Uluslararası İleri Doğa Bilimleri ve Mühendislik Araştırmaları Dergisi
Sayı 7, S. 6-10, 4, 2023

Araştırma Makalesi

IJANSER
https://as-proceeding.com/index.php/ijanser
ISSN: 2980-0811

International Journal of Advanced Natural Sciences and Engineering Researches
Volume 7, pp. 6-10, 4, 2023

Research Article

Control of Three-Phase Dimmer using Xilinx System Generator

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(Received: 8 April 2023, Accepted: 16 April 2023)

(DOI: 10.59287/ijanser.2023.7.4.496)

(1st International Conference on Scientific and Innovative Studies ICSIS 2023, April 18-20, 2023)

ATIF/REFERENCE: Mohamed, C., Kamel, M. & Lamri, L. (2023). Control of Three-Phase Dimmer using Xilinx System Generator. *International Journal of Advanced Natural Sciences and Engineering Researches*, 7(4), 6-10.

Abstract – Dimmers are alternative converters used to make dimmers for some devices running on the network, as well as in many industrial processes, in this work, the PWM control was presented for a three-phase dimmer associated with an asynchronous machine, first the Matlab/Simulink software was used and then the control was carried out using the Xilinx System Generator tool, the results obtained are comparable for the two implementation software have shown the operation of the dimmer as a starter for the asynchronous machine.

Keywords – Dimmer; PWM Control; System Generator; Asynchronous Machine.

I. Introduction

Dimmers are considered as the solution for the start-up of three-phase asynchronous machines, Dimmers can ensure the control and adjustment of the current flow by a source

Alternative in a load also alternative, with effective value controlled without change of frequency, the variation of this effective value is done by cutting the voltage using a static switch.

Several dimmer control strategies have been studied [1] [2] and implemented with different tools, in this work we present the PWM command for a three-phase dimmer associated with an asynchronous machine since its simplicity of implementation and its efficiency begin with the simulation using the Matlab/Siumlink tool then uses the Xilinx System generator tool for implement the order and finally compare the results.

The method of simulation and implementation of the dimmer command followed by the presentation and discussion of the implementation and synthesis results ends the work with a conclusion.

II. Control of Three-Phase Dimmer

A. *Definition*

The dimmer is a device that allows to convert a sine alternative voltage with fixed frequency and constant effective value into an alternative voltage with adjustable effective value.

The dimmer consists of two parts:

- the power part consists of two Thyristors mounted «head-to-head» for strong power (> 10 kW) or triac for lower power Fig 1.
- the control part consists of various electronic circuits for drawing up thyristor control signals from an external control order [3].

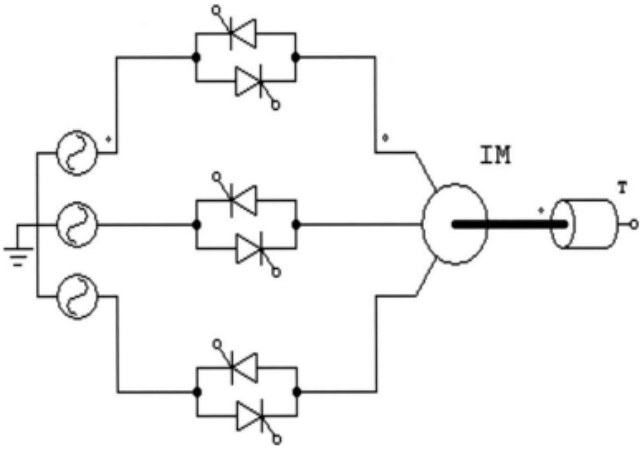


Fig. 1 Three-phase dimmer [4].

B. Application of dimmers

Dimmers are simple converters to make. They are used for:

- Lighting/lighting control in AC power circuits.
- Induction heating.
- Industrial heating and domestic heating.
- Transformer Tap Change (when hanging transformer taploads).
- Speed regulation of induction motors
- AC Magnet Controls

C. Implementation of a Dimmer Control

In this part of our work we will perform the control of a three-phase dimmer associated with an asynchronous machine, we will first use the Matlab/Simulink software then in the second step we use the Xilinx System generator tool for the implementation of the command with a comparison of the results of the two implementation tools [5].

C.1.Simulation with Matlab/Simulink

We use the matlab/Simulink software to simulate the PWM control for a three-phase dimmer, the PWM control based on the comparison of a sinusoidal signal called the modulation with a triangular signal called the carrier, Figure 2 shows the simulation diagram of the pwm control for a three-phase dimmer associated with an asynchronous machine.

- Simulation and implementation Parameters

Sampling period Ts = 2 -20
400 V dimmer power supply voltage
Power frequency F = 50 HZ
Machine parameters
Power voltage V = 400 V
Frequency F = 50HZ
Power P = 4KW
Rotation speed = 1430 RPM
Resistive torque Tr = 2 NM

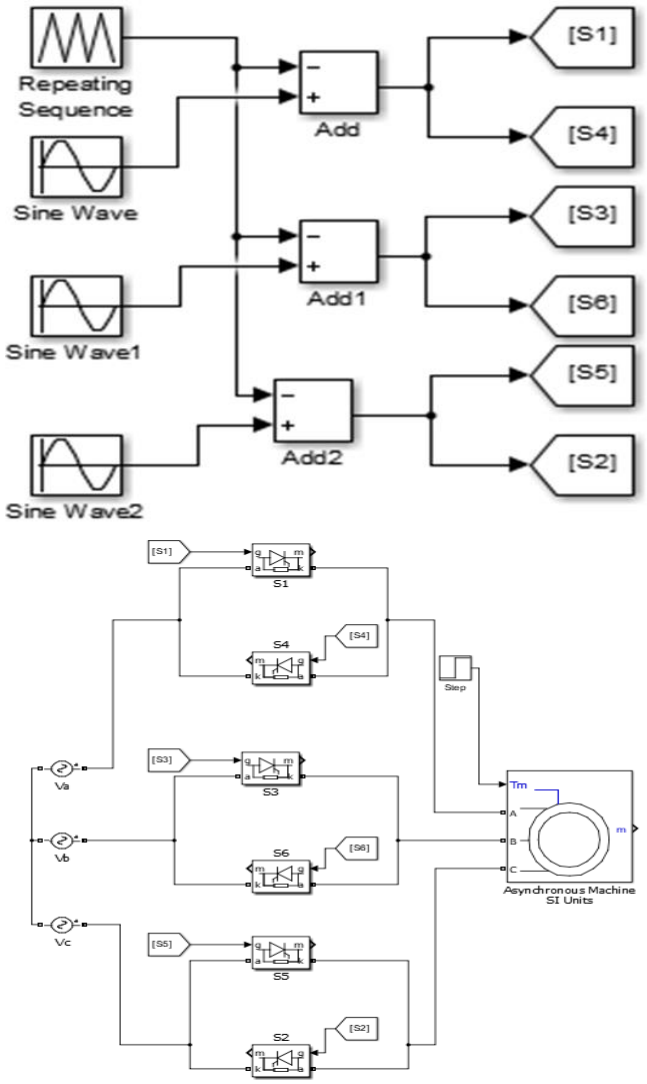


Fig. 2 Diagram of the PWM control of a dimmer using matlab/Simulink.

C.2.Implementation of the control PWM with Xilinx System generator

For the implementation of the PWM control for the dimmer we take advantage of the tool of xilinx System generator [6] which allows us later the implementation in real time on the FPGA board using the technique IN THE LOOP after some HDL conversion steps, Figure 3 shows the main system generator block.

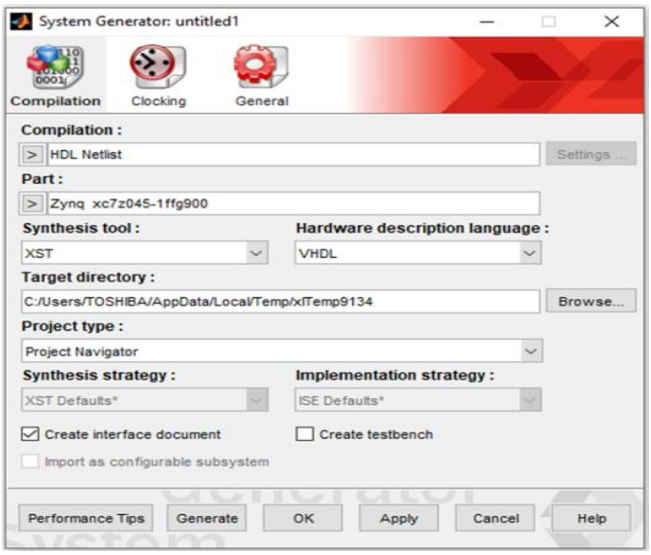


Fig. 3 the main system generator block.

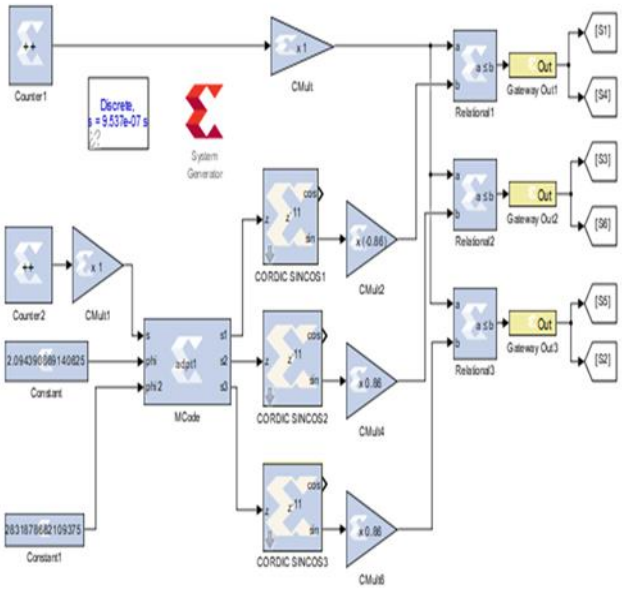
We use the system generator blocks to generate the modulation and the carrier

- The three signals of sine modulation

The idea is based on the use of a counter followed by a multiplier followed by a CORDIC SICOS block in order to obtain a pure sinusoidal signal with a gain of 0.86 to determine the amplitude of the signal, a function using the MCODE block added ADPT to phase the three 120° signals.

- Carrier signal

The triangular signal of the carrier was generated using an Up counter followed by a multiplier to determine their amplitude; Figure 4 shows us the block diagram of the three signals comparable with the carrier using Xilinx System Generator.



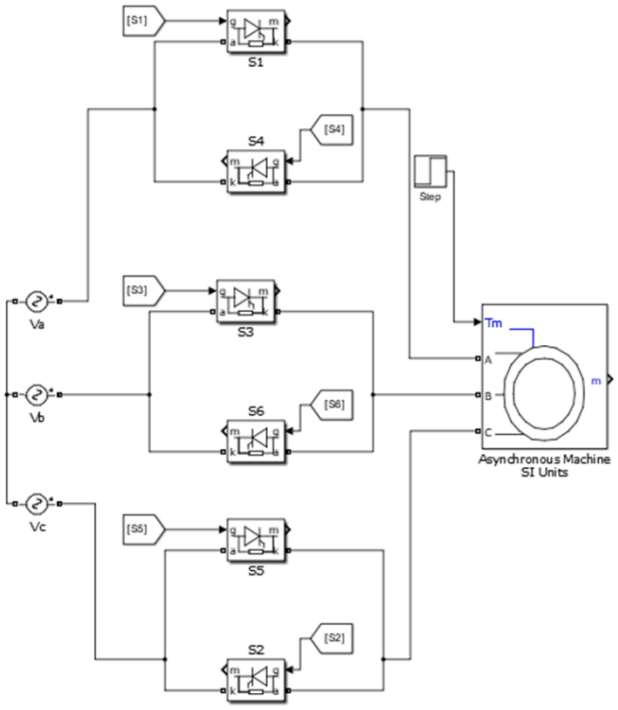


Fig. 4 Implementation diagram of the dimmer PWM control using Xilinx System Generator.

III. RESULTS

The results were considered as results for both implementation software the following parameters

Control signal for a dimmer arm

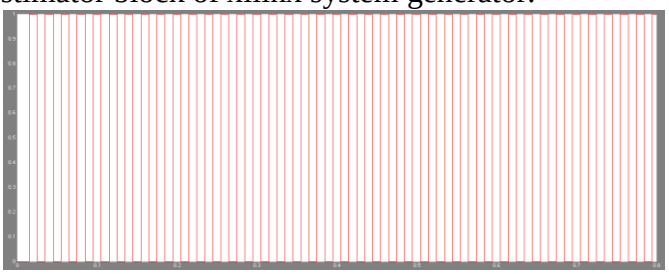
The rotation speed of the machine

The electromagnetic torque

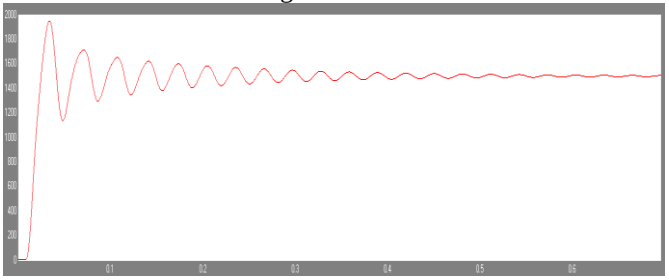
The dimmer output voltage

The current of the machine stator.

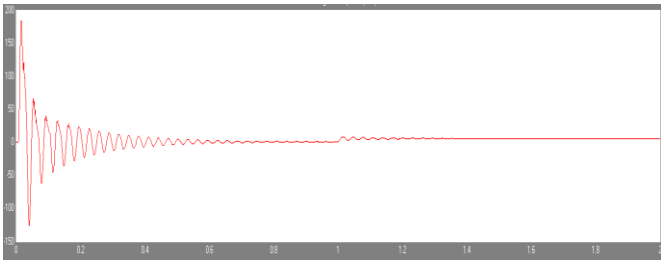
The synthesis results for Xilinx System generator,Figure 5 shows the simulation and implementation results and Figure 6 shows the synthesis results obtained using the Resource Estimator block of xilinx system generator.



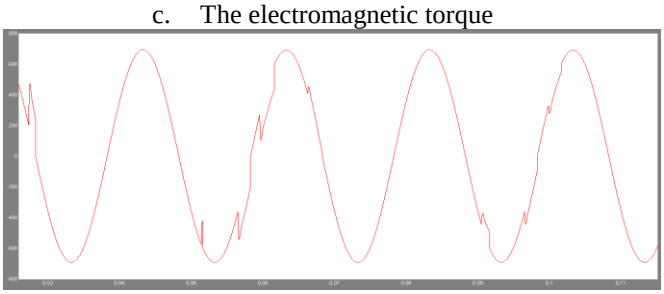
a. Control signal for a dimmer arm



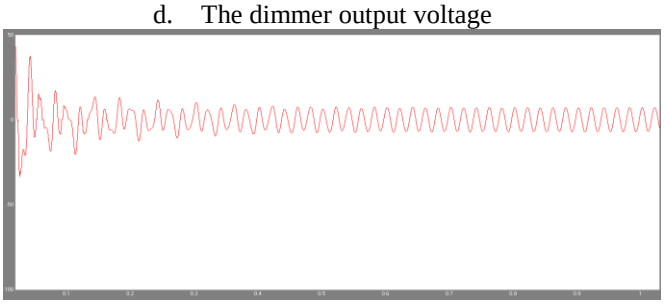
b. The rotation speed of the machine



c. The electromagnetic torque

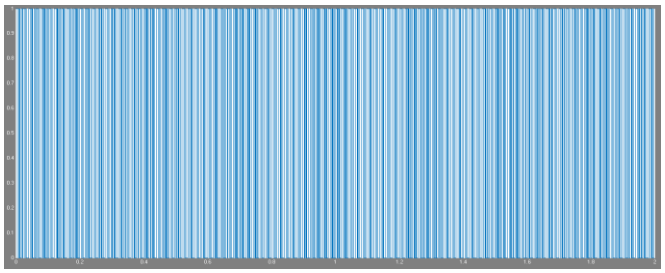


d. The dimmer output voltage

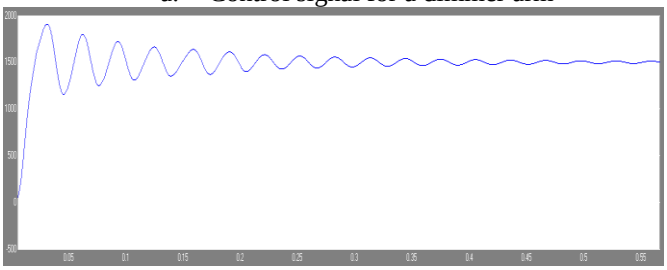


e. The current of the machine stator

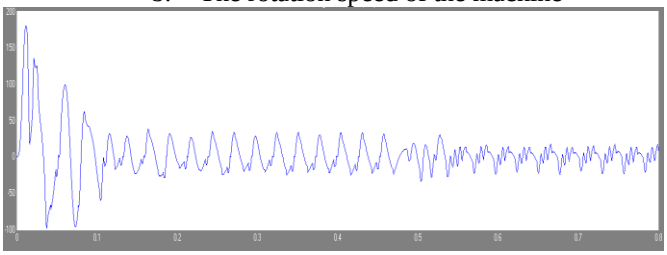
1. Simulation results with Matlab/Simulink



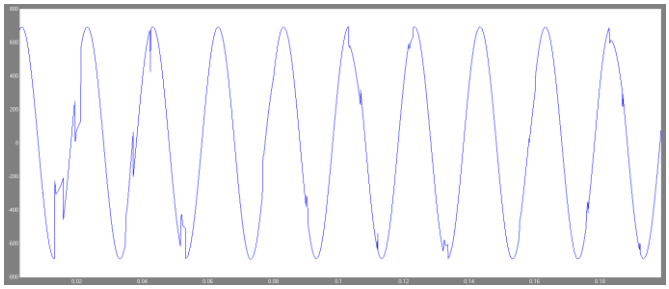
a. Control signal for a dimmer arm



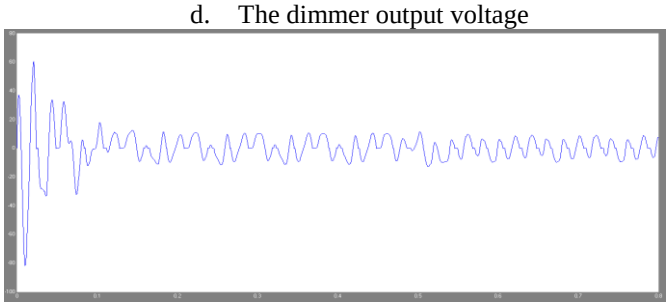
b. The rotation speed of the machine



c. The electromagnetic torque



d. The dimmer output voltage



e. The current of the machine stator

2. Implementation results with Xilinx System Generator

Fig. 5 Simulation and implementation results.

Fig. 6 synthesis results.

IV. DISCUSSION

We analyze the rotation speed curve of the machine we see the gradual increase of the speed during the start which confirms the efficiency of the dimmer in the start, the simulation results with Matlab/Simulink and the implementation results with Xilinx System Generator are comparable, concerning the synthesis results we find that the consumption of resources is acceptable.

CONCLUSION

In this work we presented a simulation of the PWM command for a three-phase dimmer associated with an asynchronous machine followed by an implementation on the Xilinx System Generator tool, the results obtained showed the efficiency of the dimmer controlled with the PWM technique to start the machine gradually, the operation of the control using the Xilinx System generator allows us to carry out the control in real time using the IN THE LOOP technique on the FPGA board.

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