International Journal of Research
Available at https://edupediapublications.org/journals

e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 04 Issue 13
October 2017

Improved Design Presaging Govern For 3-Segment Inverter With Gain LC Filter Out

[1]Balla Aravind Kumar, [2]M.V.Praveen Reddy, [3]Dr.M.Ramesh

1.Pg Scholar, Department of EEE, Vaageswari College of Engineering, karimnagar.

2.Assosciate Professor, Department of EEE, Vaageswari College of Engineering, karimnagar

3. Professor&Hod, Department Of EEE, Vaageswari College Of Engineering, Karimnagar

ABSTRACT: *Three-phase inverters with an output LC filter are commonly used to provide sinusoidal voltages with low-harmonic distortion. Constraint on peak filter current is often desirable to protect the components from potential damage. In case of constraints, implicit and explicit model-predictive control (MPC) are some of the feasible controller options. The conventional implicit MPC requires a large number of computations, whereas explicit MPC cannot directly incorporate real-time changes in model parameters, while still being computationally expensive than some of the other control schemes, e.g., hysteresis, dead beat control, etc. In this paper, we propose a new approach to solve the optimization problem in implicit MPC that has a computational complexity approximately five times less than that of explicit MPC.We have been able to achieve lower computational requirements by exploiting the inverter model and the structure of constraints.*

I INTRODUCTION: In recent days, power electronics has become one of the most studied fields of application of advanced control techniques, due to the increasing need for such devices in a wide range of systems. For example, the integration of renewable energy resources into electric distribution networks relies on power electronics devices working as conditioning interfaces, to cope with the variability of the resource and provide a proper output voltage. Other examples include electrical drives, such as induction motors, which utilize power electronics devices to synthesize the control actions provided by a controller. Traditionally, controllers have been designed and implemented without considering the commutation of the inverter switches. The control actions are passed as a reference to the inverter, which performs a Pulse Width Modulation (PWM) strategy to synthesize a signal whose first order harmonic's amplitude and frequency equal the given reference values. In an effort to include the modulation techniques into the control algorithms, Model Predictive Control (MPC) is currently being studied. In such algorithms, the control actions are chosen in order to minimize a cost function that quantifies the system's performance along a prediction of its response. The advantage of these methods is that the commutation can be easily introduced by considering that the control actions can only be one of the finite states provided by the inverter. This is sometimes called Finite-States MPC (FS-MPC). Some works in which this kind of techniques are implemented for the control of several power electronics devices are Romero et al. (2011), Rodriguez et al. (2007) and Lezana et al. (2009). In previous work (see Alvarez Leiva et al. (2013) and Romero et al. (2011)), we have made use of MPC techniques with the addition of Space Vector Modulation (SVM), a commonly used PWM method. The result is obtained by subdividing the sampling period in subintervals. With this discretization, sequences of the inverter states are proposed as the available control actions. The sequences are defined so as to follow the SVM technique. The inclusion of SVM is done to achieve constant switching frequency, resulting in a cleaner harmonic spectrum for low frequencies (as shown in Holmes (1995)). In the present article, this MPC-SVM algorithm is further studied. Some geometrical characteristics of the cost function are analyzed and exploited, obtaining a more computationally efficient method to calculate the optimal sequence, thus called Geometric MPC. The aforementioned geometrical properties are not only present in inverters intended for electrical distribution, hence the development of this technique is aimed at a general linear load. However, in the example we apply the developed technique on a typical circuit used in distributed generation systems such as a Three-Phase Voltage Source Inverter with an LC filter and a coupling inductance, so as to highlight its advantages in such an important field of application

II BACKGROUND

Energy is an integral part of the development of Malaysia. Presently, the demand for electricity energy is met by natural gas, coal, petroleum and hydro. The current maximum electricity demand in Malaysia is about 12,000 MW and is projected to grow by about 6% to 8% per annum in the coming years. A total of 9,000 MW of new generation capacity was to be installed and commissioned between the years 2003 to 2010. From that planned capacity 5,600 MW will be coal fired power plants and the remaining 3,400 MW will be natural gas fired power plants. By the year 2010, the fuel mix in Peninsular Malaysia is expected to be 50% from oil and gas, 40% from coal, and the rest will be from hydro and biomass. These new coal and gas fired power generators is expected to emit additional 42 million tons CO_2 annually (34 million tons from coal and 8 million tons CO_2 from gas). This will lead to a tremendous increase in greenhouse gas (GHG) emissions, thus contributing to the global environmental problems. To mitigate the negative environmental impact from the electricity supply industry, Malaysia is increasing its efforts to promote renewable energy (RE) and energy efficiency (EE). Solar energy is the world's most abundant permanent source of energy that is also an important and environmentally compatible source of renewable energy. The ongoing national issues such as the forecast increase of electricity demand, the continuous growth of building industry, and the potential of solar energy, clearly points towards the application of building integrated photovoltaic (BIPV) technology in Malaysia. The BIPV technology will create a sustainable impact to the buildings industry and will be able to substitute part of the conventional fossil fired electricity generators

III CURRENT SOURCE INVERTERS (CSI).

Respectively, CSI the DC source appears as a constant current input and the voltage is changing with the load. The protection filter is normally a capacitance in parallel with the DC source. Self-commutated inverters produce very good sine wave outputs with the use PWM technic and low pass filters [8]. Another basic criterion for categorizing PV inverters is whether or not use galvanic isolation (transformer) to connect to the grid. There are many advantages and disadvantages in each type to be considered, with Electromagnetic Interference (EMI) being one of the most important issue. Inverters with low-frequency transformers (50 Hz) or high frequency transformers (10 kHz to 50 kHz) have the DC circuit seperated from the AC circuit, offering recuction of EMI. However, the big size especially when using low frequency transformers, the lower efficiency of the inverter due to transformer losses and the extra cost turn the attention to transformless topologies and their improvement to work in higher power ranges than today [8]. Transformless topologies still need more innovative and complicated solutions to become competitive especially in terms of electrical safety. Furthermore, in cases when the the DC output of the PV system is not as the one of the grid or higher, a stepup DC-DC converter is needed. Thus, part of the losses that were avoided from not using a transformer are compensated by the use of the converter. Nevertheless, almost all the typical applied inverter structures today need a boosting and require a DC-DC converter [12]. In general, there are numerous different topologies of inverters that could apply in grid connected systems..

IV MPC ALGORITHM

The models used in MPC are generally intended to represent the behavior of complex dynamical systems. The additional complexity of the MPC control algorithm is not generally needed to provide adequate control of simple systems, which are often controlled well by generic PID controllers. Common dynamic characteristics that are difficult for PID controllers include large time delays and high-order dynamics. MPC models predict the change in the dependent variables of the modeled system that will be caused by changes in the independent variables. In a chemical process, independent variables that can be adjusted by the controller are often either the setpoints of regulatory PID controllers (pressure, flow, temperature, etc.) or the final control element (valves, dampers, etc.). Independent variables that cannot be adjusted by the controller are used as disturbances. Dependent variables in these processes are other measurements that represent either control objectives or process constraints.

MPC uses the current plant measurements, the current dynamic state of the process, the MPC models, and the process variable targets and limits to calculate future changes in the dependent variables. These changes are calculated to hold the dependent variables close to target while honoring constraints on both independent and dependent variables. The MPC typically sends out only the first change in each independent variable to be implemented, and repeats the calculation when the next change is required.

While many real processes are not linear, they can often be considered to be approximately linear over a small operating range. Linear MPC approaches are used in the majority of applications with the feedback mechanism of the MPC compensating for prediction errors due to structural mismatch between the model and the process. In model predictive controllers that consist only of linear models, the superposition principle of linear algebra enables the effect of changes in multiple independent variables to be added together to predict the response of the dependent variables. This simplifies the control problem to a series of direct matrix algebra calculations that are fast and robust.

When linear models are not sufficiently accurate to represent the real process nonlinearities, several approaches can be used. In some cases, the process variables can be transformed before and/or after the linear MPC model to reduce the nonlinearity. The process can be controlled with nonlinear MPC that uses a

International Journal of Research
Available at https://edupediapublications.org/journals

e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 04 Issue 13
October 2017

nonlinear model directly in the control application. The nonlinear model may be in the form of an empirical data fit (e.g. artificial neural networks) or a high-fidelity dynamic model based on fundamental mass and energy balances. The nonlinear model may be linearized to derive a Kalman filter or specify a model for linear MPC.

An algorithmic study by El-Gherwi, Budman, and El Kamel shows that utilizing a dual-mode approach can provide significant reduction in online computations while maintaining comparative performance to a non-altered implementation. The proposed algorithm solves N convex optimization problems in parallel based on exchange of information among controllers.

Algorithm 1: Proposed Implicit MPC Algorithm

1: Measure or estimate if a,k , van,k and ioa,k

2: Compute dI min by keeping if a,k+1 = Imin in (8)

3: Compute dImax by keeping if a,k+1 = Imax in (8)

4: Compute da,k using (11) for the unconstrained problem

5: **if** constraint (10) is violated

6: Compute J1 (cost for da,k = max{dI min, dmin})

7: Compute J2 (cost for da,k = min{dImax, dmax})

8: **if** J1 < J2

9: da,k= max{dI min, dmin}

10: **else**

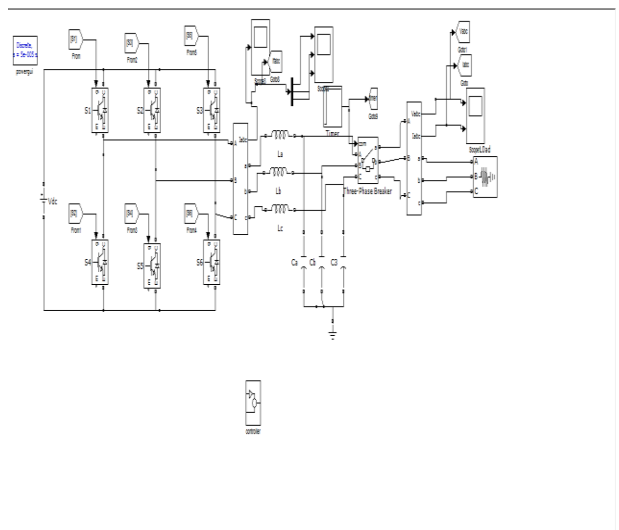
11: da,k= min{dImax, dmax}

12: **end**

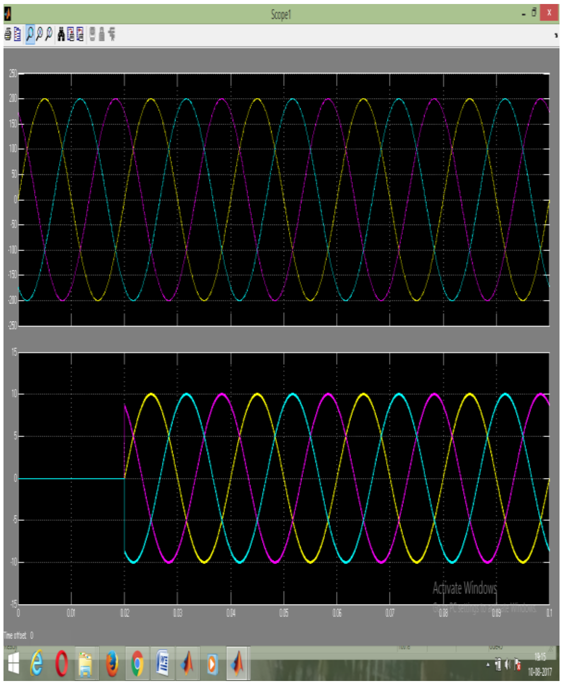
13: **end**

V RESULTS:

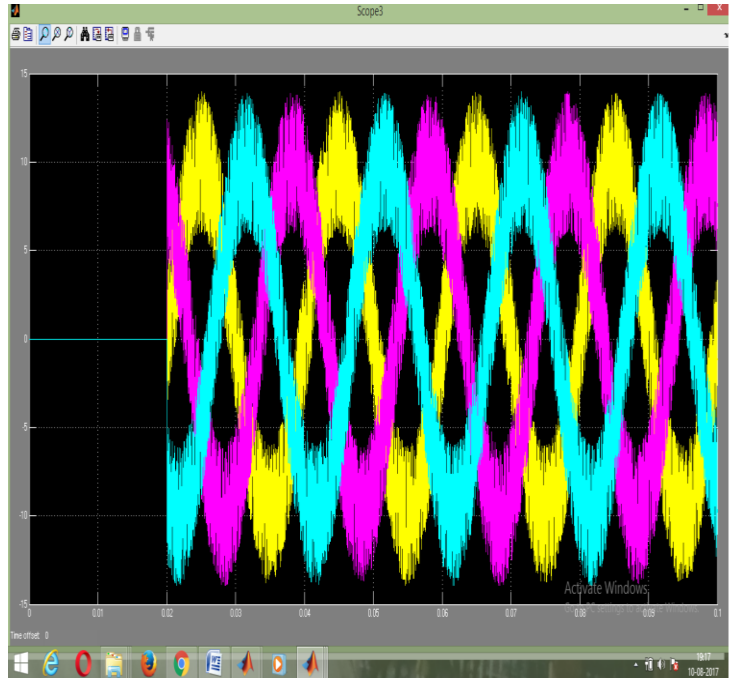
MODEL FILE & SIMULATION RESULTS:

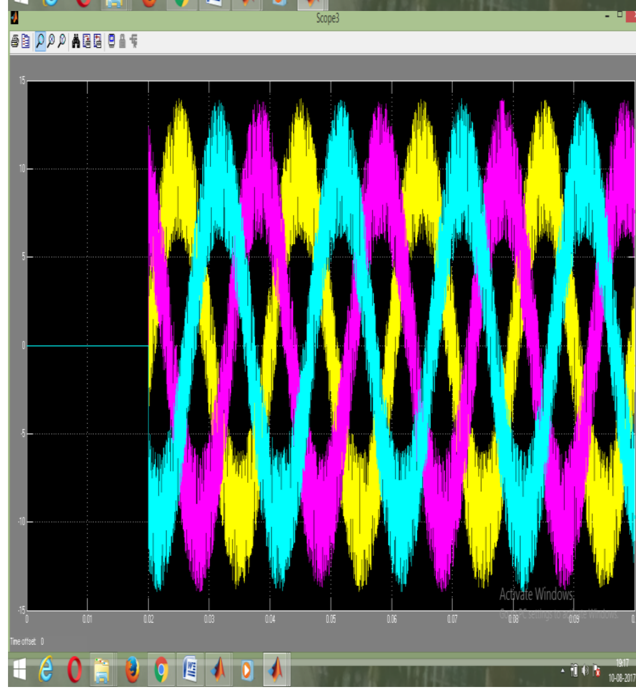


Vload&Iload



With out filter(before lc filter)





V CONCLUSION

In this paper, a simple and tailored approach based on active set methods has been presented for an implicit MPC of a threephase inverter with an output LC filter. The proposed scheme is computationally efficient as compared to the explicit MPC. The proposed scheme reduces the computational load by exploiting the structure of the inverter model and the constraints. Simulations have been performed to show that the proposed algorithm regulates the output voltages of the inverter subject to constraints on filter current and duty cycle. The reduced computational requirements could help operation of the controller at higher frequencies, implementation on a cheaper hardware, or a tradeoff between them.

REFERENCES

[1] P. Cortes, G. Ortiz, J. Yuz, J. Rodriguez, S. Vazquez, and L. Franquelo, "Model predictive control of an inverter with output LC filter for ups applications," IEEE Trans. Ind. Electron., vol. 56, no. 6, pp. 1875–1883, Jun. 2009.

[2] O. Kukrer, "Deadbeat control of a three-phase inverter with an output LC filter," IEEE Trans. Power Electron., vol. 11, no. 1, pp. 16–23, Jan. 1996.

[3] T. Habetler, R. Naik, and T. Nondahl, "Design and implementation of an inverter output LC filter used for dv/dt reduction," IEEE Trans. Power Electron., vol. 17, no. 3, pp. 327–331, May 2002.

[4] P. Cortes, M. Kazmierkowski, R. Kennel, D. Quevedo, and J. Rodriguez, "Predictive control in power electronics and drives," IEEE Trans. Ind. Electron., vol. 55, no. 12, pp. 4312–4324, Dec. 2008.

[5] M.Kazmierkowski and L. Malesani, "Current control techniques for threephase voltage-source PWM converters: A survey," IEEE Trans. Ind. Electron., vol. 45, no. 5, pp. 691–703, Oct. 1998.

[6] D. Zmood and D. Holmes, "Stationary frame current regulation of PWM inverters with zero steady-state error," IEEE Trans. Power Electron., vol. 18, no. 3, pp. 814–822, May 2003.

[7] J. Mossoba and P. Lehn, "A controller architecture for high bandwidth active power filters," IEEE Trans. Power Electron., vol. 18, no. 1, pp. 317–325, Jan. 2003.

[8] Y. Nishida, O. Miyashita, T. Haneyoshi, H. Tomita, and A. Maeda, "A predictive instantaneous-current PWM controlled rectifier with ac-side harmonic current reduction," IEEE Trans. Ind. Electron., vol. 44, no. 3, pp. 337–343, Jun. 1997.

[9] E. Wu and P. Lehn, "Digital current control of a voltage source converter with active damping of LCL resonance," IEEE Trans. Power Electron., vol. 21, no. 5, pp. 1364–1373, Sep. 2006.

[10] P. C. Loh, M. Newman, D. Zmood, and D. Holmes, "A comparative analysis of multiloop voltage regulation strategies for single and three-phase ups systems," IEEE Trans. Power

Electron., vol. 18, no. 5, pp. 1176–1185, Sep. 2003.

[11] S. Mariethoz andM.Morari, "Explicit model-predictive control of aPWM inverter with an LCL filter," IEEE Trans. Ind. Electron., vol. 56, no. 2, pp. 389–399, Feb. 2009.

[12] S.-K. Kim, C. R. Park, J.-S. Kim, and Y. I. Lee, "A stabilizing model predictive controller for voltage regulation of a dc/dc boost converter," IEEE Trans. Control Syst. Technol., vol. 22, no. 5, pp. 2016–2023, Sep. 2014.

[13] M. Zeilinger, C. Jones, and M. Morari, "Real-time suboptimal model predictive control using a combination of explicit MPC and online optimization," IEEE Trans. Autom. Control, vol. 56, no. 7, pp. 1524–1534,
Jul. 2011.

[14] J. Nocedal and S. Wright, Numerical optimization. New York, NY, USA: Springer-Verlag, 2006, ch. 16.

[15] S. Kwak and J.-C. Park, "Switching strategy based on model predictive control of VSI to obtain high efficiency and balanced loss distribution," IEEE Trans. Power Electron., vol. 29, no. 9, pp. 4551–4567, Sep. 2014.

[16] M. Vatani, B. Bahrani, M. Saeedifard, and M. Hovd, "Indirect finite control set model predictive control of modular multilevel converters," IEEE Trans. Smart Grid, vol. 6, no. 3, pp. 1520–1529, May 2015.

[17] R. Middlebrook and S. Cuk, "A general unified approach to modeling switching-converter power stages," in Proc. IEEE Power Electron. Specialist Conf., 1976, pp. 18–34.

[18] N. Mohan, Power Electronics: A First Course. Hoboken, NJ, USA:Wiley, 2012, ch. 12.

[19] A. Bemporad, "A multiparametric quadratic programming algorithm with polyhedral computations based on nonnegative least squares," IEEE Trans. Autom. Control, vol. 60, no. 11, pp. 2892–2903, Nov. 2015.

AUTHOR'SPROFILE:

BALLA ARAVIND KUMAR, Pg Scholar, Department of EEE, Vaageswari College of Engineering, karimnagar

M.V.PRAVEEN REDDY, Assosciate Professor, Department of EEE, Vaageswari College of Engineering, karimnagar

Dr. M. Ramesh was born in Guntur District, Andhra Pradesh, on 07-06-1977. I completed my B.Tech. (EEE) from Viswanadtha Institute of Technology and Management affiliated Jawaharlal Nehru Technological University, Hyderabad in 2002, M. Tech.(Advanced Power Systems) from Jawaharlal Nehru Technological University, Kakinada, Andhra Pradesh in 2005 and completed Ph.D.(Application of Artificial Intelligent Techniques for Enhancement of Stability in HVDC Transmission System) from Jawaharlal Nehru Technological University College of Engineering, Ananthapuram in 2017. I have one year of Industrial experience and 15 years of teaching experience and presently working as a Professor and HOD, EEE Dept, Vaageswari College of Engineering, karimnagar Dist. I published 30 International Journals to my credit. I published 10 International and National papers in various conferences held at India and also abroad. My research interests are AI Techniques, Power Systems & FACTS. I have Member in IEEE, Life Member of Indian Society of Technical Education (M.I.S.T.E), Life Member

International Associationof Computer Science an d Information Technology, Life Member of International Association of Engineers, Member of Engineeing Council of India (MECI)