Human Opinion Dynamics Based Optimization For Harmonic Reduction In Electrical Drives Using Multilevel Inverter

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Abstract-**This paper presents the HOD optimization method for harmonic elimination in a cascaded multilevel inverter. This is an effective method for harmonic elimination in multilevel inverter .In this paper, the human opinion dynamics (HOD) algorithm is applied to a multilevel inverter for solving the equations. Selective harmonic elimination method provides an efficient method to remove lower order harmonic in various configurations of inverters. HOD is one such resent area which has been recently claimed to solve complex optimization problem. The algorithm is based on the opinion formation mechanism of a group of individuals during discussion and has four primitive fundamentals-social arrangement, point view area, social impact and restore order.**

Keywords–**HOD, Harmonics, BFA, GA, PSO**

I. INTRODUCTION

Multilevel inverter

Multilevel inverter technologies have become more attractive for their use in high voltage and high power applications. In Multilevel inverters the desired output voltage is achieved by Suitable low combination of multiple low dc voltage sources used at the input side. As the number of dc sources increases the output voltage will be pure closer to sinusoidal waveform. Multilevel inverters have drawn tremendous interest in the field of high-voltage high-power applications such as laminators,Mills, conveyors, compressors, large induction motor drives, UPS systems, and static vary compensation level by connecting different dc sources of lower. There are several methods used for harmonic elimination in multilevel inverter. If the switching losses in an inverter are not a concern (i.e., switching on the order of a few kHz is acceptable), then the sine-triangle PWM method and its variants are very effective for controlling the inverter output voltage.

ADVANTAGES

- They can generate output voltages with extremely low distortion and low dv/dt.
- They draw input current with very low distortion.
- They generate smaller common-mode (CM) voltage, thus reducing the stress in the motor bearings. In addition, using sophisticated modulation methods, CM voltages can be eliminated.
- They can operate with a lower switching frequency.

APPLICATION

- Flexible ac transmission system (FACTS) equipment
- High voltage direct current lines.
- Electrical drives.

HARMONICS

Selective Harmonic Elimination method provides an efficient method to remove lower order harmonics in various configurations of inverters. The selection of the type of inverter and the topology of the inverter plays an important role in the performance. This leads to a critical design requirement in terms of pulse wave design to be fed at the gate terminals of the various power electronics switches. The problem can also be visualised as an optimisation problem with the pulse widths being the tuning parameters which needs to be optimised in terms of minimal Total Harmonic Distortion of the output. As mentioned above the pulse gate design can be visualised as an optimisation problem which can be solved using various optimisation algorithms. The research problem which we are targeting here is the design of multilevel inverters and their optimal selection of pulse width in order to reduce the total harmonics distortion to a minimal value, order harmonics in various configurations of inverters. The selection of the type of inverter and the topology of the inverter plays an important role in the performance. This leads to a critical design requirement in terms of pulse wave design to be fed at the gate of the induction machine. Improving the performance of the induction machine.

MODIFIED HUMAN OPINION DYMNAMICS (MHOD) Modelling human behaviour has been an interesting area of research for quite a time now and a lot of theories have been put forward to emulate the real life dynamics into a mathematical model. HOD is one such recent area which has been recently claimed to solve complex optimization problem. Although roots of this approach lies in Social Impact Theory Optimisation (SITO), they are found to have limited utility in high dimensionality problems and are based on discrete opinion formation. HOD model is utilized to develop an optimizer referred as Continuous Opinion Dynamics Optimizer (CODO). The model is based on the opinion formation mechanism of a group of individuals during a discussion and has four primitive fundamentals- social arrangements, point view area, social impact and restore order. Social

structure forms the platform for different individuals to interact with each other rather than immediate orthogonal members as in Van Neumann topology or all immediate eight neighbours as in simplistic Moore's topology. Opinion space is different from the social space and refers to a hyperspace, where the opinions of each individual affects each other and is modified under a certain update rule. An important difference of HOD based optimization from PSO is wheremodified form of Moore's neighbourhood where all the individuals are included as neighbours of each other that, in opinion space, collision is possible, i.e. two individuals can have same opinion at a time while two insects cannot have the same position in the swarm at a time. Opinions are considered to be continuous here to suit our problem of optimization where optimizingparameters can have any value within a finite range. Opinions are influenced by the opinionsof its neighbours depending on theirsocial influence which is defined here as the ratio of social rank of any individual to the distance between them.

II. LITERATURE REVIEW

Manoj Kumar &Mamtasingh[1]:-The harmonics of network voltage effect on operation of all electrical equipment like relays, those are the guards of power system, electric motors and measurement equipment that are the wheels of industries In fact, all these equipment are designed to work in normal conditions, the power is non-sinusoidal in real networks that reduces the motor efficiency and their lifetime .Temperature increase of machines is the most successful parameter that reduce the age of insulation and therefore the lifetime of the machine that depend on the condition of its insulation.It is proposed to study the performance of an induction machine using various types of inverter. A multilevel inverter is proposed to be designed with seven levels and the an improved Particle Swarm Optimisation is aimed to be implemented for deciding the pulse width of the various levels so as to obtain minimum Total Harmonic Distortion. The performances will be compared with those existing in literature and FFT analysis of the induction machine parameters will be done. Selective Harmonic Elimination method will be used for removing the lower order harmonics and the higher order harmonics will be removed using filters of lower size.

Baharuddin Ismail[2]:-In this paper presents an efficient selective harmonics elimination method for a cascaded five level inverter by using Particle Swarm Optimization (PSO) method. The aim of this research is to eliminate selected low-order harmonics by solving non-linear equations using the developed PSO algorithm, while at the same time the fundamental component is retained efficiently. In this paper, elimination of desired low-order harmonics using SHEPWM strategy is investigated. Multiple switching angles have been calculated by solving the non-linear equation using PSO algorithm. With the proposed method, the low- order harmonics could be eliminated up to 17th for the five-level cascaded inverter. The programming language has been described in Verilog and synthesized using Quartos II software before being implemented in Altera FPGA board. It was then applied to the gates of the power MOSFET. The entire model has been simulated using PSIM software and a single phase five-level inverter.

T.SudhakarBabu[3]:- Pulse width modulation (PWM) techniques are increasingly employed in power electronic circuits. Among the various PWM methods used, selective harmonic elimination PWM (SHEPWM) method is popular and it is widely accepted for its better harmonic elimination capability and its ability to maintain output voltage regulation. In this paper, bacterial foraging algorithm (BFA) method is proposed for switching angle selection in PWM inverter. The results obtained with BFA are compared with other optimization techniques such as GA and PSO. Based on the results, it can be concluded that BFA works efficiently for selective harmonic elimination together with output voltage regulation. This method showed superior convergence, reduced computational burden and better solution quality. In addition, hardware results were presented to validate the computed results.

Prashant L Gopal[4]:- In this paper the Genetic optimization method for harmonic elimination in a cascaded multilevel inverter and an optimal solution for eliminating pre specified order of harmonics from a stepped waveform of a multilevel inverter topology with equal dc sources.. In this project, elimination of low-order harmonics using SHEPWM strategy is investigated. GA is applied to solve the equations. Simulation results obtainthe accuracy and ability of GA for convergence objectives. Also, solutions have near probability to attain global minimum for 1, 2, 5, and 10 times runs. Finally, to verify GA solutions, experimental results are presented which gives the accuracy of the proposed method.

Chekka G K AyyappaKumar[5]:-In this paper presents the Five level inverter with single DC source which is used to generate a five level output with two bridges and six switches and performance of three phase induction motto conventional Voltage Source Inverter-fed induction motor drive is modelled and simulated using Mat labSimulink and the results are presented. Multilevel inverter employing Selective Harmonic Elimination (SHE) method is also simulated and the corresponding results are presented. The FFT spectrum for the outputs is analysing to study the reduction in harmonics. It is observed that the total harmonic distortion produced by the multilevel inverter system is less than that of VSI fed drive system. Therefore the heating due to multilevel inverter system is less than that of VSI fed drive system. The scope of this work is the modelling and simulation of multilevel inverter and VSI fed induction motor drive system. Experimental investigations will be done in future.

SumanDebnath[6]:- In this paper presents the solutions of Selective Harmonic Elimination (SHE) problem based on Genetic algorithm (GA) and Particle Swarm Optimization (PSO) techniques. Total Harmonic Distortion (THD) of output voltage is minimized maintaining selected harmonics within allowable limits. Artificial intelligence especially Genetic Algorithm and Particle Swarm Optimization. Selected lower order of harmonics are controlled within allowable limits while the fundamental output voltage is maintained at desired level, thus resulting in the minimum THD and the corresponding switching angles are computed. From the presented case studies it is observed that GA technique provides superior performance compared to PSO as far as the minimization of THD is concerned.

Ayoubkavousi[7]:- In this paper presents the Bee optimization method for harmonic elimination in a cascaded multilevel inverter. In this paper, elimination of low-order harmonics using SHEPWM strategy is investigated. BA is applied to solve the equations. Simulation results show accuracy and ability of BA is applied to solve the equations. Simulation results show accuracy and ability of BA for convergence objectives.

NeelashettyKashappa& Ramesh Reddy [8]:- This paper deals with performance of voltage source multilevel inverter-fed induction motor drive. A Voltage source inverter (VSI) is compared with multilevel inverter. A conventional Voltage Source Inverter-fed induction motor drive is modelled and simulated using mat labSimulink and the results are presented. Multilevel inverter employing Selective Harmonic Elimination (SHE) method is also simulated and the corresponding results are presented. The FFT spectrum for the outputs is analysed to study the reduction in harmonics. It is observed that the total harmonic distortion produced by the multilevel inverter system is less than that of VSI fed drive system. Therefore the heating due to multilevel inverter system is less than that of VSI fed drive system. The scope of this work is the modelling and simulation multilevelinverter and VSI fed induction motor drive system. Experimental investigations will be done in futurergence objectives.

.**Mohhamed Azab[9]:-**This paper presents accurate solutions for nonlinear transcendental equations of the selective harmonic elimination technique used in three-phase PWM inverters feeding the induction motor by particle swarm optimization (PSO). With the proposed approach, the required switching angles are computed efficiently to eliminate low order harmonics up to the 23rd from the inverter voltage waveform, whereas the magnitude of the fundamental component is controlled to the desired value. The PSO-based algorithm is determined with a high-precision set of solutions of switching angles with a relatively high speed convergence. PSO can be used successfully to control the operation of three-phase VSIs that feed induction motor drives. The fundamental component of the output voltage has the desired magnitude, eliminating several selected harmonics.

James kennedy&Russeleberhart[10]:-In this paper, the concept for the optimization of nonlinear functions using particle swarm methodology is introduced. Particle swarm optimization is an extremely wimple algorithm that seems to be effective for optimizing a wide range of functions. We view it as a mid-level form of A-life or biologically derived algorithm, occupying the space in nature between evolutionary search, which requires eons, and neural processing, which occurs on the order of milliseconds. This algorithm belongs ideologically to that philosophical school that allows wisdom to emerge rather than trying to impose it, that emulates nature rather than trying to control it, and that seeks to make things simpler rather than more complex.

III. CONCLUSION

In this paper, we showed that human opinion formations and their interaction dynamics can be used to solve complex mathematical problem. Although, from a social physical point of view these opinion dynamics models are very native and limited in nature, but we feel the present research will have a path towards developing novel methods and tools to understand real world problem solving by human beings in asocial structure. We will also compare the overall preformation with PSO. It is worthwhile to note that the proposed algorithm has a single control parameter unlike other optimizer making it easier to tune.

IV. REFERENCES

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