ICITACEE 2018

PROCEEDINGS

GREEN TECHNOLOGY AND SMART ENVIRONMENT FOR A CONNECTED WORLD

Proceedings

2018 5th International Conference on Information Technology, Computer and Electrical Engineering (ICITACEE 2018)

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Publisher:

Department of Electrical Engineering
Diponegoro University

ISBN : 978-1-5386-5527-6 (PRINT, Part Number : CFP1889Z-PRT)
ISBN : 978-1-5386-5528-3 (DVD, Part Number : CFP1889Z-DVD)
ISBN : 978-1-5386-5529-0 (XPLORE COMPLIANT, Part Number : CFP1889Z-ART)

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Yoanes Bandung (Institut Teknologi Bandung, Indonesia)
Suryono (Diponegoro University, Indonesia)

Program

Thursday, September 27

Thursday, September 27 9:30 - 11:30

INV: Invited Paper

Green Computing: Opportunity of Using Breadth Fixed Gossip Algorithm for Optimizing Power Supply Route in Power Plant
Mauridhi Purnomo (Institut Teknologi Sepuluh Nopember, Indonesia)
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Communication Protocol on 64-Channel ECVT Data Acquisition System
Arbai Yusuf (Universitas Indonesia & C-Tech Labs Edwar Technology, Indonesia)
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Cooling System Design Based on Thermoelectric Using Fan Motor on-off Control
Munnik Haryanti (Universitas Dirgantara Marsekal Suryadarma, Indonesia)
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Design of The 3D Surface Scanning System for Human Wrist Contour Using Laser Line Imaging
Riky Tri Yunardi and Ario Imandiri (Universitas Airlangga, Indonesia)
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Temperature Controlling Using PID Controller on Rice Grain Fluidized Dryer Prototype
Aris Triwiyatno (Diponegoro University, Indonesia)
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PID Based Air Heater Controller Implemented With Matlab/Simulink and Arduino Uno
Bambang Supriyo, Dadi Dadi, Sulistyo Warjono, Adi Wisaksono, Sri Astuti and Kusno Utomo (Politeknik Negeri Semarang, Indonesia)
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Design A Low Cost Wind Direction Sensor With High Accuracy
Yoga Utama (University of Widya Kartika, Indonesia)
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Quadruped Robot with Stabilization Algorithm on Uneven Floor using 6 DOF IMU based Inverse Kinematic
Rofiq Prayogo (Diponegoro University, Indonesia)
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Design and Characterization of Low-Cost Soft Pneumatic Bending Actuator for Hand Rehabilitation
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B1: Electric & Power System

Design and Performance Test of Three Phased SRF-PLL using DSPIC30F4011
Syarief Ali, Iwan Setiawan and Susatyo Handoko (Universitas Diponegoro, Indonesia)
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The Effect of Excitation Capacitors on Induction Generators in Loss-of-Grid Events
Mokhammad Isnaeni Bambang Setyonegoro (Universitas Gadjah Mada, Indonesia); Danang Wijaya (UGM, Indonesia); Eka Firmansyah (Universitas Gadjah Mada, Indonesia)
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Transient Stability Study in Grid Integrated Wind Farm
Samuel Adi Kusumo (Universitas Gadjah Mada, Indonesia); Lesnanto Multa Putranto (UGM, Indonesia); Tiyono Tiyono (Universitas Gadjah Mada, Indonesia)
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Analysis of Energy Potential of Biomass Electricity from Leaf Waste by Using Briquette Method
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DVR to Voltage Sag Mitigation Due to Induction Motor Starting and 3 Phase Fault
Muhammad Kuncoro and Iwa Garniwa (University of Indonesia, Indonesia)
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A Single Phase 11-Level Inverter for Photovoltaic Application
Wira Adhitama and Leonardus Pratomo (Soegijapranata Catholic University, Indonesia)
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Design and Implementation of Inverter Single Phase Nine-Level Using PIC18F4550
Natanael Novalutfi and Leonardus Pratomo (Soegijapranata Catholic University, Indonesia)
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Relational Database Structure and Operations Engineering Based on UML Diagram
Lukman Hakim (Bandung Institute of Technology, Indonesia); Sukrisno Mardiyanto (Institut Teknologi Bandung, Indonesia)
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Design of Secure IoT Platform For Smart Home System
Arvandy Arvandy and Yoanes Bandung (Institut Teknologi Bandung, Indonesia)
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Marker Image Variables Measurement of Augmented Reality in Mobile Application
Ike Windasari, Yudi Windarto and Risma Septiana (Diponegoro University, Indonesia)
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Prototype of Online Examination on MoLearn Applications Using Text Similarity to Detect Plagiarism
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Performance Comparison Between AES256-Blowfish and Blowfish-AES256 Combination
Muhammad Muin (Universitas AMIKOM Yogyakarta & STMIK Bina Patria, Indonesia); Arief Setyanto (Universitas AMIKOM Yogyakarta, Indonesia); Sudarmawan Sudarmawan (AMIKOM Yogyakarta University, Indonesia); Kartika Santoso (STMIK Bina Patria, Indonesia)
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A Natural Childbirth Training Simulation in Virtual Environment For Prospective Midwife
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High Throughput Wireless Printer Server Based on IEEE 802.11n
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Analysis on Batik Water Waste Monitoring System based on LoRa Communication
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A GIS-based Waste Water Monitoring System Using LoRa Technology
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Design and Development of Injection Current Control On Inverter-Based Proportional Resonant Method
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Performance Improvement of Robot Warehouse Based on Battery Operational Conditions
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Design and Development of Injection Current Control On Inverter-Based Proportional Resonant Method

Abdul Haris Kuspranoto[1], Syah Jahan Al Achmad[2], Iwan Setiawan[3], Mochammad Facta[4]
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***Abstract*—A current controller in PV on-grid systems have a significant effect on the quality of the current injected to the grid. In this case, the current controller should provide a high quality sinusoidal current waveform with the low appearance of harmonic distortion. One popular current control method that could be found in literatures is proportional-resonant control system. This paper is preliminary work on the implementation of the current injection control system for on-grid PV system which have been built in our Lab. The PR control system have been simulated in Matlab-Simulink software environment with good result and will be embedded in a low cost dsPIC microcontroller.**

Keywords—Photovoltaic (PV), proportional resonant (PR), inverter, current injection

I. INTRODUCTION

Over the years, power converters of various topologies have been found with wide applications across a range of grid-interfaced systems, including distributed power plants with renewable energy sources such as wind, hydro, solar energy, microgrid power and active power filters [1]. The existence of renewable energy sources is expected to play a role as a replacement of existing energy sources.[2][3][4]

In all applications the grid converter has much in common its function of having to control the current and control the dc voltage using a sinusoidal signal reference [5]. The current controller can have a significant effect on the quality of the current supplied to the grid by the PV inverter, therefore it is important that the controller provides high quality sinusoidal quality to avoid the creation of harmonic distortion. Two controls commonly used in inverter current control are PI control and proportional resonant (PR) controls [6].

Proportional Resonant Control (PR) has been proposed in many recent works, as an effective controller for many applications. In Proportional Resonant (PR) control there is no phase delay into the control cycle at the resonant frequency. The gain on the PR is not limited to the resonance frequency, thus ensuring steady state errors close to zero and minimizing current distortion at load [7]. PR methods have an advantage in a system such as constant frequency change, resistance to input and output changes, fast dynamic response, and easier implementation of logic control [8].

II. BASIC THEORY

A. Inverter System Strategies With Renewable Energy Sources synchronized with grid

Filter on current control affects frequency response. LC resonance caused by LCL filter, need to be selected correctly. Otherwise, the system will become unstable. The parameters of the unconfirmed system can make resonance frequencies difficult to identify[9]. This series connects L1 + R forming L type filter which serves to smooth the signal from ripple. A DC-DC converter connected to a photovoltaic panel increases the stable DC voltage for a DC-AC inverter. Inverter system topology on grid with photovoltaic source is shown in Fig. 1.

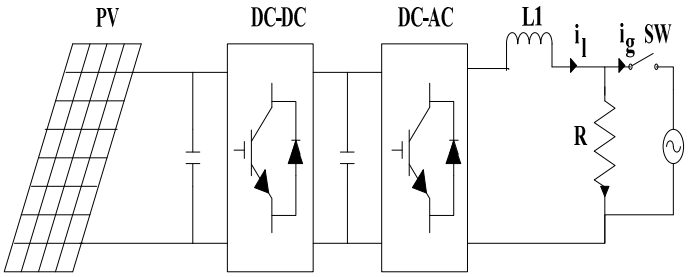

Fig. 1. Inverter system topology on grid with PV source

H-bridge Inverter DC-AC produces the right sinusoidal current with power factor based on Maximum Power Point Tracking (MPPT) and Phase Locked Loop (PLL) algorithm. Ideally, PLL will provide fast respon, accurate power informations and not easily disturbed by noise, harmonics, unbalanced, and any other distortions[10]. The expected output is the current flowing in the load resulting from the control current. The output current flowing at the load must be in accordance with the reference current and synchronized on the grid. Sampling current of PV panel and voltage of MPPT algorithm. The DC voltage control algorithm provides a reference current to be injected.

Generally current PI current control scheme with voltage feedback is used, but this solution causes stationary error in sinusoidal input tracking and poor harmonic compensation will be achieved. Instead, PR techniques can be used for current controllers.

B. Proportional Resonant (PR)

Based on the power balance theorem, the DC bus voltage dynamic in the inverter systems basically is governed by a nonlinear differential equation. The most common strategy used to regulate the DC bus capacitor voltage is a linear PI control method, but this solution causes the output is not smooth in following the reference and the harmony that bad will be achieved[11].Based on Proportional Resonant (PR) can be designed based on frequency output. The purpose of the PR controller is to control the sinusoidal variable which has a resonant frequency at 50Hz and at the same time rejects the other frequency [12]. Using only PI controls that have a zero pole causes infinite gain when zero frequency can not solve the problem. Due to this loss, the Proportional-Resonant Controller is used where it is given a gain at the specified resonance frequency[7]. Fig. 2 shows the Proportional-Resonant control block diagram.

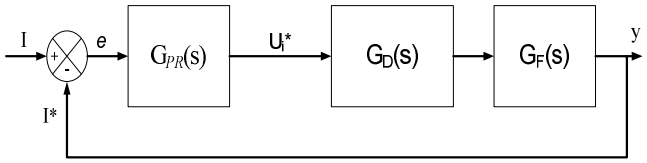

Fig. 2. Simple PR Current Control block diagram

Where, $G_{PR}(s)$ is PR current control, $G_D(s)$ is process delay on microcontroller and $G_F(s)$ is representation of L filter.The ideal PR current controller GPR(s) is represented by:

$$G_{PR}(s) = K_p + \frac{2K_i s}{s^2+\omega_0^2} \quad (1)$$

Where, K_p is the Proportional Gain, K_i is the Integral Gain term and ω_0 is the resonant frequency. the ideal PR controller that can solve the problem due to unlimited gain[13]. Avoiding this problem, PR controllers can be made not ideal. Equation of PR can be written:

$$G_{PR}(s) = K_p + \frac{2K_i\omega_c s}{s^2+2\omega_c s+\omega_0^2} \quad (2)$$

Where, $\omega_c$cut off frequency of the controller. The controller is now finite but it is still large enough to provide only a very small steady state error. This equation also makes the controller more easily realizable in digital systems due to their finite precision[6].

The parameters required for a PR controller are as follows [14]:

1. $\omega_c$to adjust the bandwidth around the resonant frequency.
2. $K_p$to get a fast transient response and good stability.
3. $K_i$to eliminate steady-state phase error and magnitude.
4. $\omega_0$is the resonant frequency.

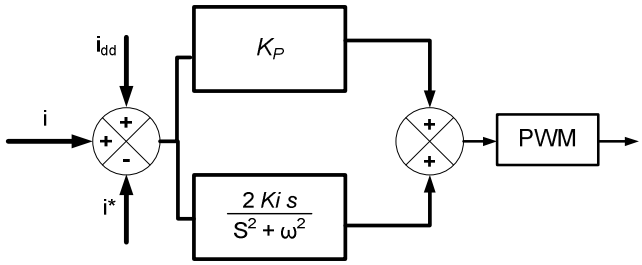

Fig. 3. PWM drive based on PR Control

PR techniques is shown in Fig. 3. The loop control with the sine wave reference is obtained from the PLL. The PR current controller is an integrated base frequency control and a low order harmonic compensation (3, 5, 7)[15]. PR techniques like Fig. 3 can be simulated into a program such as matlab. The PR control simulation as shown in Fig 4.

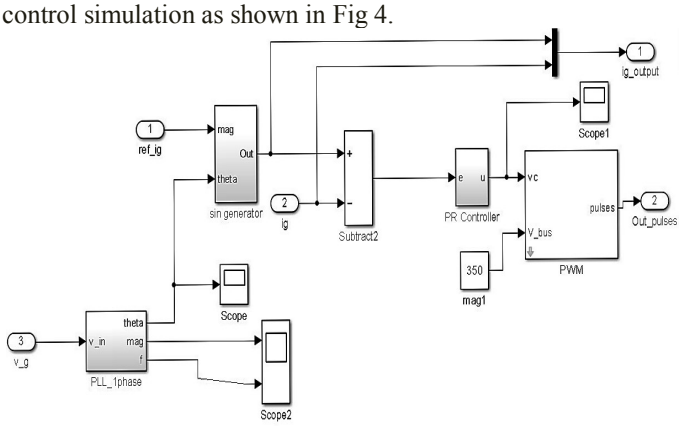

Fig. 4. Block diagram of PR Control Simulation

Single phase PLL block to detect zero crosing of sine wave detector. The PR controller will get insert from the sin generator. Sine wave result from sin generator will be processed with PR equation on controler block. The result of a processed sine wave PR controller is a SPMW signal that is in the PWM block[9].

III. System Overview and Modeling

A. Proportional Resonant Current Controller

The Proportional Resonant control signal is used to feed the output current from the inverter by controlling the sinusoidal variable which has a resonance frequency at 50 Hz. The error value e (t) is obtained from the reduction of the actual current value measured by the current sensor (i_{act}) and the current reference value given by the potentiometer (i_{ref}). After the value e (t) is obtained, the controller will calculate the error value with the gain value to generate the control signal. the current control will be synchronized from the information provided by the PLL. Block diagram of the proportional resonant controller as shown in Fig. 5.

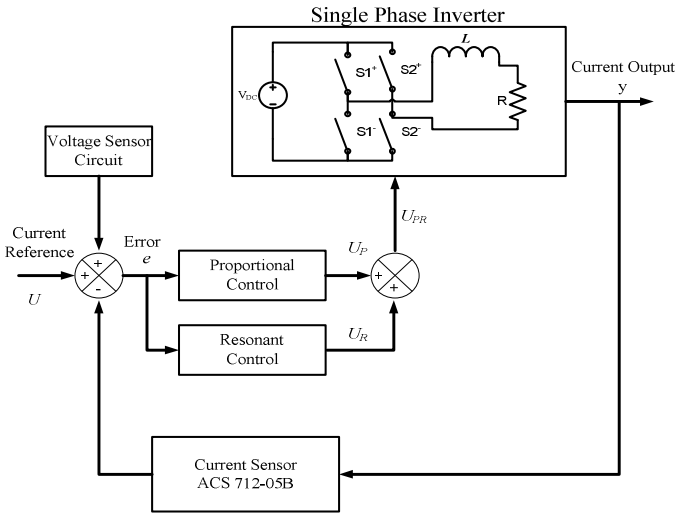

Fig. 5. Block Diagram of The Proportional Resonant Controller

Based on equation 2, the transfer function in the domain s must be discrete to k domain in order to be processed in the microcontroller. The method of Backward Difference approach shown in equation (3).

$$s = \frac{1-z^{-1}}{T} \tag{3}$$

The following is the value of the proportional controller parameter performed by the empirical techniques:

$$K_p = 0{,}9$$

Obtained proportional controller formula as follows:

$$u_P(k) = Kp.e(k)$$
$$u_P(k) = 0{,}9.e(k)$$

The discretized equation is the resonant gain because it has a second-order system in the transfer function by domain s

$$\frac{u_R(s)}{e(s)} = \frac{2Ki\omega_c s}{s^2 + 2\omega_c s + \omega_0^2} \tag{4}$$

$$u_R(z) = \left(\frac{1}{1 + 2\omega_c T + \omega_0^2 T^2}\right)\left(-u(z).z^{-2} + u(z).z^{-1}(2 + 2\omega_c T) - e(z).z^{-1}(2Ki\omega_c T) + e(z)(2Ki\omega_c T)\right) \tag{5}$$

$$u_R(k) = \left(-\frac{u(k-2)}{1 + 2\omega_c T + \omega_0^2 T^2} + \frac{(2 + 2\omega_c T).u(k-1)}{1 + 2\omega_c T + \omega_0^2 T^2} - \frac{2Ki\omega_c T.e(k-1)}{1 + 2\omega_c T + \omega_0^2 T^2} + \frac{2Ki\omega_c T.e(k)}{1 + 2\omega_c T + \omega_0^2 T^2}\right) \tag{6}$$

The values of the proportional controller parameter performed by the empirical techniques:

a. $K_i = 7135{,}69$
b. $\omega_c = 0{,}07$
c. $\omega_0 = 314$
d. $T = 0{,}0001$

Based on equation (6) obtained the resonant controller equation as follows:

$$u_R(k) = -0{,}999.u(k-2) + 1{,}998.u(k-1) - 0{,}09998.e(k-1) + 0{,}09998.e(k)$$

After that obtained the final equation of Proportional Resonant controller as follows:

$$u_{PR}(k) = u_P(k) + u_R(k) \tag{7}$$
$$u_{PR}(k) = 0{,}9.e(k) - 0{,}999.u(k-2) + 1{,}998.u(k-1) - 0{,}09998.e(k-1) + 0{,}09998.e(k)$$

B. *Hardware Plant*

The main block is single phase AC source, power circuit, control circuit, ACS712-05B current sensor, Digital to Analog Converter AD7302, voltage sensor, TLP250 MOSFET driver circuit and load. Control circuit using DSPIC30F4011 microcontroller. In the power circuit there is a full wave bridge rectifier as a source for inverter.

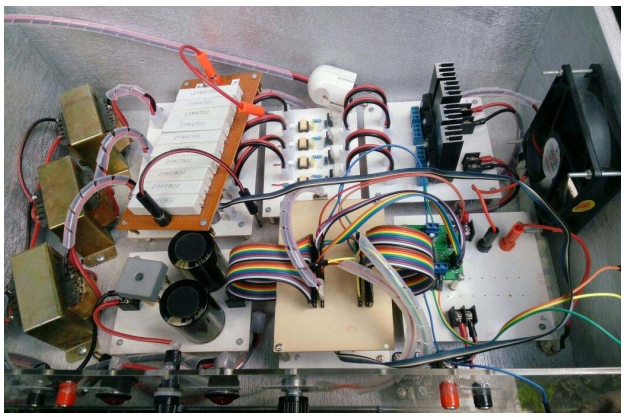

Fig. 6. Hardware Setup

Specification of a full bridge single phase inverter based on Fig. 6 as follows :

1. Single phase AC voltage source is used to supply power circuits and control circuits.
2. The DC voltage supply for the inverter power circuit is obtained from AC voltage rectification using bridge rectifier.
3. Supply 15V DC for MOSFET driver circuit and DSPIC30F4011 microcontroller obtained from AC transformer output rectifier result using center-tapped full wave rectifier.
4. DSPIC30F4011 16-Bit Microcontroller is used to generate Proportional Resonant control signals based on the actual current measured by the sensors and reference currents provided. The reference current is generated through potentiometer reading through the ADC facility.

5. TLP250 is used as MOSFET driver with DC supply having different ground on high side of one phase inverter.
6. The type of designed inverter is a full bridge single phase inverter, consisting of four IRF460 type MOSFETs.
7. The ACS712-05B current sensor is used to measure the inverter output current and send the voltage information to the DSPIC30F4011 microcreoler via the ADC facility.
8. Digital-to-Analog Converter AD7302 is used to display the output voltage that represents the reference current and the actual current measured by the sensor on the oscilloscope.
9. The load block consists of a load connected to a single phase inverter output. The load used in the design is a resistor.
10. The voltage sensor circuit is used for signal conditioner so that the voltage could be read by the microcontroller DSPIC30F4011

C. *Matlab Simulation*

The method to simulate a synchronized single phase inverter and observe changes in the result of a proportional resonant current control can be done using matlab software, as shown in Fig. 7.

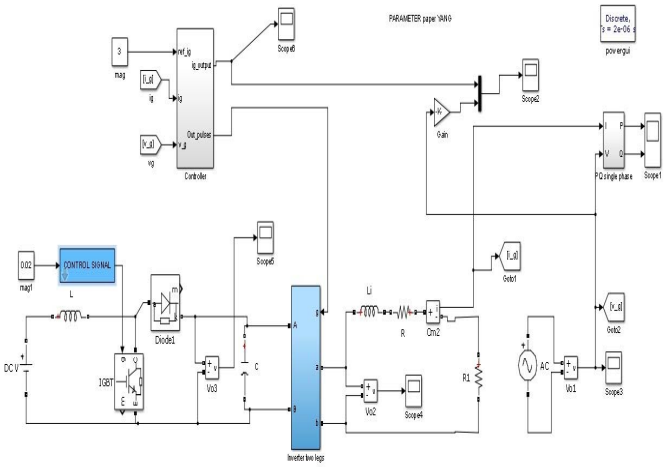

Fig. 7. Single Phase Inverter Simulation in Matlab[9]

IV. Results and Discussion

A. *Single-Phase PV Inverter Based on Open Loop Control*

The test results in Fig. 8 obtained the form of reference output current reference wave 2 A (yellow) with actual current (blue) of 2 div. Reference Current 2 A with Actual current at load 4 Ohm (t / div = 5ms). However, the waveform of the actual current can not follow the waveform of the reference current because the gain value of the controller is insufficient to reach the reference. Ripple currents that occur due to inductor filter values that are less appropriate. The wave observations are performed on v / div = 1 V, t / div = 5 ms, and 1x oscilloscope scale.

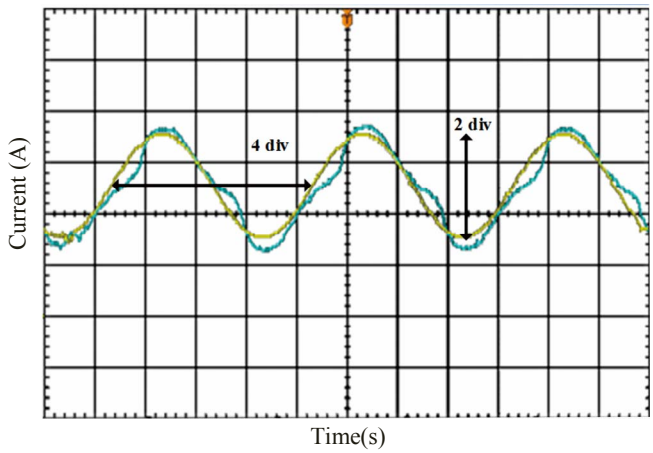

Fig. 8. Testing Inverter with Open Loop Control

B. *Simulation Result*

System block diagram has been simulated on Matlab Simulink. Table 1 is a summary of the system parameter values.

Table 1. Simulation parameters

Parameter	Description	Value
L	Inductor filter	3.8 mH
R	Inductor resistance	0.02 Ohm
f	Grid frequency	50 Hz
Vdc	DC bus voltage	350 V
Vac	AC Voltage Source	310 V
RL	Load	100 Ohm
Iref	Current reference	3 Ampere

The signal is synchronized with the AC Voltage source but less in the transient response. The signal output starts to stabilize at the fifth harmonic. The observed current is the reference current and the output current of the PR control. It is synchronized with AC Voltage Source with frequency 50Hz. K_p and K_i will be changed based on gain. $K_p$is smaller than K_i, K_p is equal to K_i and K_p is bigger than K_i.

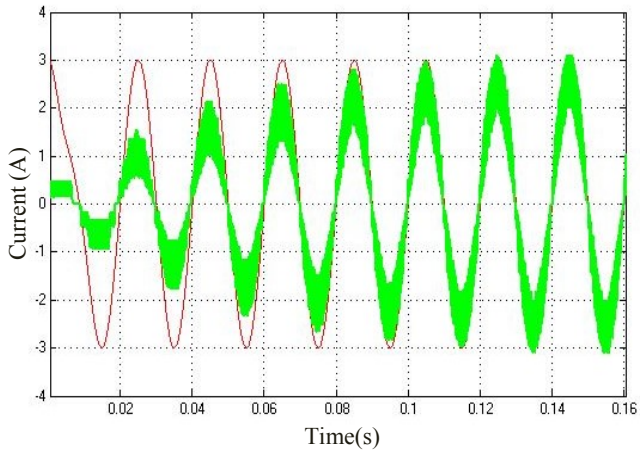

Fig. 9. Measurement of Parameters (K_p= 10 and K_i = 1000)

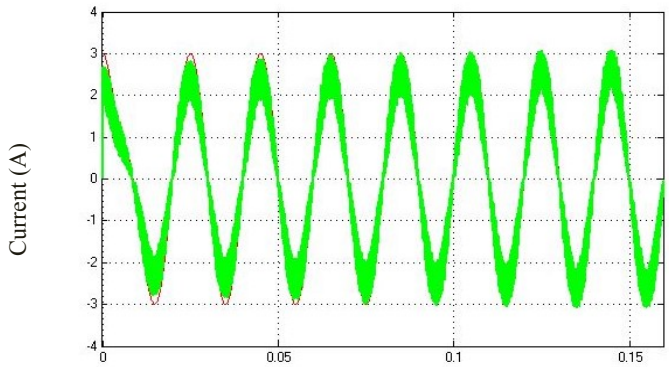

Fig. 10. Measurement of Parameters (K_p= 300 and K_i = 1000)

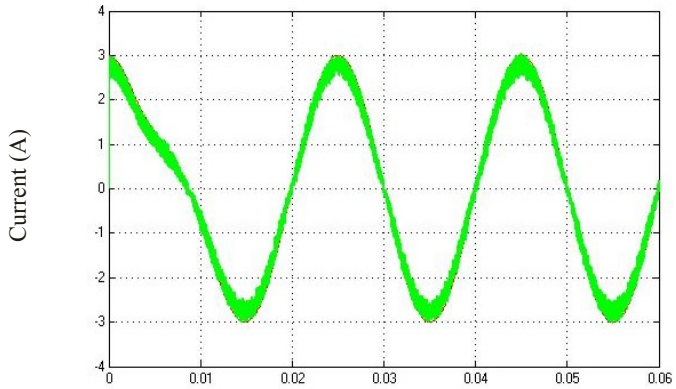

Fig. 11. Measurement of Parameters (K_p= 900 and K_i = 1000)

Fig. 9, 10, and 11 shown that proportional gain affects a transient response. The greater of gain make good stability. Fig. 12 showK_p= 1000 and K_i= 200. Current control to reference faster transient response in first, second and third harmonic and small stady state error.Average total harmonic distortion in 950-1 seconds is 4.66%. When K_p and K_i is equal, error decreases. Average total harmonic distortion in 950-1 seconds harmonic is 2%. Result as shown in Fig. 13. The advantage of the PR method is the gain can be very high in K_p and K_i because the output signal will remain resonant at a certain frequency of 50 Hz. The parameter set onω_0. The result of the integral gain measurement is K_i reducing steady state error.

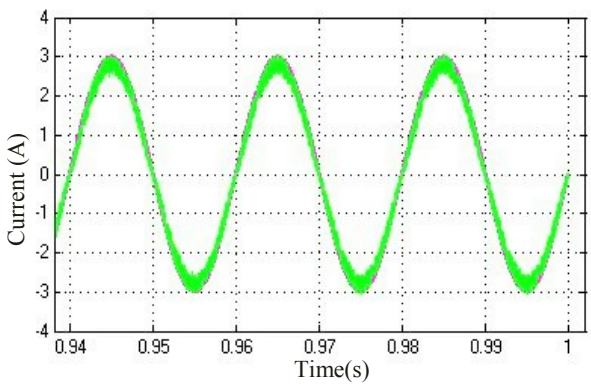

Fig. 12. Output of Proportional Resosnant Control , K_p= 1000 and K_i = 200

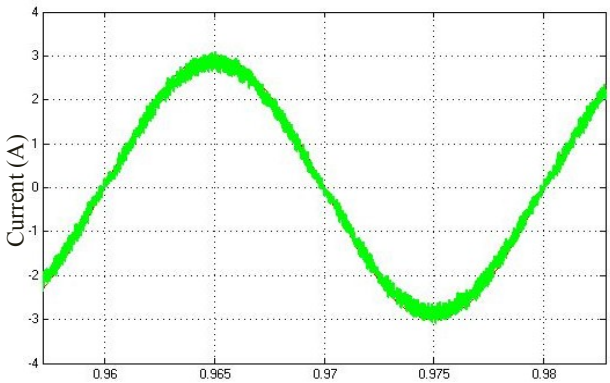

Fig. 13. Output of Proportional Resosnant Control , K_p= 1000 and K_i = 500

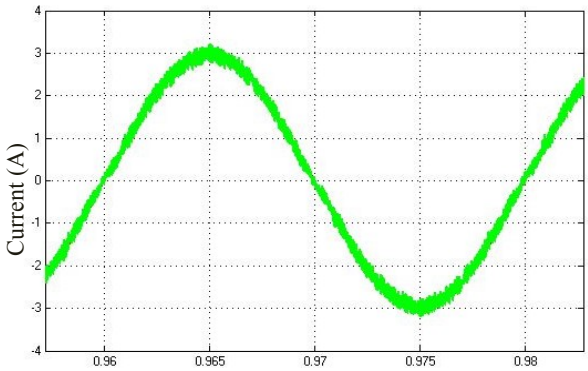

Fig. 14. Output of Proportional Resosnant Control , K_p= 1000 and K_i = 3000

C. *Simulation Measurement of Synchronized Inverter Current*

After the current is injected according to the reference, it is ensured the current is synchronized with ac voltage source. phase angle is the trigger of the injection process. The phase wave determines input phase angle of the wave. When the maximum peak voltage (maximum amplitude), the phase wave will be at the lowest point. The maximum and minimum values of the phase angle will be in the same position so that 0 and 2π are in the same place (synced). The current wave can be synchronized at 20ms as shown in Fig. 15.

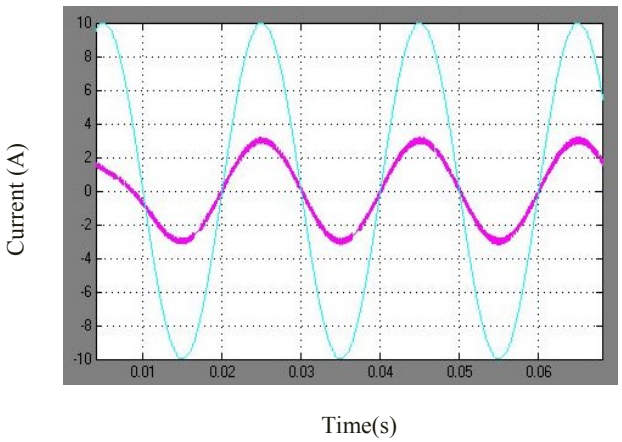

Fig. 15. Output Current Control

V. CONCLUSION

From the simulation result, it can be concluded that Proportional resonant method could follow the50 hz time varying current reference with good result. The Important control parameter:the Proportional gain will be directly influence the dynamic of the transient response and stability. Whereas the resonant gain in this control scheme will eliminate steady state error on the magnitude current. The real time implementation of this control method will be accomplished in the next work.

ACKNOWLEDGMENT

This work is part of the research progamme RPI with project number 385-88/UN7.P4.3/PP/2018, which is financed by UniversitasDiponegoro (UNDIP) Semarang, Indonesia

REFERENCES

[1] Setiawan, Iwan, Ardyono Priyadi, Hajime Miyauchi, and Mauridhi Hery Purnomo. "Adaptive B□spline neural network□based vector control for a grid side converter in wind turbine□DFIG systems." IEEJ Transactions on Electrical and Electronic Engineering 10, no. 6 (2015): 674-682.

[2] C. Alexandra, A. M. Almaktoof, and A. K. Raji, "Development of a Proportional + Resonant (PR) Controller for a Three-Phase AC Micro-Grid System," Int. Conf. Electr. Electron. Eng. Clean Energy Green Comput., pp. 107–112, 2013.

[3] R. Teodorescu and F. Blaabjerg, "Proportional-resonant controllers. A new breed of controllers suitable for grid-connected voltage-source converters," 9th Int. Conf. Optim. Electr. Electron. Equipments, pp. 9–14, 2004.

[4] A. Yazdani and R. Iravani, Voltage-Sourced Converters in Power Systems. 2010.

[5] R. Teodorescu, F. Blaabjerg, M. Liserre, and P. C. Loh, "Proportional-resonant controllers and filters for grid-connected voltage-source converters," vol. 153, no. 5, 2006.

[6] C. S. S. D. Zammit M. Apap, "Comparison between PI and PR Current Controllers in Grid Connected PV Inverters," Int. J. Electr. Robot. Electron. Commun. Eng., vol. Vol:8, no. No:2, p. 6, 2014.

[7] F. Bin Deraman, "Development of Pid Current Control for Dc Motor Using," Universiti Tun Hussein Onn Malaysia, 2014.

[8] A. Hasanzadeh and H. Mokhtari, "A SIMPLIFIED DROOP METHOD IMPLEMENTATION IN PARALLEL UPS INVERTERS WITH PROPORTIONAL-RESONANT CONTROLLER," Iran. J. Sci. Technol., vol. 33, pp. 163–178, 2009.

[9] L. Yang, C. Xiong, Y. Teng, Q. Hui, and Y. Zhu, "Harmonic Current Suppression of Grid-Connected PV Based on PR Control Strategy," Proc. - 2015 6th Int. Conf. Intell. Syst. Des. Eng. Appl. ISDEA 2015, pp. 433–436, 2016.

[10] Setiawan, Iwan, Mochammad Facta, Ardyono Priyadi, and Mauridhi Hery Purnomo. "Comparison of three popular PLL schemes under balanced and unbalanced grid voltage conditions." In Information Technology and Electrical Engineering (ICITEE), 2016 8th International Conference on, pp. 1-6. IEEE, 2016.

[11] Setiawan, Iwan, Mochammad Facta, Ardyono Priyadi, and Mauridhi Hery Purnomo. "Investigation of Symmetrical Optimum PI Controller based on Plant and Feedback Linearization in Grid-Tie Inverter Systems." INTERNATIONAL JOURNAL OF RENEWABLE ENERGY RESEARCH 7, no. 3 (2017): 1228-1234.

[12] S. Aizam and Z. Zarafi, "Comparison Study in Various Controllers in," no. SCOReD, pp. 13–14, 2010.

[13] N. Zhang, H. Tang, and C. Yao, "A systematic method for designing a PR controller and active damping of the LCL filter for single-phase grid-connected PV inverters," Energies, vol. 7, no. 6, pp. 3934–3954, 2014.

[14] T. Ye, D. NingYi, C.-S. Lam, M.-C. Wong, and J. M. Guerrero, "Analysis , Design , and Implementation of a Quasi-Proportional-Resonant Controller for a Multifunctional Capacitive-Coupling," IEEE Trans. Ind. Appl., vol. 52, no. 5, pp. 4269–4280, 2016.

[15] C. Tarasantisuk, S. Kumsup, W. Piyarat, and K. Witheepanich, "Stationary frame current regulation using Proportional Resonant controller for single phase grid connected inverter," 2016 13th Int. Conf. Electr. Eng. Comput. Telecommun. Inf. Technol. ECTI-CON 2016, no. 2, 2016.

CERTIFICATE

This is to certify that

Abdul Haris Kuspranoto

has contributed as

Presenter

in The 5th International Conference on Information Technology, Computer and Electrical Engineering (ICITACEE) 2018
in Semarang Indonesia, September, 26-28th 2018

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