger mode the amount of power generated depends on the UDC voltage, the angles of the opening and closing phase and the speed n. In Fig. 4 PGEN (UDC) dependence is shown under some fixed conditions (solid lines). The curve in the case of PWM = 100% (red line) represents the maximum binding of the SRD power supplied to the DC connector under adjusted conditions. The termination of power growth in the event of UDC> 300 V is caused by the action of the current limit. If there is any UDC power control the red line can be obtained in a variety of ways, for example due to the reduction of the PWM setting in the entertainment category (t0… t1). The probability of such control is indicated by the curve PWM = 95% and PWM = 90%.

Independent operation of the opposing upload

As previously mentioned, the performance of the SRD in conjunction with the unlimited power network assumes that the load resistance value does not affect the performance of the SRD. The situation changes in the event of offline SRD operation in the production mode in the resistive line (power supply is used only for initial condenser C charging, then disconnected). Balance mode can only be in the case of PGEN = PLOAD. In the event of PGEN> PLOAD more power will be used to increase the power stored in the DC condenser connector, which will lead to further growth of UDC until the status of PGEN = PLOAD i

Work with different fun and uploading circuits

Obtaining SRD's stable operation in full production mode and improving its repair features is possible with different entertainment and loading circuits (Figure 5). As well as network-like operation, PGEN generating power control can be achieved due to the conversion of PWM switch VTH to the opening stage, due to the conversion of PWM switch VTL in its operating phase, and due to the switching of all switching angles (θON + U , θOFF + U, θOFF). The difference is that the voltage in the loading will not remain constant, and will increase with the growth of PGEN. Also, such a system would be unreasonable with the motive mode as the power of the stage closure stage can be restored to the power supply, and is completely depleted to the Rload. The great interest in the operation of the SRD in all four quadrants of mechanical markers represents a supply case from a fixed source. In Fig. 6 is displayed by inserting a VD0 diode into the source circle. The integration of the SRD generator and RLOAD generator between them is possible with the DC / DC converter switch. As an example in Fig. 6 DC DC / DC ¬converter is displayed. In the simplest case only VT1 can be used by the UDC referral controller. The setting of this controller must be slightly higher than the operating capacity of the motive mode. In such control and the corresponding selection of the Rload value SRD function in the second and fourth quadrants falls into an independent state with variable load loading or continuous UDC value due to the operation of the VT1 Mechanical switch transmitter controller in binding mode can be

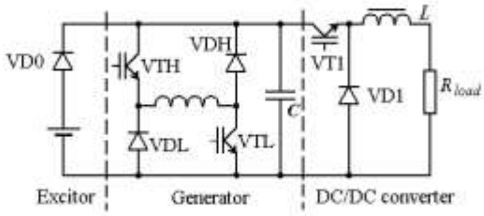


Figure 6.4. Separate interesting and loading regions with DC / DC converter

Modified demand by the use of closed regulation systems for medium or fast torque values [1]. From the analysis made it follows that the required amount of SRD torque in the breakdown mode can be found in various combinations of control actions and interfering influences. Figure 7 can serve as an illustration where Ψ (i) curves of three different angles with approximately the same WMECH values are shown.

Control actions:

--ON – Opening phase angle – use voltage + UPH PWM + - set

PWM of + UPH θU = 0 - turn off angle + UPH - short circuit

ΘOFF – angle of extinguishing phase – enter voltageUPHUPH PWM− - set

PWM for H UPH IMOT_LIM - current limit level in motive mode

IMOT_GEN - current limit level in generator mode Basic interference effects:

N ≡ f – rotor speed equal to the frequency of phase shifts

Load load of UDC - DC voltage voltage includes its deviation And in the construction of closed loop control systems it is necessary to consider whether the dependence of torque on the above-mentioned elements can be connected and inconsistent.

DIRECTION OF SRD CONTINUATION VIEWER IN BRAKE PERFORMANCE MODE

An effective diagram of the precise torque control system of m-phase SRD for brake operating mode is shown in Fig. 6.5. In a general sense it repeats the control structure, previously considered by the authors in the SRD operating mode [6]. The control system consists of a module, which measures the total torque value of TΣ by its components TPH, 1… m from each phase incorporated in the current, and the transmission torque controller, which creates the control signals UPH1… m, that the commutator phase converts sign -S1… m for proper switching of the inverter. The set torque value signal T * accepts the installation of the torque controller.

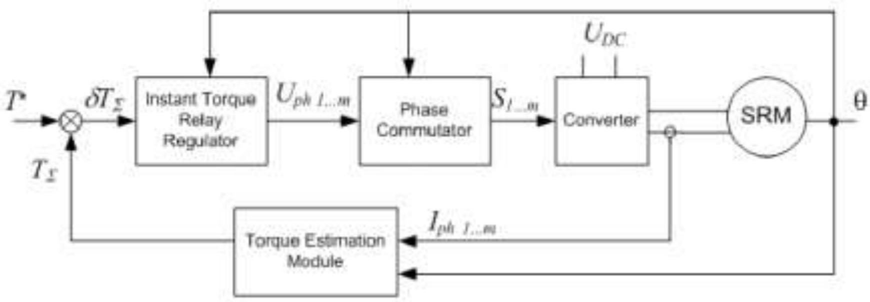


Figure 6.5 Effective diagram of direct SRD direct torque control in brake operating mode

SRD torque control in brake mode is provided using a phase power algorithm such as () ph U ph = UDC ignsign δT. By reducing the switching frequency of the inverter transistor the hysteresis area with ngobT diameter is included in their performance algorithm. Also, their third condition, when the SRD phase is closed with a short circuit, is used, i.e. Uph = 0. Therefore, the operational feature of the rapid torque transmission controller is shown in Fig. 6.6

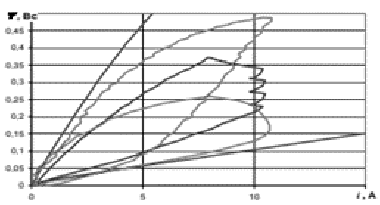


Figure 6.6. I (i) under different circumstances and WMECH ≅ const

It is usually some difficulty in the SRD brake mode assembly compared to the motive mode caused by the phase shift. Due to the large failure of obtaining the required starting value of the current IPH in the operating phase it is necessary to use the phase that generates full power supply for a longer period of time, rather than the motive method. Alternatively, as mentioned above, the entertainment category can proceed in sequence into three categories (dL / dθ> 0, L = const and dL / dθ <0). However in the event of direct torque control the high accuracy of the set θON angle is generally not required as the deviation of the torque, which has arisen as a result, can be compensated for by the operation of the adjacent phase.

SRD motor Simulink model in brake operating mode

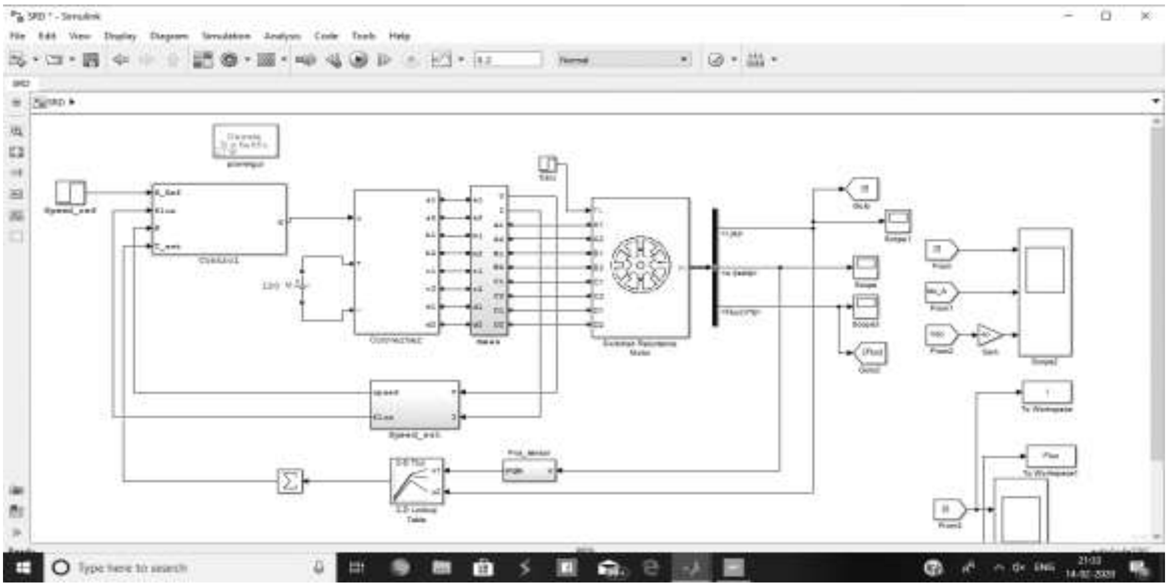


Figure diagram of Fig 6.7 of the existing system

Simulation Effect:

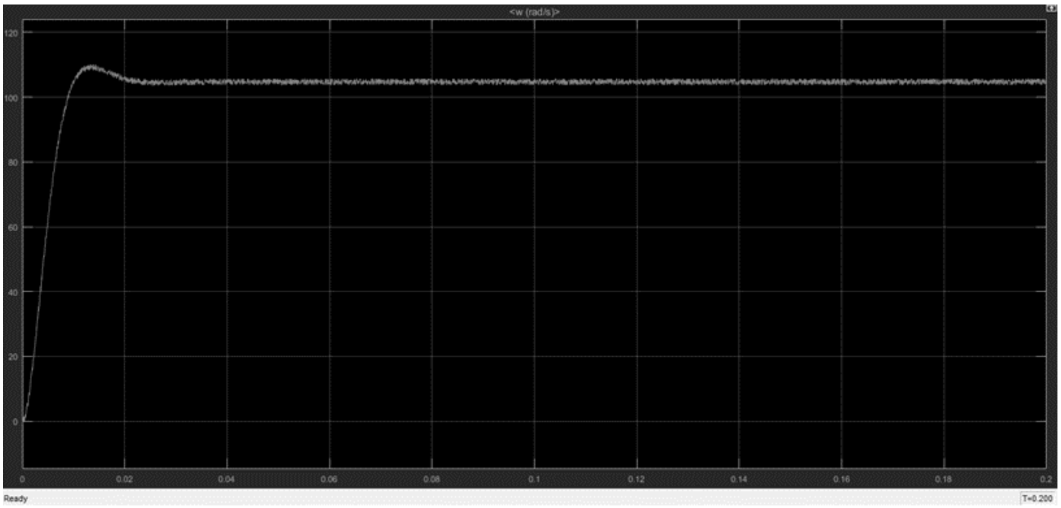


Figure 6.8 Imitation of Angular velocity ω rad / s

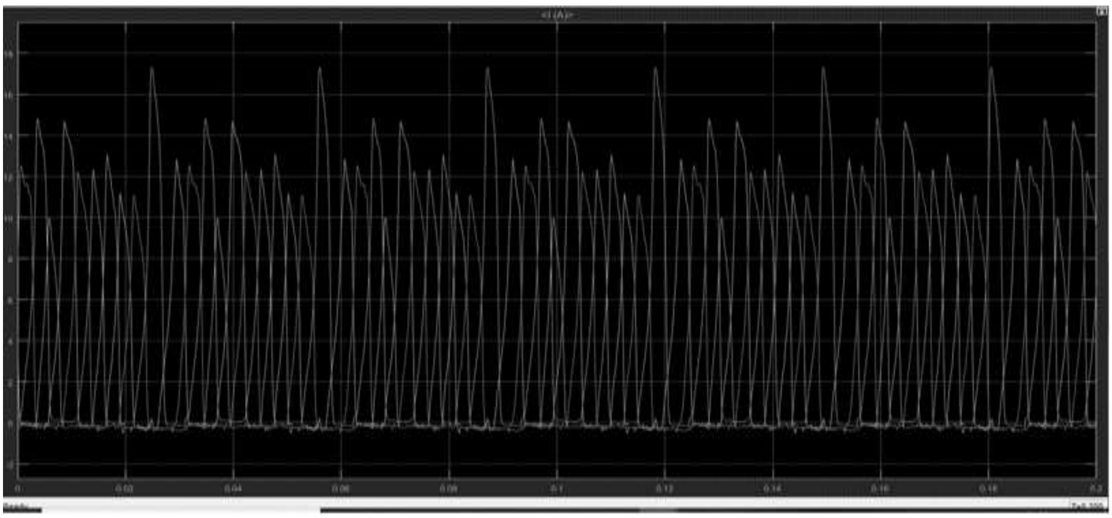


Figure 6.9 Simulation of Current Output I (A)

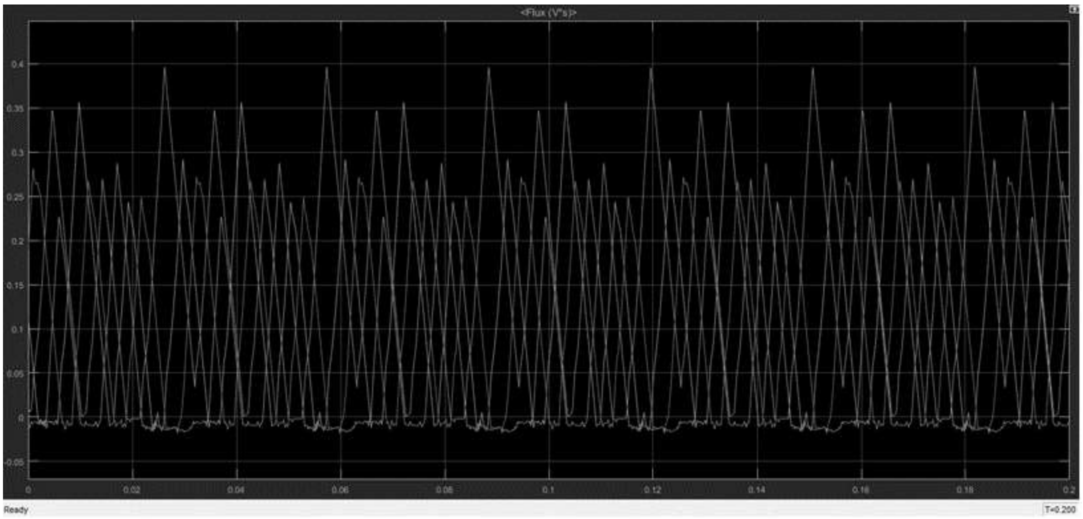


Figure 6.10 Flux measurement output

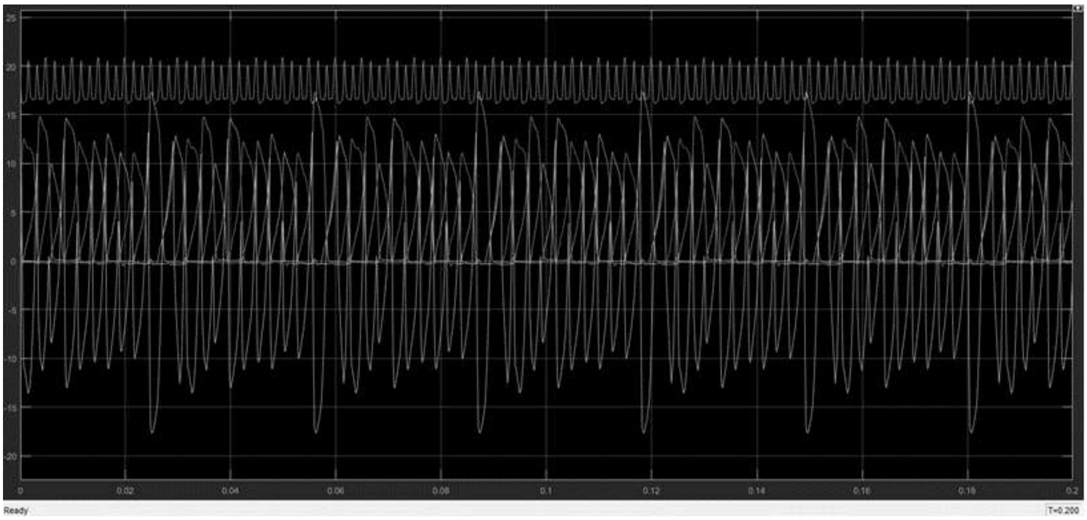


Figure 6.11. Oscillogram SRD test performance at high speed

CHAPTER 7

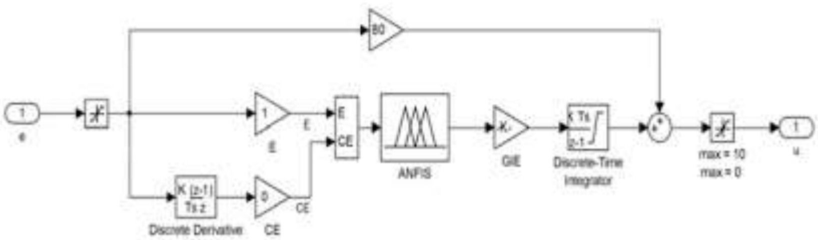
PROPOSED SYSTEM

Proposed ANFIS controller in production mode and SRD motoring mode

A flexible neuro-fuzzy inference system system or adaptive network based fuzzy inference system (ANFIS) is a type of neural implant network based on the Takagi-Sugeno fuzzy inference system. This method was developed in the early 1990's.

As it integrates both neural networks and vague mental systems, it has the potential to reap the benefits of both in one framework. By using ANFIS efficiently and effectively, one can use the excellent parameters found in the genetic algorithm.

It is possible to identify two components in a network structure, which are structural components and outputs. In more detail, the construction is made up of five layers. The first layer takes the input values and determines the membership functions that they own. It is usually called a layer of fuzzification. Membership qualifications for each job are calculated using a set parameter set, namely {a, b, c}. The second layer is responsible for making the shooting power in the rules. Because of its function, the second layer is described as the "legal layer". The role of the third layer is to measure the combined shooting power, by dividing the total amount of shooting energy in total. The fourth layer assumes the inclusion of standard values and the parameter set results {p, q, r}. The values returned by this layer are defuzzificated and those values are transferred to the final layer to regain the final result.



Model 7.1 ANFIS

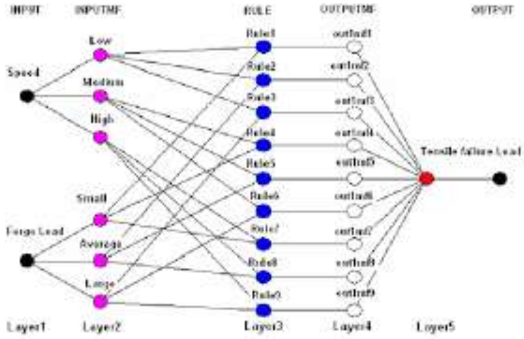


Figure 7.2 Speed control at ANFIS

ANFIS controller simulation diagram in SRD mode

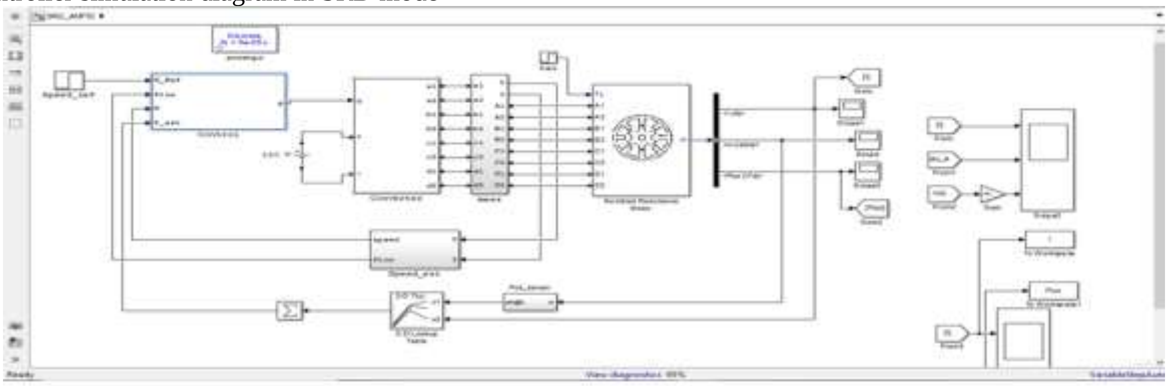


Figure 7.3 simulation of the proposed system in brake mode

ANFIS controller simulation diagram in SRD motoring mode

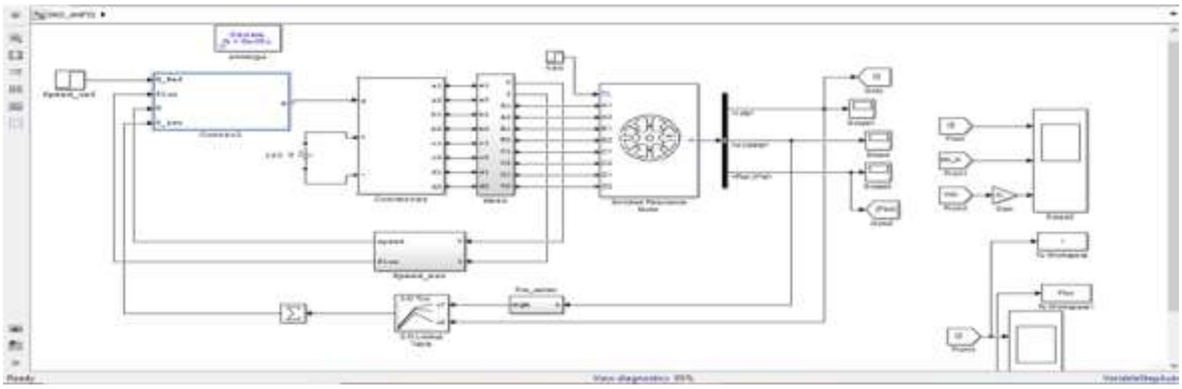
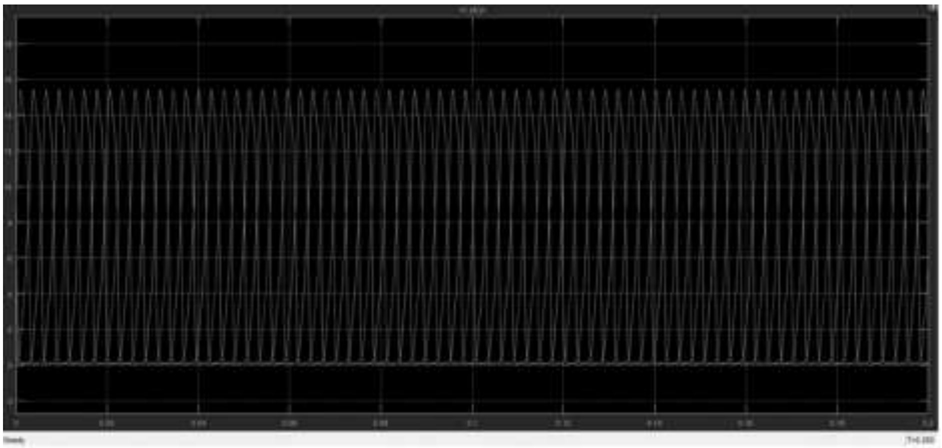


Figure 7.4 simulation of the proposed system in reverse mode

Imitation Effect



Brake mode

Figure 7.5 The current (I) A (A) Equalizations are in brake mode

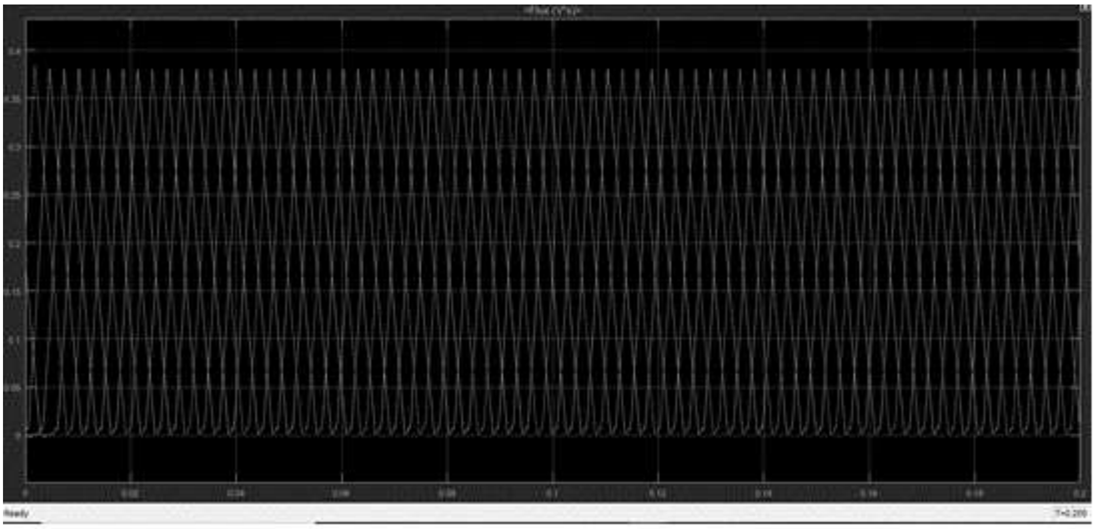


Figure 7.6 Flux measurement output in brake mode

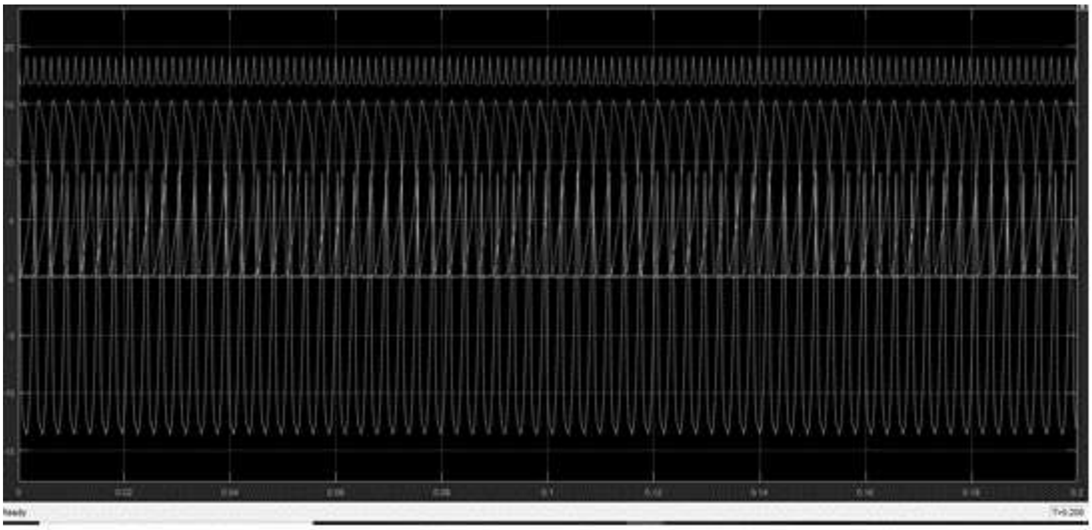


Figure 7.7. To test the performance of the oscillogram SRD at high speed in brake mode

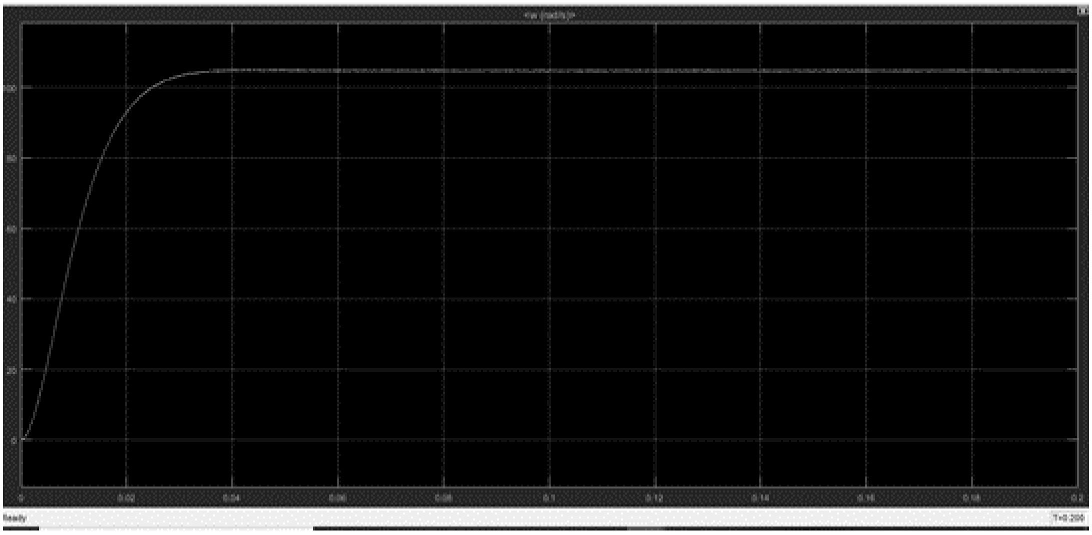


Figure 7.8 Imitation of Angular velocity ω rad / s in brake mode

Reverse mode

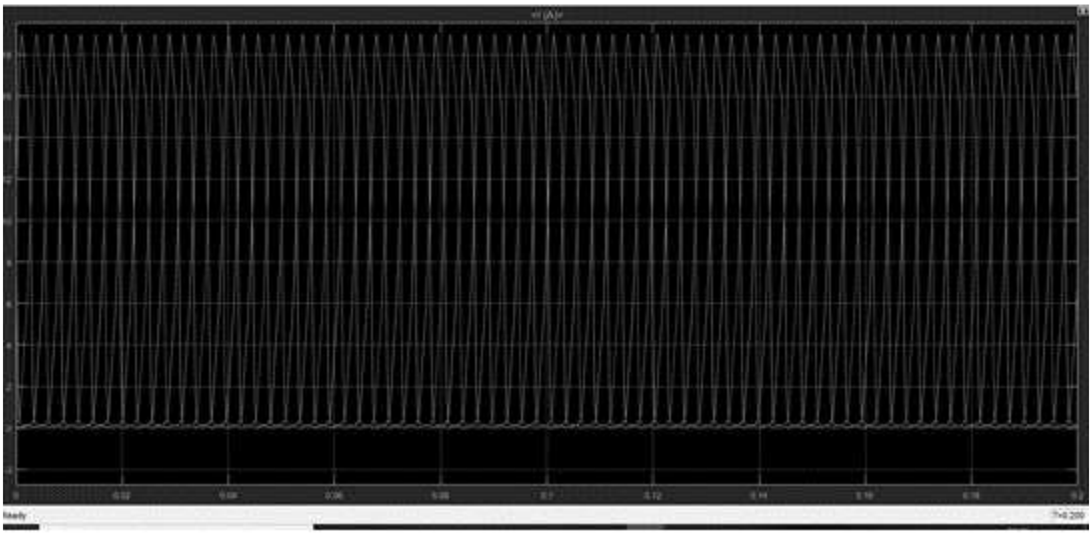


Figure 7.9 Current I (A) Evaluation in reverse mode

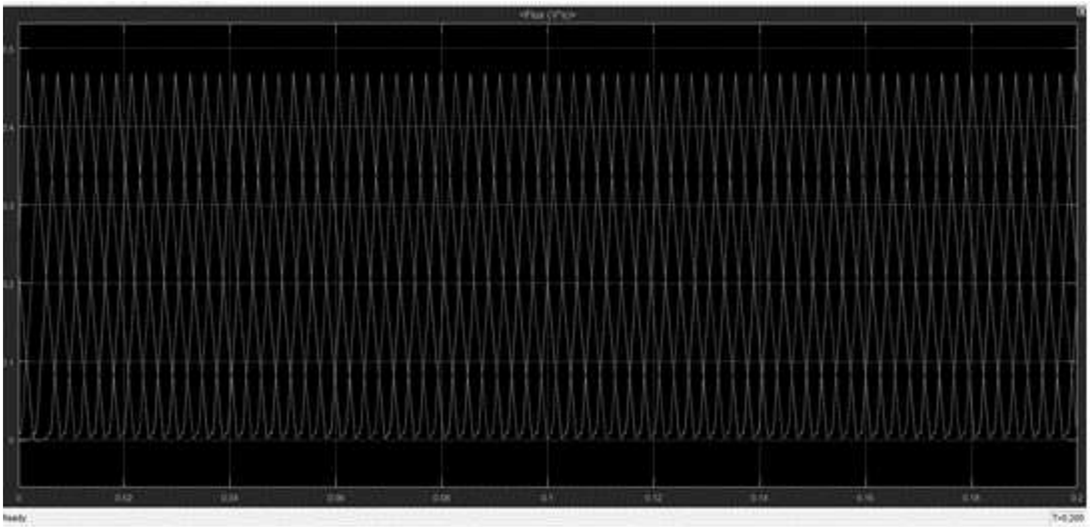


Figure 7.10 Flux rating output in reverse mode

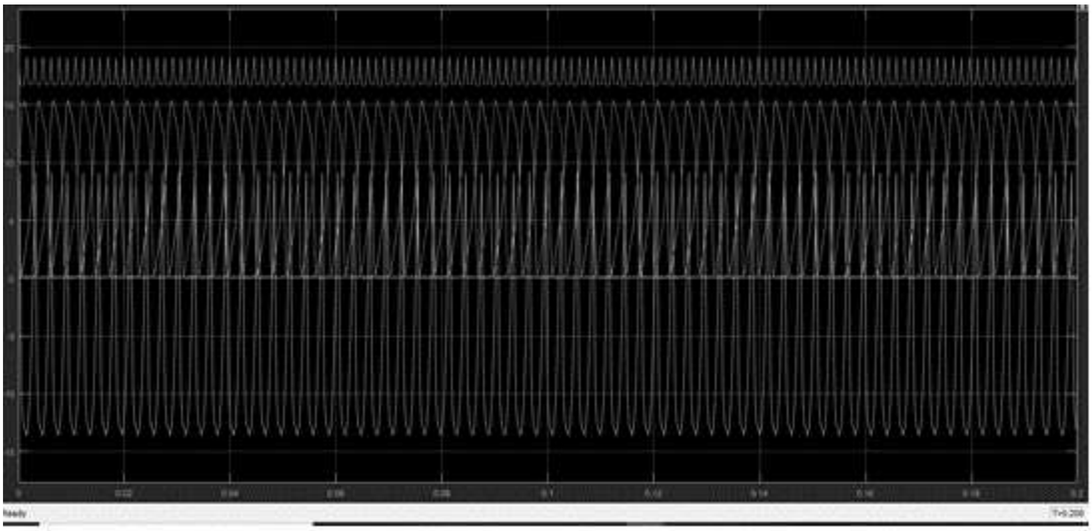


Fig. 7.11 Speed oscillogram SRD performance test at high speed in reverse mode

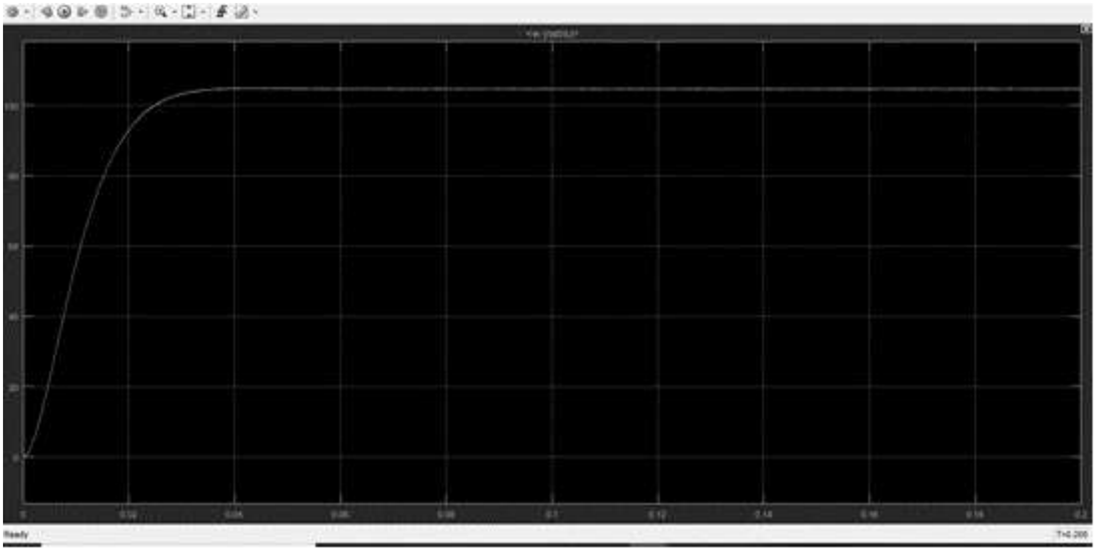


Figure 7.12 Angular velocity simulation, rad / s emission in reverse mode

Comparison

Parameters	**Existing**	Proposed system At Generating mode	Proposed system At Motoring mode
Ψ	0.3145	0.2998	0.3225
I	17.82	15.89	18.45

Extraction Graph
The program is in brake mode

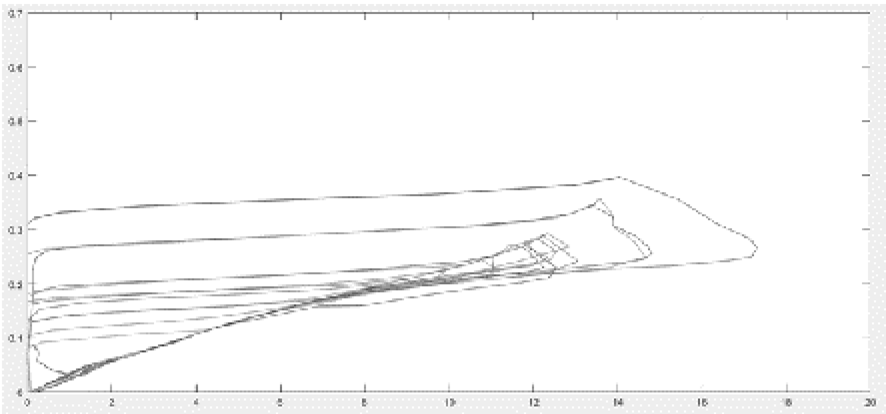


Figure 7.13. I (i) under different circumstances and WMECH ≅ const

Proposed system in brake mode

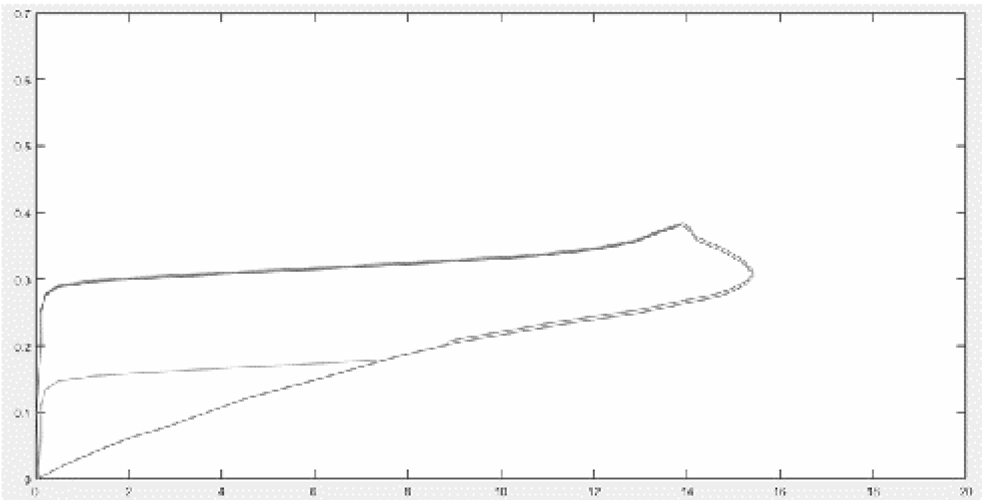


Figure 7.14 Ψ (i) under different circumstances and WMECH ≅ const

Proposed system in reverse mode

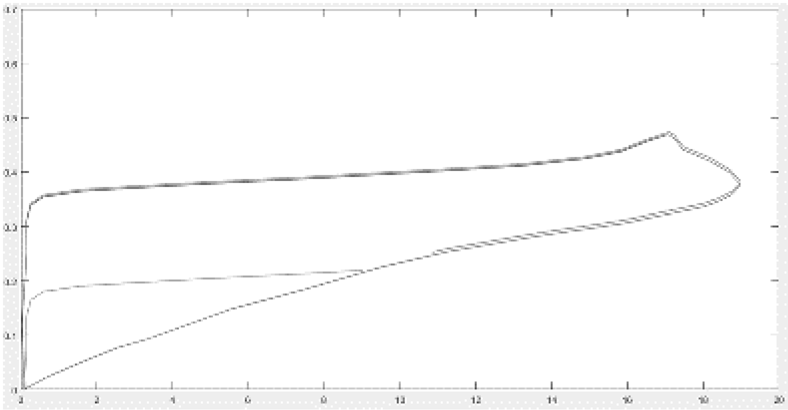


Figure 7.15 Ψ (i) under different circumstances and WMECH ≅ const

CHAPTER 8
CONCLUSION

In the event of a proper accounting for all specific aspects of direct torque control in brake mode its operation allows to increase the precision of the steering control and reduce the drive response time in comparison to traditional PWM control system for power phase and simultaneous reduction of precision requirements. .

The performance of a direct torque controller is useless at high speeds such as in the operating phase of the switching phase of each phase in SRD-producing mode may result in an uncontrolled growth in the current phase above the allowable values. To compensate for this situation it is necessary to increase the power supply, or to change the cycle of the phase to the lag, however, the increase in electrical torque increases.

In the event of the use of a fast torque transfer controller it will be necessary to consider the preferred option for using electrical circuits and selecting where rational structures to eliminate unwanted processes that are strong in their interaction during phase shifts.

Determining the application limit of the algorithm provided for direct control of SRD in brake mode in high-speed mode taking into account all disruptive influences, requires special revisions to be made in the future.

