Technical University of Sofia ‘2020, FA

PhD proof of work

Atanas Yanev

2020, Sofia, Bulgaria

Agenda

- Overview
- Timeline
  - 2016-2017
  - 2017-2018
  - 2018-2019
  - Summary
- Publications
- Upcoming

Overview

Start of the doctorate: 01.07.2016

Dissertation topic: Modeling and analysis of electromagnetic emission of electrotechnical objects

Scientific advisers: Assoc. Prof. Dr. Atanas Chervenkov

Department: Theoretical Electrical Engineering

Faculty: Automation

Doctoral Program: Theoretical Electrical Engineering

Profession field: 5.2 Electrical Engineering Electronics and Automation

2016-2017

- 2016.11 **Exams**
  - PhD exam Theoretical Electrical Engineering, 18.11.2016, grade 5.25
  - PhD second language exam - English, 21.11.2016, grade passed
- 2016.09 **XI Summer school Theoretical electrical engineering '2016**
  - Date: 15.09.2016 – 16.09.2016
  - Paper title: Simulation of sinusoidal voltage inverter using reducing switching losses PWM strategy
  - Publisher: Advanced Aspects of Theoretical Electrical Engineering Sofia '2016
  - Location: Sofia, Bulgaria
  - Authors: Atanas Chervenkov, Todorka Chervenkova, Atanas Yanev

2016-2017

- 2017.01 – 2017.06 **Erasmus+ student exchange program**
  - Jönköping University, Sweden
  - Server-side Web Development (TPWK16)
  - Client-side Programming (TKPK17)
  - Web Development with JavaScript and DOM (TWJK14)
- 2017.06 **International Conference Automatics '2017**
  - Date: 02.06.2017 – 04.06.2017
  - Paper title: Simulation of three-phase invertor for quasi-sinusoidal voltage
  - Publisher: Proceedings of the TU-Sofia, Volume 67, Issue 2, 2017, ISSN 1311-0829
  - Location: Sozopol, Bulgaria
  - Authors: Atanas Chervenkov, Todorka Chervenkova, Atanas Yanev
- 2017.07 **Attestation**
  - Date: 03.07.2017
  - Result: Passed

2017-2018

- 2017.11 **Exam**
  - Modeling of electro technical systems, grade 5.75
- 2017.12 **Exam**
  - Simulation of electro technical systems, grade 5.50
- 2018.03 – 2018.05 **Teaching**
  - Laboratory exercises – Total of 24 students, separated in 2 groups. Each group consist of 4 subgroups with 3 students each, doing one exercise per laboratory occupation
  - Information about students – Faculty of Transport, Aviation equipment and technologies (ATT), Course 2, Thread 11, Group 57

2017-2018

- 2018.06 **International Conference Automatics '2018**
  - Date: 01.06.2018 – 03.06.2018
  - Paper title: Modelling and analysis of hybrid power station
  - Publisher Proceedings of the Technical University of Sofia, Volume 68, Issue 2, 2018, ISSN 1311-0829
  - Location: Sozopol, Bulgaria
  - Authors: Atanas Chervenkov, Todorka Chervenkova, Atanas Yanev
- 2017.06 **Attestation**
  - Date: 07.06.2018
  - Result: Passed

2018-2019

- 2018.09 **XII Summer school Theoretical electrical engineering '2018**
  - Date: 13.09.2018 – 14.09.2018
  - Paper title: Numerical modeling of the magnetic field distribution in single-phase single-core transformer
  - Publisher: Advanced Aspects of Theoretical Electrical Engineering Sofia '2018, ISSN: 1313-9487
  - Location: Sofia, Bulgaria
  - Authors: Atanas Yanev, Atanas Chervenkov
- 2019.05 **PhD extending doctoral studies**
  - Date: 23.05.2019
  - Reason: 6 months abroad, Erasmus+
  - Extend period: 6 months

2018-2019

- 2019.06 **International Conference Automatics '2019**
  - Date: 01.06.2019 – 03.06.2019
  - Paper title: Interactive education web-based platform for theoretical electrical engineering related topics
  - Publisher: Proceedings of the Technical University of Sofia, Volume 69, Issue 2, 2019
  - Location: Sozopol, Bulgaria
  - Authors: Atanas Chervenkov, Atanas Yanev
- 2019.06 **16-th International Conference ELMA '2019**
  - Date: 06.06.2019 – 08.06.2019
  - Paper title: Performance analysis and modelling of grid-connected small photovoltaic system
  - Publisher: XVI-th International Conference on Electrical Machines, Drives and Power Systems ELMA '2019, IEEE
  - Location: Sozopol, Bulgaria
  - Authors: Atanas Chervenkov, Atanas Yanev, Todorka Chervenkova

2018-2019

- 2019.07 **Member of an appointed committee**
  - Date: 18.07.2019
  - Committee of developing a methodology for determining the amount of additional scholarships PhD students, Faculty of Automatics
  - Direction: N38/16.07.2019, Dean of the FA of TU-SOFIA
- 2019.06 **Attestation**
  - Date: 04.06.2019
  - Result: Passed

Summary

- **Examinations** – Passed
- **Scientific papers** – Author/co-author of 7 published (for now)
- **Student mobility** – Took part in Jonkoping University, Sweden within Erasmus+ program
- **Teaching** – Responsible for conducting laboratory exercise in electrical engineering field of study

Publications

Simulation of sinusoidal voltage inverter using reducing switching losses PWM strategy

The article examines the work of a converter that sy nthesizes sinusoidal voltage supply to the active-inductive load through method of controlled high-frequency pulses with sinusoidal pulse-width modulation

- Proven the capabilities of the inverter for the synthesis of sinusoidal output voltage

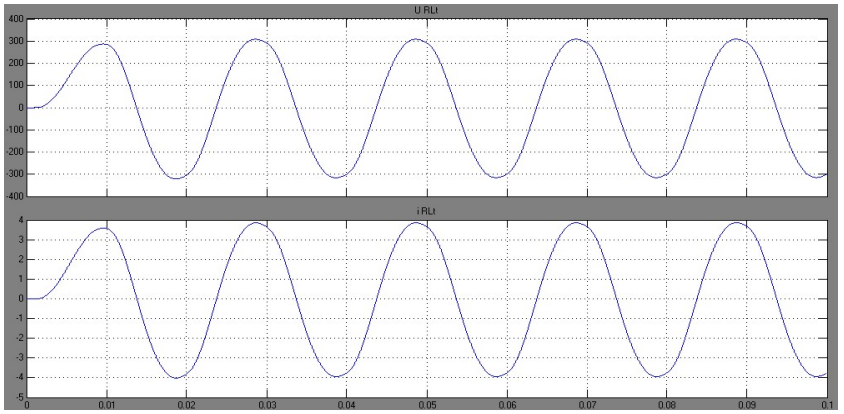

Fig. 6 Sinusoidal voltage trough active-inductive load and output current in divided transformer

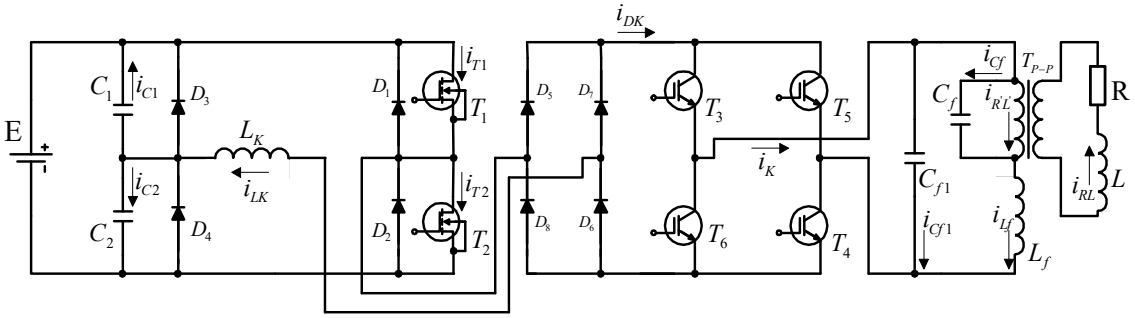

Fig. 1 Circuit model of the studied invertor

Publications

Simulation of three-phase invertor for quasi-sinusoidal voltage

An inverter that synthesizes three-phase quasi-sinusoidal voltage supply to the active load through method of controlled pulses with pulse-width modulation is investigated.

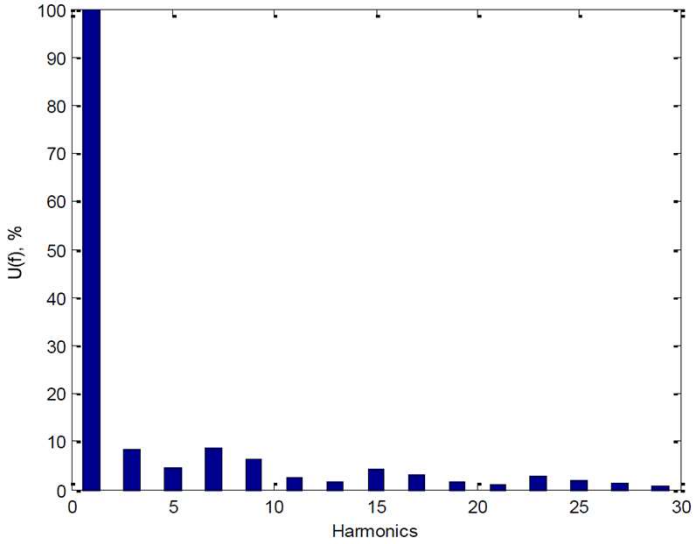

Fig. 8 Amplitude spectrum of quasi-sinusoidal output voltage

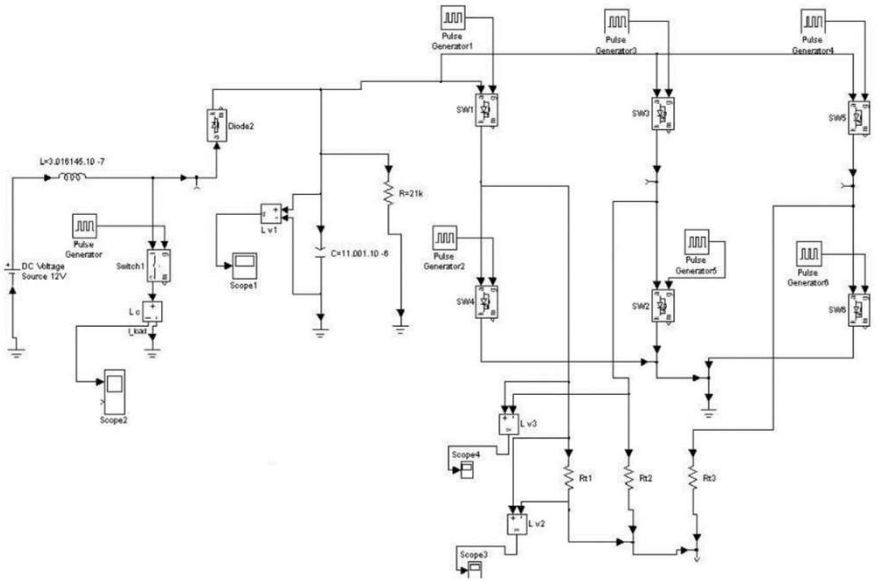

Fig. 1 Simulink model of the three-phase invertor

- The obtained quasi-sinusoidal voltage is not ideal one but leads to a significant reduction of harmonics in the converter load. This ensures lower level of electromagnetic interference and improves electromagnetic compatibility.

Publications

Modeling and analysis of hybrid power station

- Simulation model of hybrid power station containing Photovoltaic and wind generator sources as well as energy storage.
- Simulations of the power station operation have been carried out in different modes.
- The performance of hybrid power station is analyzed.
- The harmonic composition of the generated AC voltage with an industrial frequency is investigated.

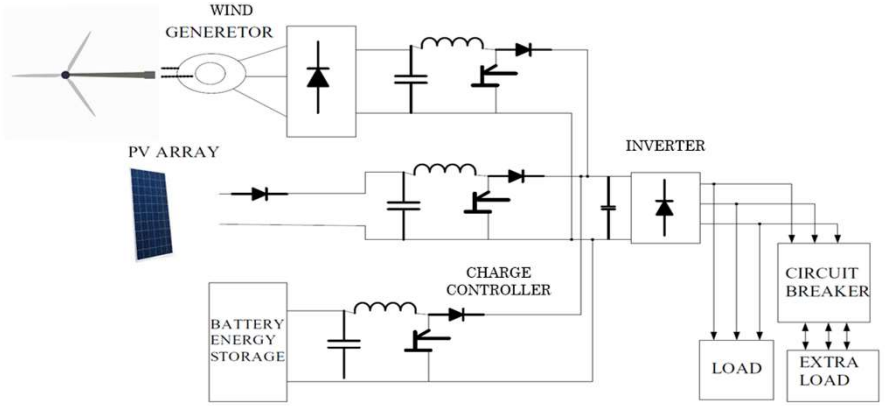

Fig. 1 Circuit model of the studied invertor

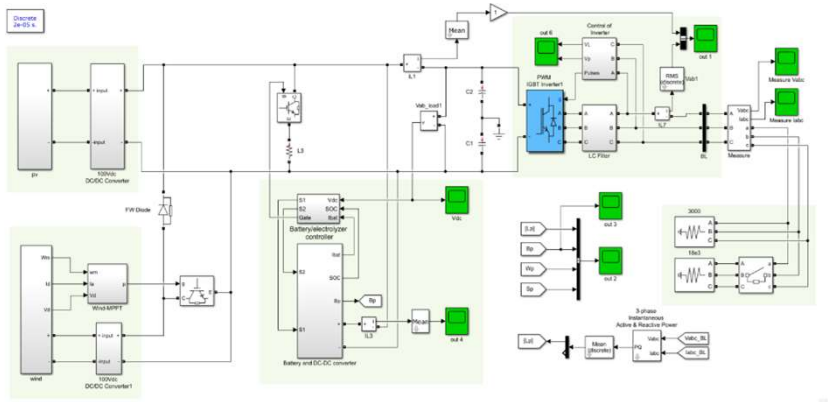

Fig. 6 Block diagram of the simulated Hybrid Power Station

Publications

Modeling and analysis of hybrid power station

- Simulation 1, case of variable weather conditions

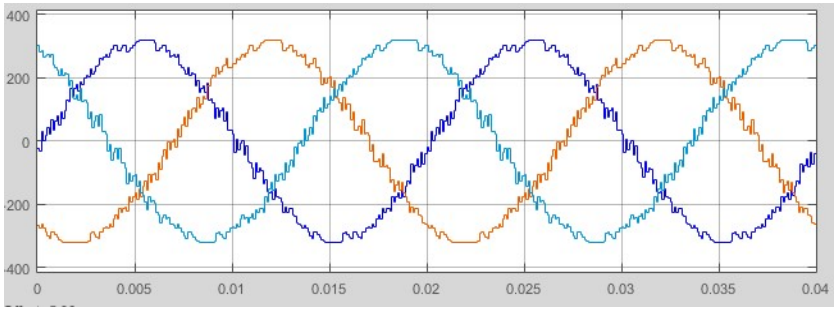

Fig. 7 Voltages in the three phases

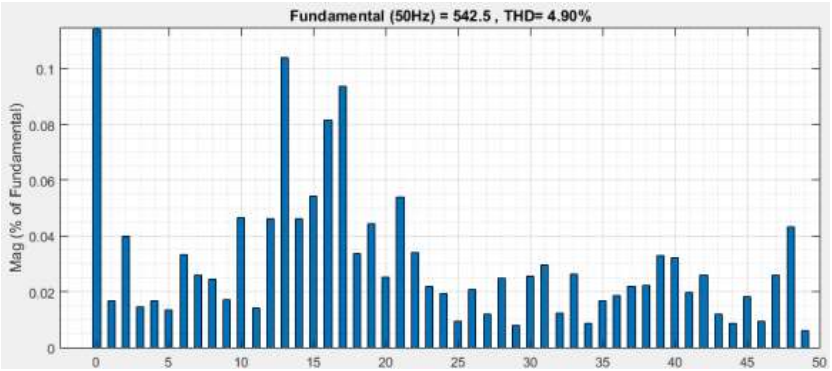

Fig. 10 Harmonics analysis with two sources

- The power hybrid station with renewable generating sources is considered.
- Highly safe for the environment as it does not produce any emission and harmful waste product like conventional energy resources.
- Simulations of the hybrid station operation in different modes.
- The performance of hybrid power station is analyzed.
- The harmonic composition of the generated AC voltage with an industrial frequency is investigated.
- Effective solution for power generation than conventional energy resources.

Publications

Numerical modeling of the magnetic field distribution in single-phase single-core transformer

An electromagnetic model of single-phase single-core transformer is made and a numerical simulation of the electromagnetic field is performed

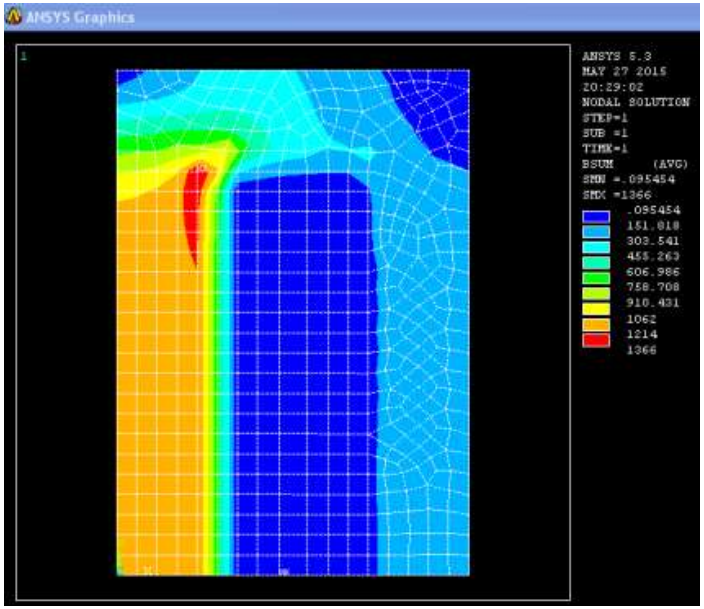

Fig. 2 Distribution on magnetic induction in magnetic core.

- Low power transformer P = 250VA
- Transformer's magnet made of 0.35 mm thick silicon steel sheets
- Circular copper conductors for primary and secondary winding
- Primary winding - voltage 220V, d=1mm, 289 turns
- Secondary winding - voltage 72, d=1.62mm, 104 turns

Publications

Numerical modeling of the magnetic field distribution in single-phase single-core transformer

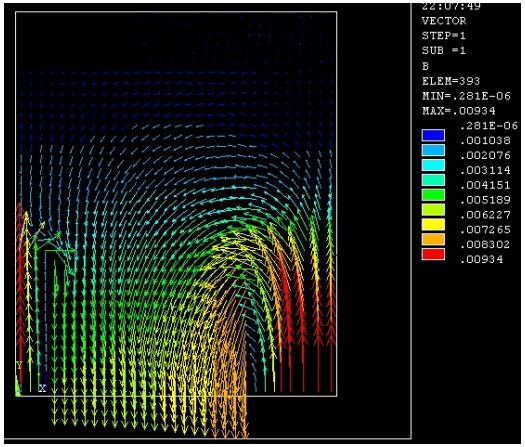

Fig. 7 Distribution on magnetic induction vectors by short circuit mode.

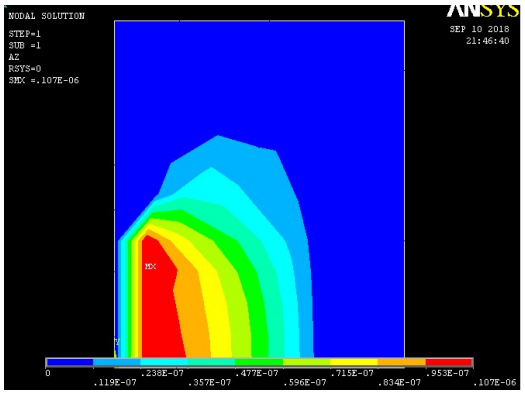

Fig. 5 Distribution of magnetic vector-potential by idle mode.

- Electromagnetic model of single-phase single-core transformer
- Numerical simulation of the electromagnetic field is performed
- The distribution of the magnetic induction in the transformer's core and in the surrounding space is obtained.
- The investigation enables the determination of the magnetic flux dissipated in the surrounding space outside the transformer that generates the electromagnetic interference.

Publications

Interactive education web-based platform for theoretical electrical engineering related topics

Web-based educational platform, which delivers resources and theoretical electrical engineering related topics.

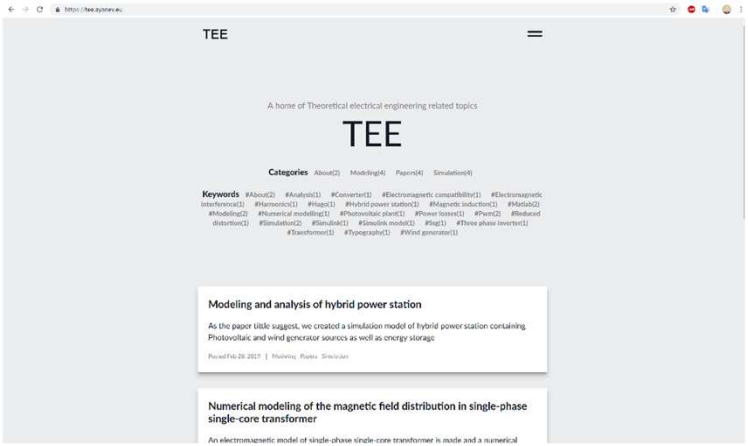

Fig. 4 Home page of the application

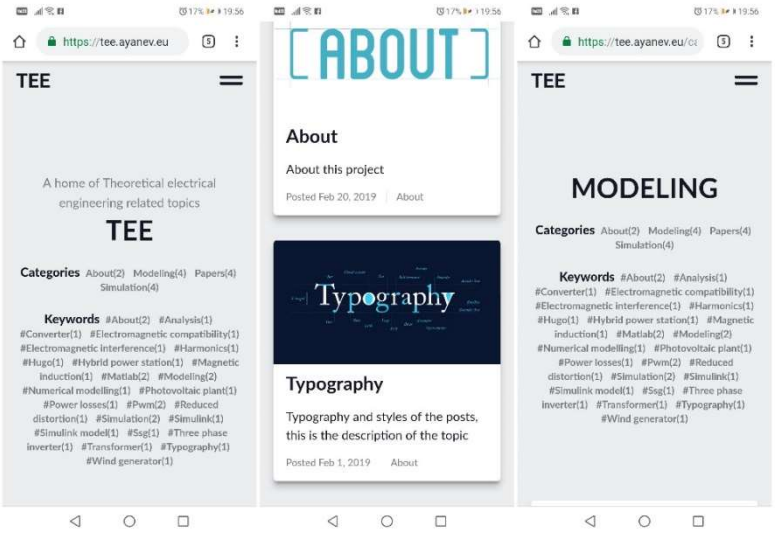

Fig. 9 Responsive mobile design. Home pages and selected category page

tee.ayanev.eu

- easily access by everyone because of its web-based nature.
- provides a variety of significant, quality, and understandable content.
- scalable and extendable.

Publications

Performance analysis and modelling of grid-connected small photovoltaic system

A grid-connected 30 kW small PV system, located in Southeast Bulgaria has been studied. Performance analysis of the PV system is done.

The PV system is balanced according reactive power.

The total harmonic distortion THD of the object is very low and satisfies the requirements of the standards.

A model of PV system is created in MATLAB.

Simulations of the operation in different modes have been carried out.

The electromagnetic compatibility of analyzed small PV power system is satisfied.

PV system details.

- PV modules Polycrystalline silicon TRITEC TRI-MAX EU 250Wp.
- The modules are placed on a support rail with spacing to ensure free flow on air under the modules.
- A string by combination of series connecting modules (6 strings of 20 modules) is formed.
- PV system uses one HUAWEI SUN2000-33KTL - 30 KW.
- The inverter outputs at 400 V, 50 Hz.

Publications

Performance analysis and modelling of grid-connected small photovoltaic system

Performance analysis

- The performance analysis with apparatus Metrel MI 2392F was conducted. (instruments for power quality analysis)
- For gathering the necessary information, the device is connected to the inverter via L1/2/3 Clamps
- Several measurements are made over a certain time interval, each of 200ms duration and a density of 1024 points

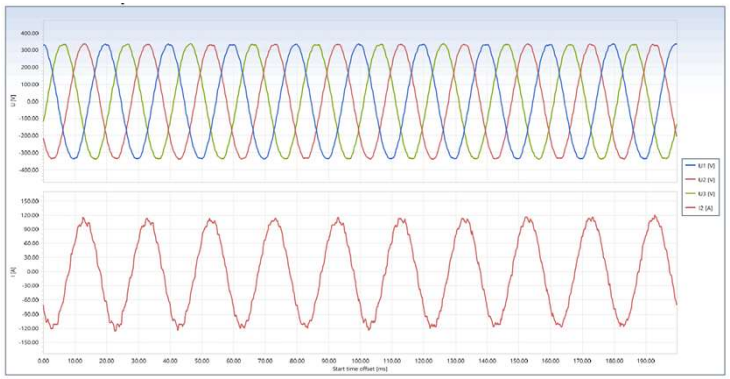

Fig. 3 Waveforms of voltages and current in normal mode

Measurements

- The shape of the voltage and current are close to the sinusoidal curve.
- The power system is balanced according reactive power.
- Total harmonic distortion is minimal according to IEEE 519

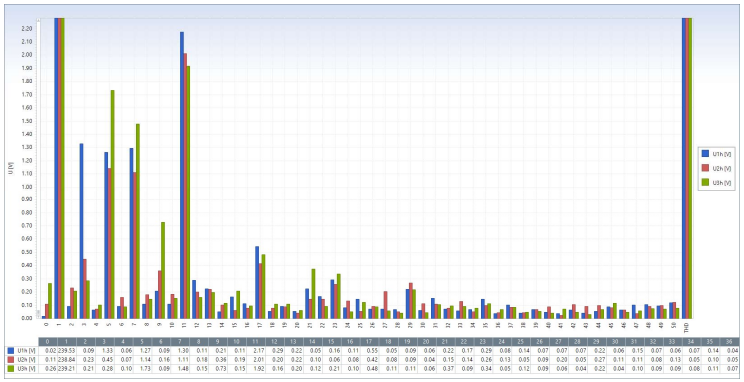

Fig. 5 Closer view of THD

Publications

Performance analysis and modelling of grid-connected small photovoltaic system

PV system model

- Model of power system in MATLAB is created.
- The results of the simulation prove the stability and reliable operation of the investigated system.

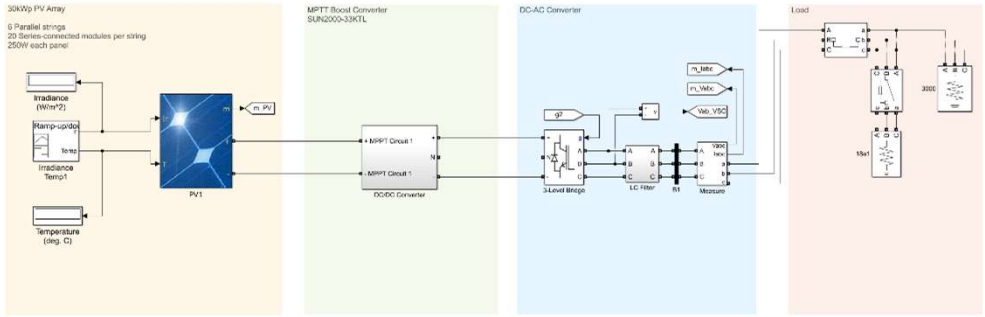

Fig. 6 Block diagram of the simulated PV system

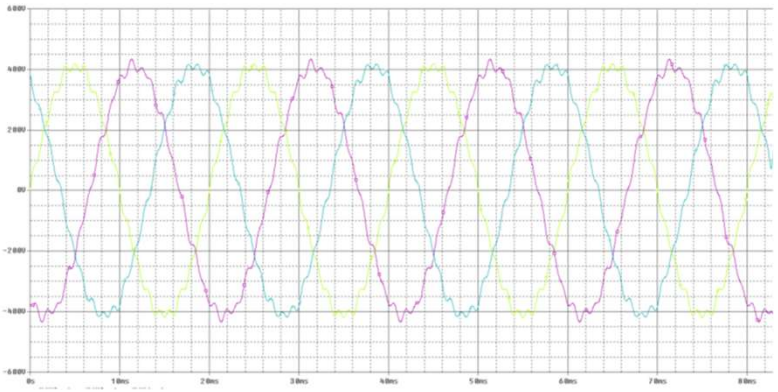

Fig.8 Simulation result of the voltages in normal mode of PV system

Conclusions

- The analyzed photovoltaic system has a significant adva ntage. It reduces the cost of transmission and distributi on of electrical energy, because the power is produced with low voltage at the end point of use.
- The PV system is balanced according reactive power in normal mode.
- The total harmonic distortion of the object is very low a nd satisfies the requirements of the standards.

Upcoming

- **Scientific papers** – Two new papers are work in progress, while the one of them will hopefully took place at **International Conference Automatics '2020** later this summer
- **Dissertation** – Most of the work is done/committed, upcoming dissertation layout and formatting, assembling all the pieces together

Thank you for your Attention, Support and Trust!

DEPARTMENT OF THEORETICAL ELECTRICAL ENGINEERING, FA

2020, Sofia, Bulgaria