GRID CONNECTED PV PANEL WITH A dq CONTROLLED INVERTER

By

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PROBLEM STATEMENT

- Solar panels produce DC power. This DC should be converted to AC before injecting it to the grid.
- Solar panel output depends upon the irradiance and temperature, which may change throughout the day.
- Irrespective of the output of the solar panel, energy fed to the grid from the inverter should have constant voltage and frequency.

PROBLEM ANALYSIS

- The output of a solar cell is very less. MPPT technique should be used to harness the maximum power from the panel. Also this DC power output should be increased by using a boost converter before feeding to the inverter.

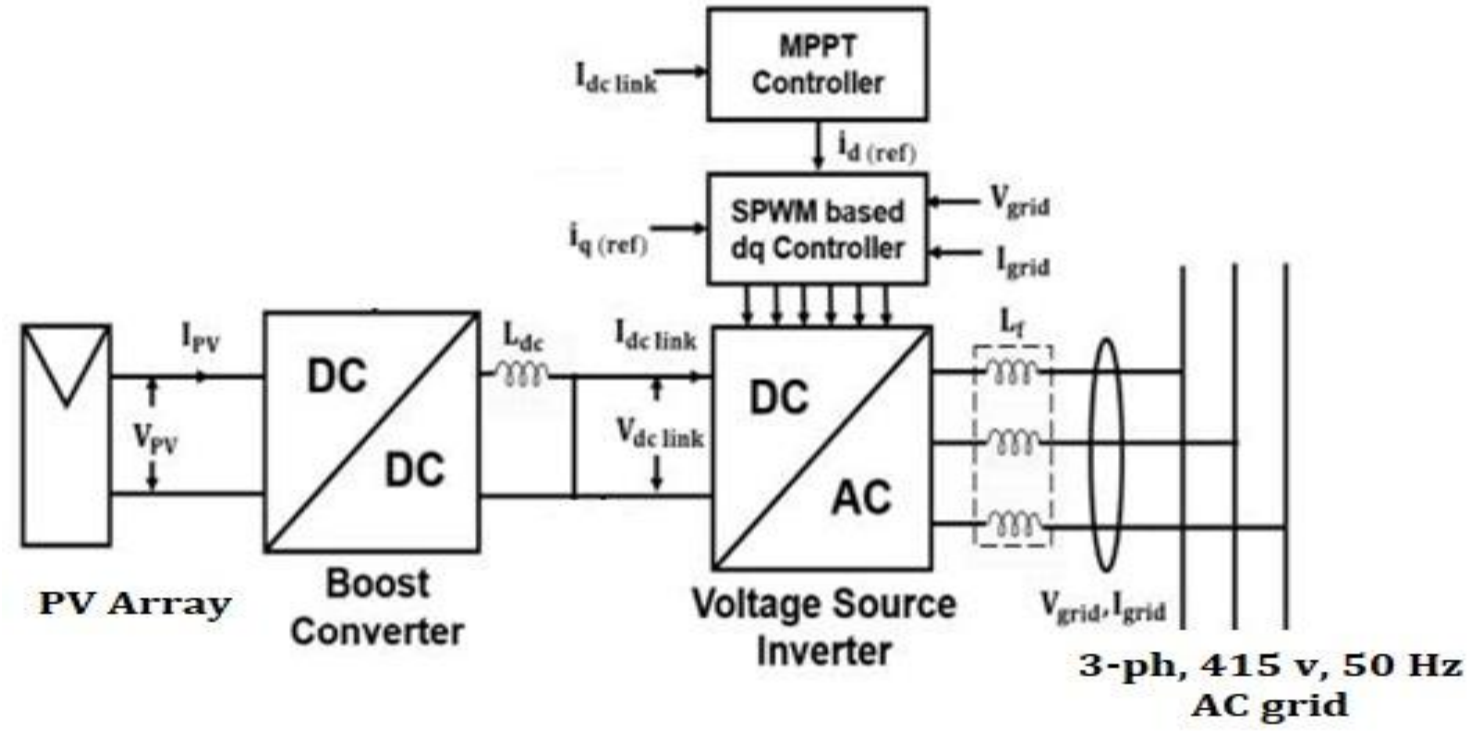
- To maintain constant voltage and frequency dq (Direct Quadrature) control method can be used.

OBJECTIVE

- The controller design and MATLAB simulation of a 3 phase grid-connected inverter is being implemented in this project.

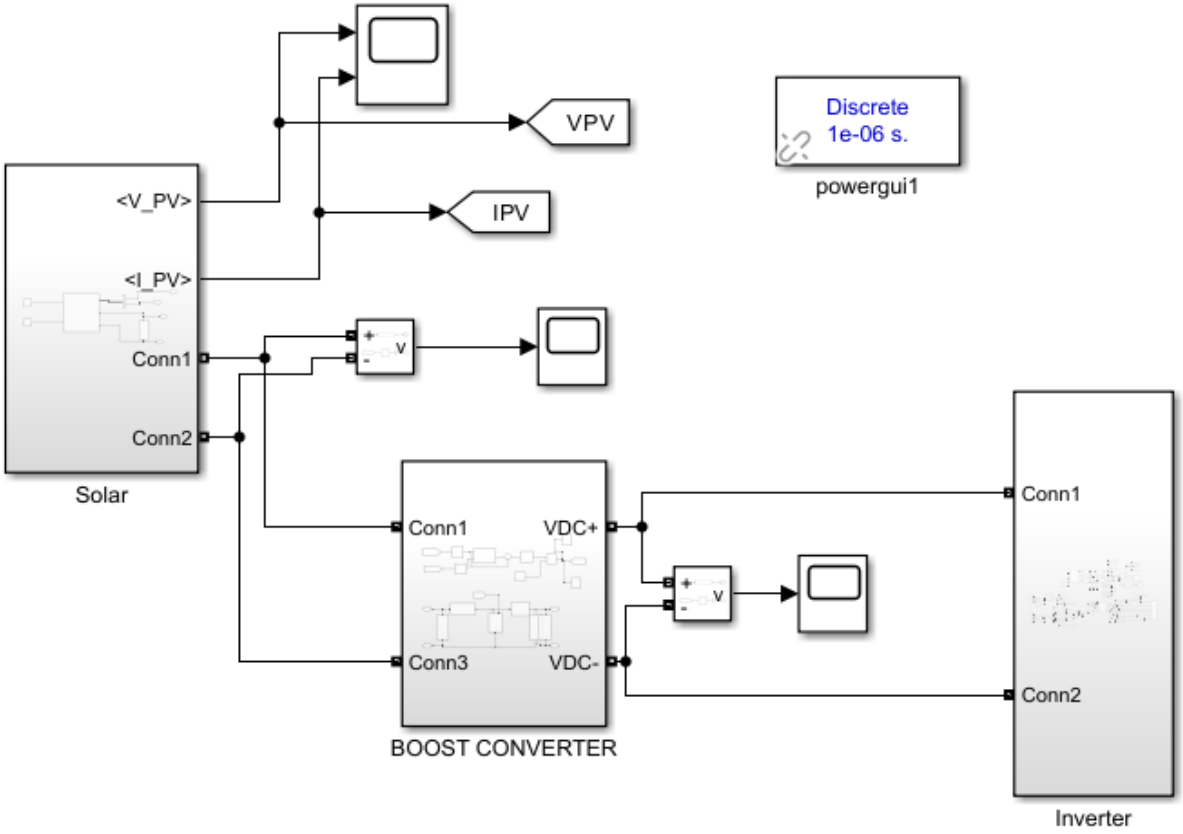
- Inverter is used to convert DC to alternating current (AC), which the electrical grid uses. The energy fed to the grid from inverter is to be maintained at constant voltage and constant frequency. To improve the dynamic response of the grid connected inverter the dq control method is used.

BLOCK DIAGRAM

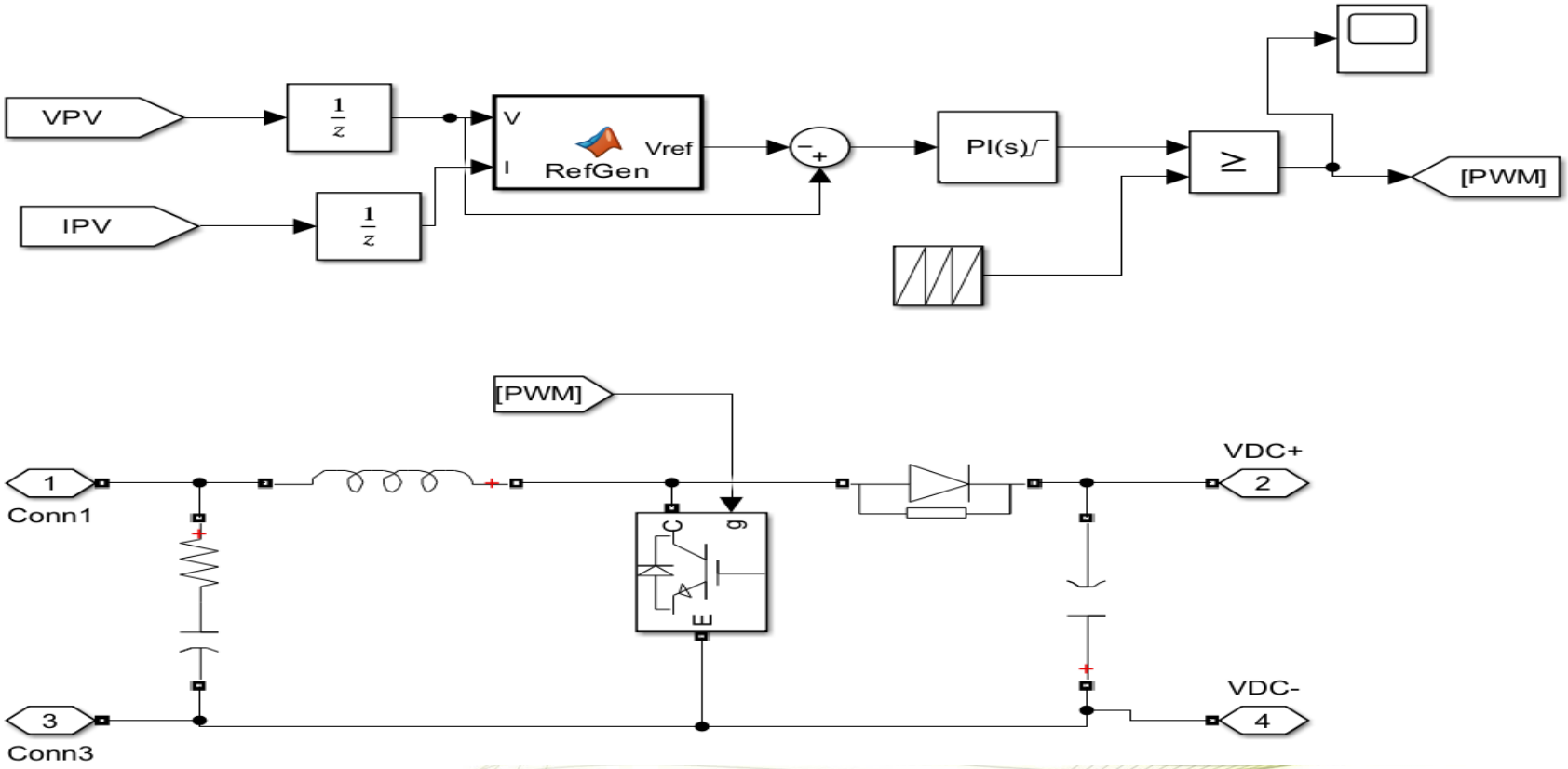


STATUS OF THE PROJECT

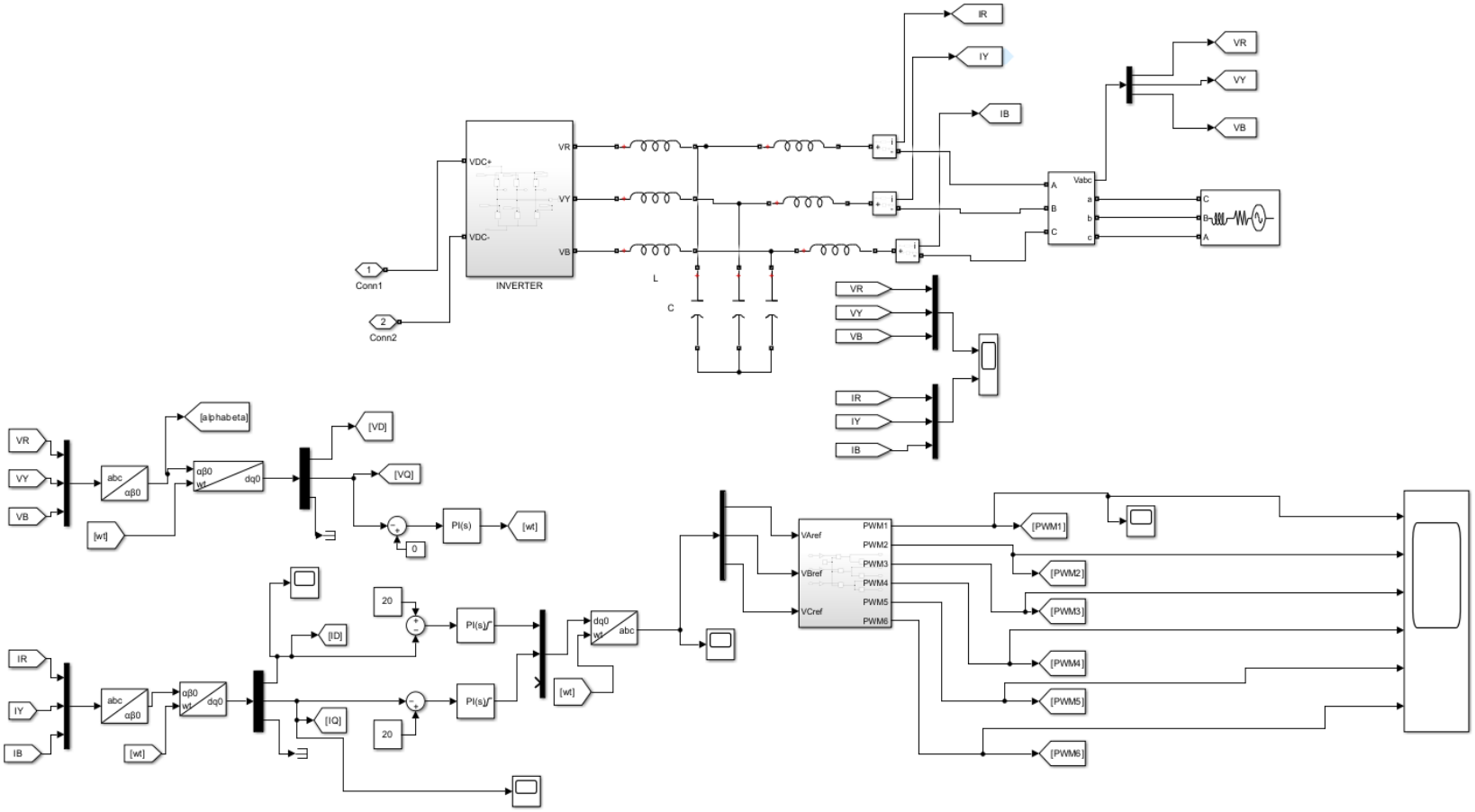
FINAL DESIGN



BOOST CONVERTER DESIGN



dq CONTROLLED INVERTER



LITERATURE SURVEY

- The idea of "Direct-quadrature Control Method To Simulate A 3 Phase Grid Connected Inverter Using Matlab" is reference to the article entitled Choi, W., Morris, C., & Sarlioglu, B. (2016, February). Modelling three-phase grid-connected inverter system using complex vector in synchronous dq reference frame and analysis on the influence of tuning parameters of synchronous frame PI controller. In *2016 IEEE Power and Energy Conference at Illinois (PECI)* (pp. 1-8). IEEE.

- The information about MPPT Techniques for PV Systems is referred to the paper "Beriber, D., & Talha, A. (2013, May). MPPT techniques for PV systems. In *4th International conference on power engineering, energy and electrical drives* (pp. 1437-1442). IEEE".

- The information of the design of closed loop Boost converter using PI Controller referred to the paper "Hasaneen, B. M., & Mohammed, A. A. E. (2008, March). Design and simulation of DC/DC boost converter. In *2008 12th International Middle-East Power System Conference* (pp. 335-340). IEEE".

- The information about dq controlled inverter referred to the paper "Makovenko, E., Husev, O., Roncero-Clemente, C., Romero-Cadaval, E., & Vinnikov, D. (2017, October). Modified dq control approach for three-phase inverter. In *2017 IEEE 58th International Scientific Conference on Power and Electrical Engineering of Riga Technical University (RTUCON)* (pp. 1-3). IEEE".

EXISTING METHODS

- There are many control methods are existed for inverter such as Stationary Reference Frame Control, Natural Frame Control, Evaluation of Control Structures and dq method.

- We are using dq method because it is easy and accurate method among all these method.

TECHNOLOGIES USED

- **Software**

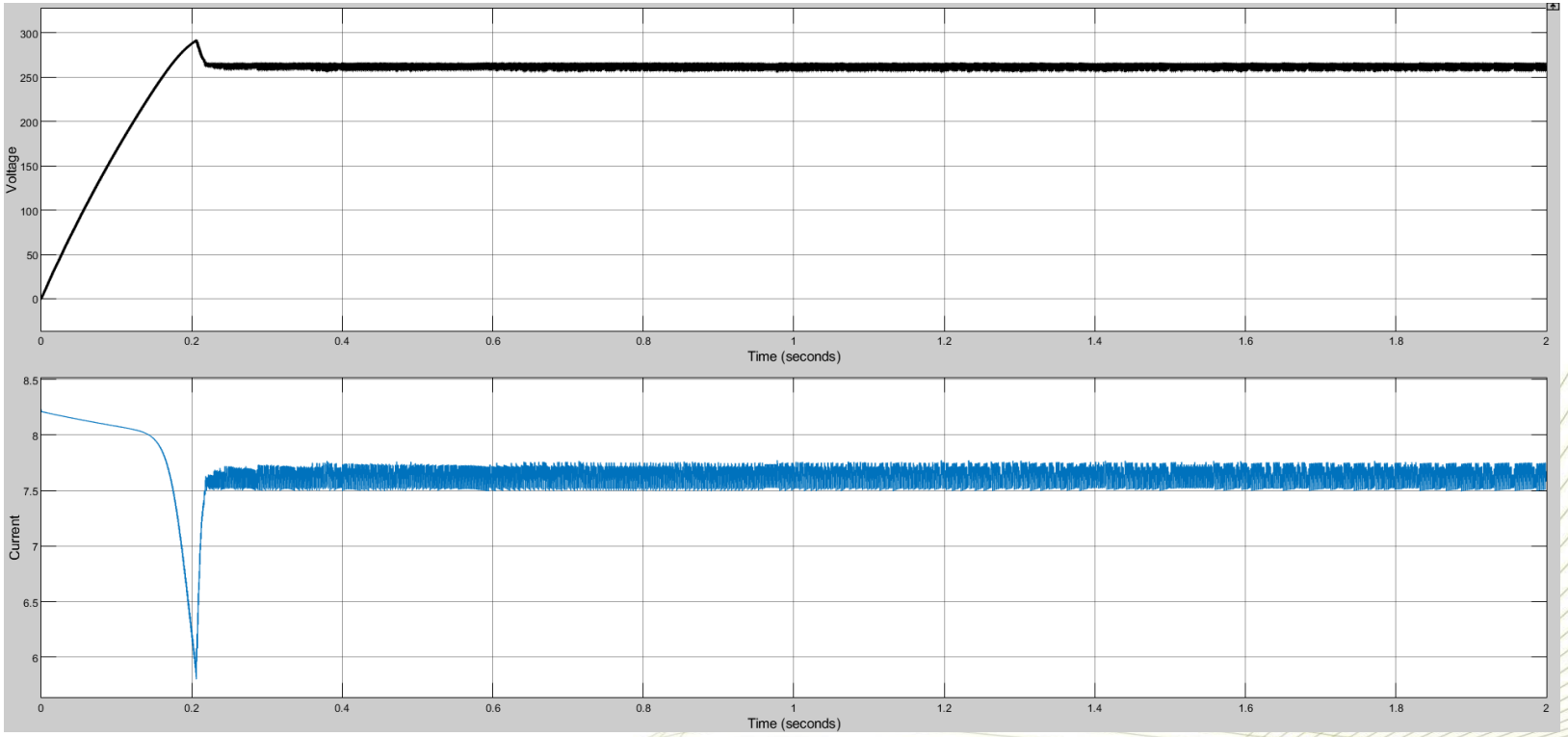
METHODOLOGY

- The output of the solar panel is less so, boost converter is used to boost up the voltage. Maximum Power Point Tracking (MPPT) is used to extract maximum available power by perturb and observe algorithm. Inverter is used to convert DC to alternating current (AC), which the electrical grid uses.

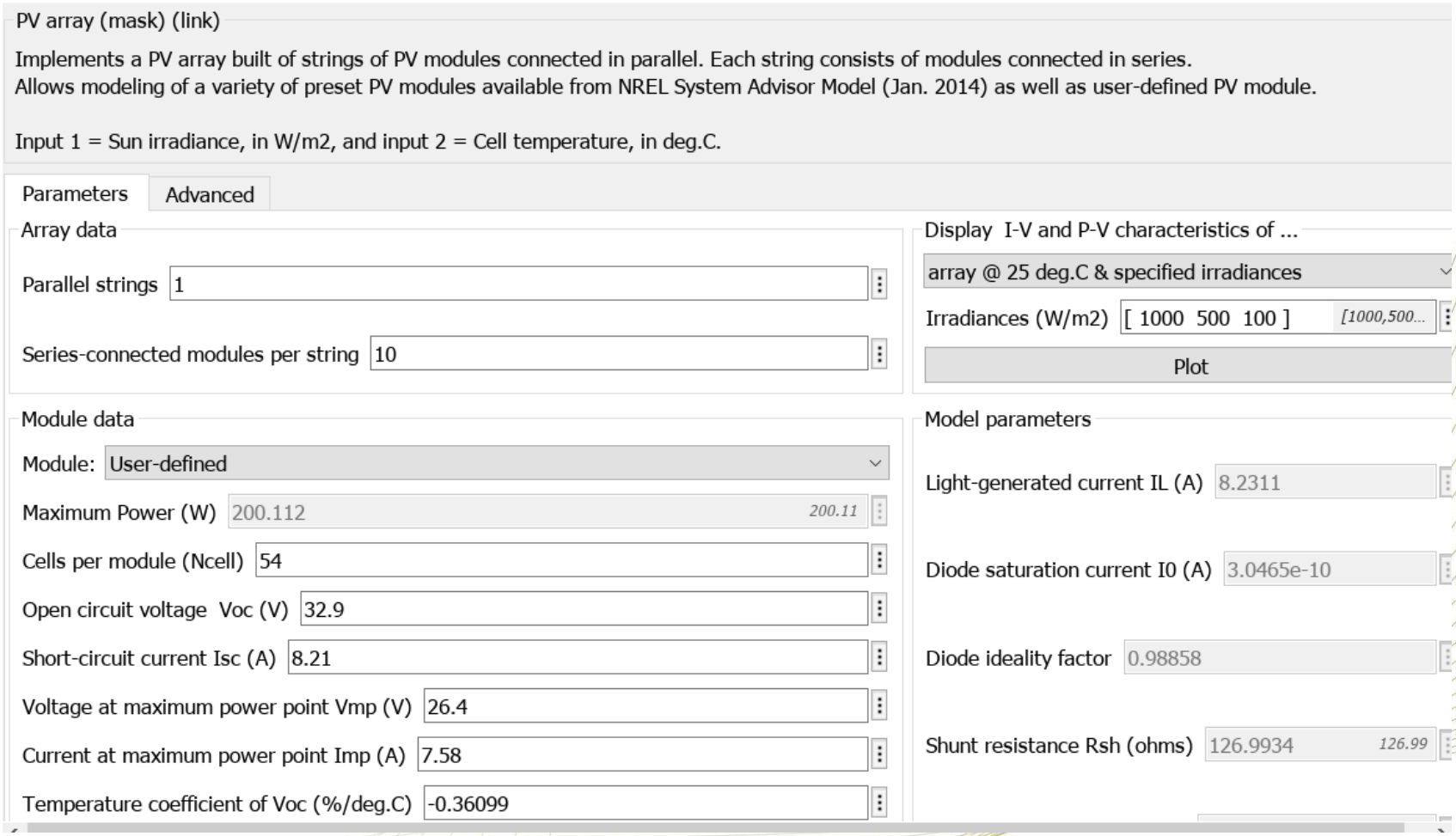
- The energy fed to the grid from inverter is to be maintained at constant voltage and constant frequency. To improve the dynamic response of the grid connected inverter the dq control method is used. This transformation is achieved by use of the Clarke and Park transformation methods, which convert the abc to αβ and αβ to dq. This transformation produces DC components.

RESULTS

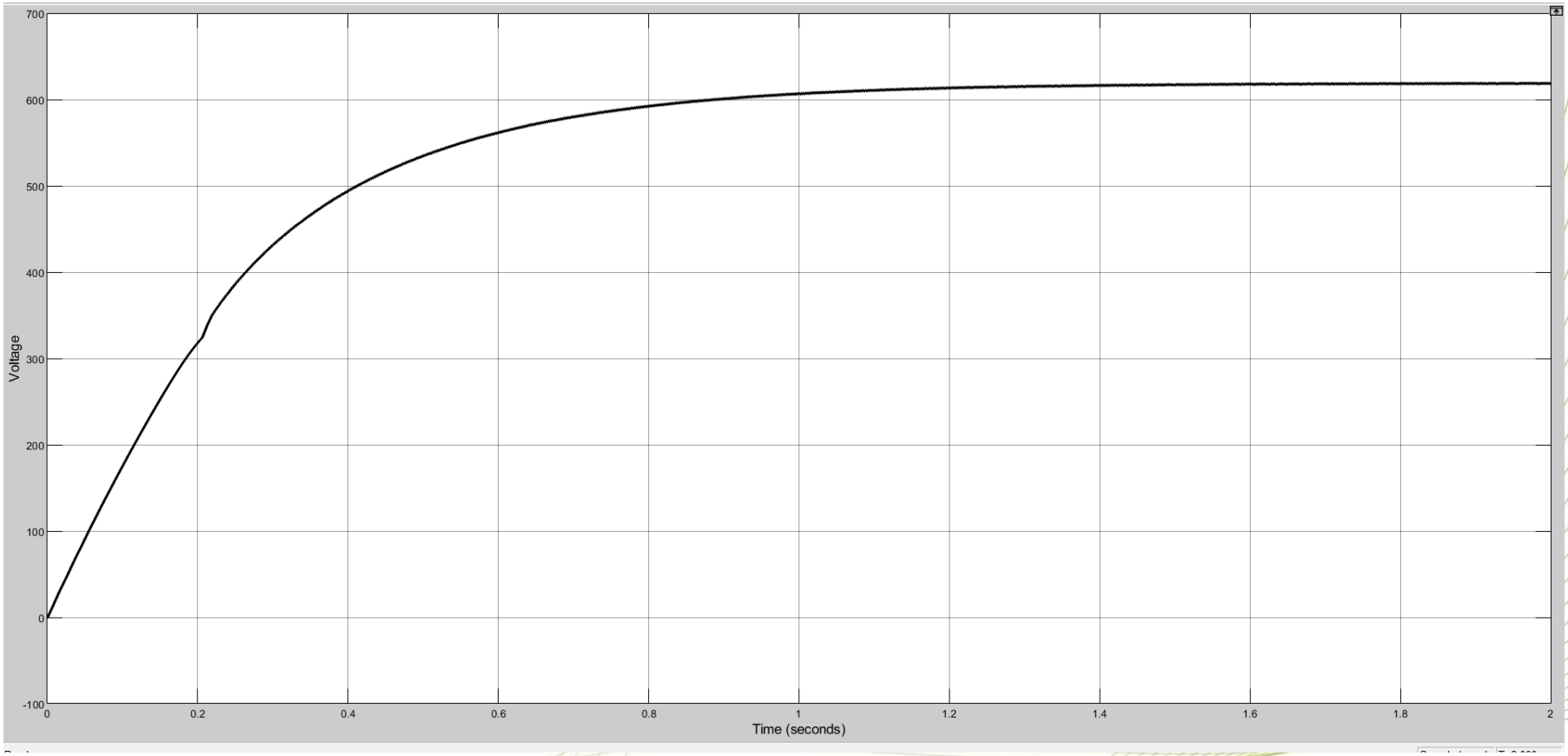
- **Solar Panel Output(Voltage vs Time) and (Current vs time)**



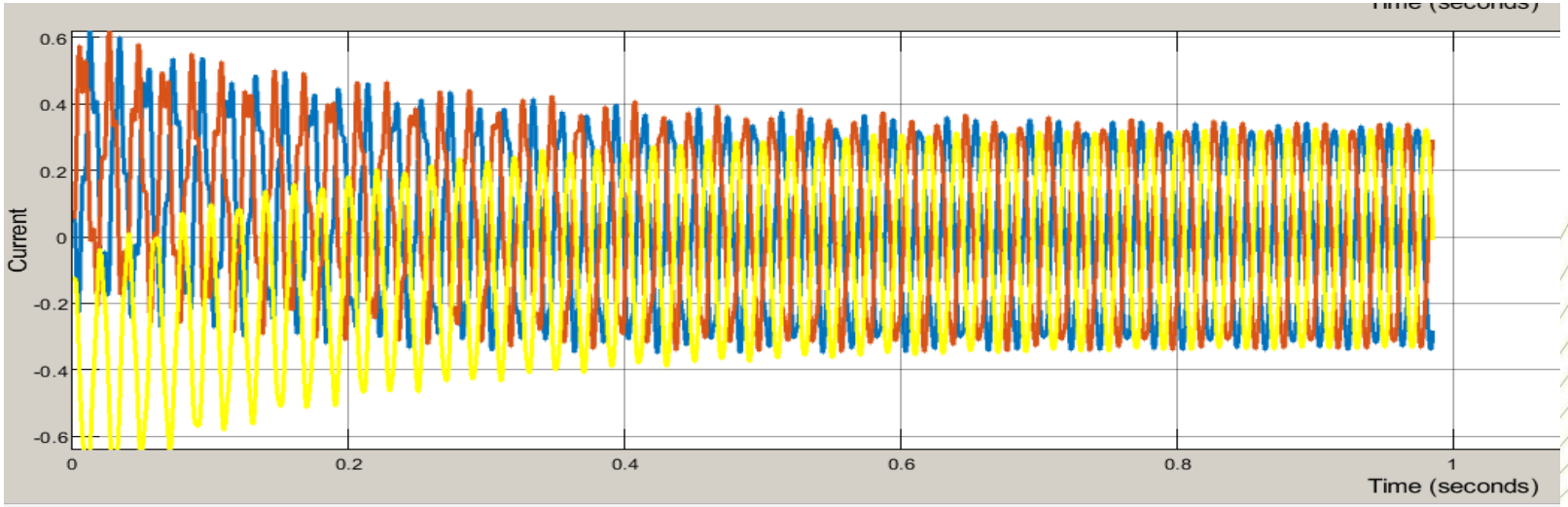
SOLAR PANEL PARAMETERS



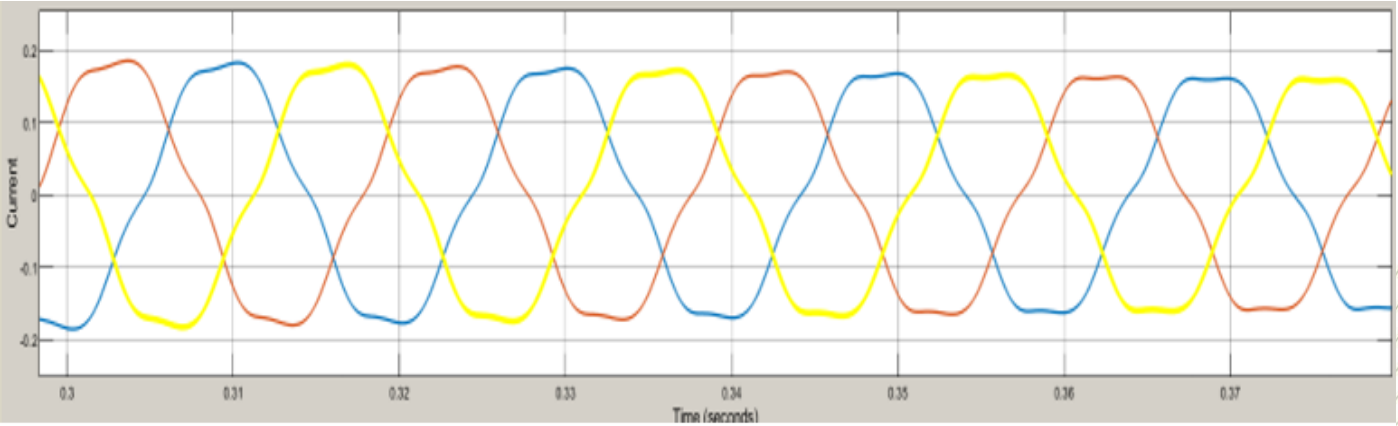
BOOST CONVERTER OUTPUT



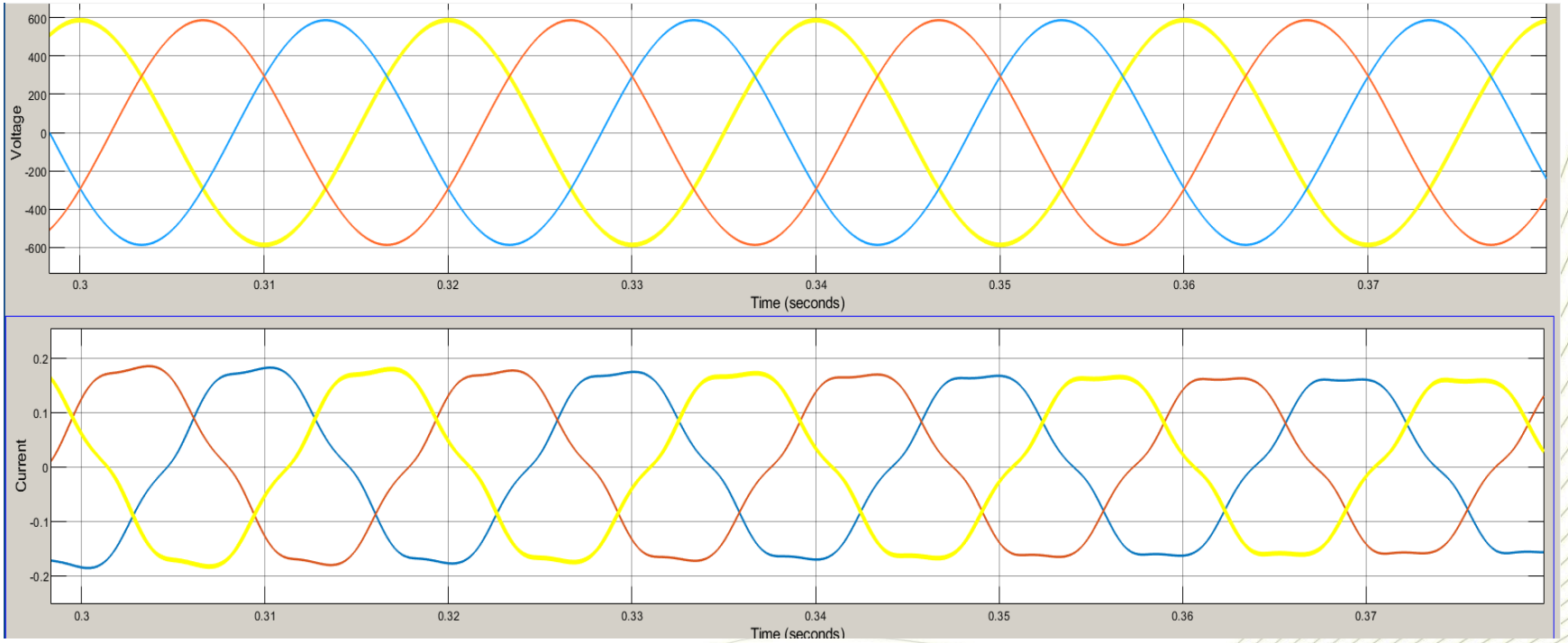
WITHOUT dq CONTROLLER CURRENT OUTPUT



WITH dq CONTROLLER CURRENT OUTPUT



DIRECT QUADRATURE OUTPUT



CONCLUSION

- The PV panel, a boost converter, an inverter and utility grid are physically modelled in this model.

- dq controlled inverter is used to maintain constant voltage and frequency at the grid. The transformation is achieved by use of the Clarke and Park transformation methods, which convert the abc to αβ and αβ to dq. dq control strategy improves the dynamic response of the grid-connected inverter.

FUTURE SCOPE

- Instead of dq method fuzzy logic control method can be used.
- Fuzzy logic control (FLC) techniques usually decompose a complex system into several subsystems according to the human experts' knowledge about the system.
- The major advantages of fuzzy logic control includes better error detection and correction, wider range of operating conditions and more readily customizable.

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THANK YOU