Overview of R&D capabilities for electrical drives

University of Rijeka
FACULTY OF ENGINEERING

Who are we?

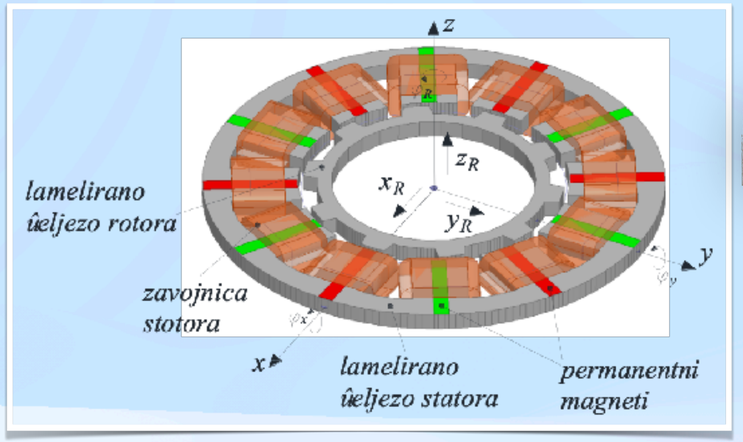
- Small and flexible team with advance knowledge in low and medium voltage drives application.

What we do?

- Lectures in the topics of: Control of electrical drives, Digital control systems and Control theory
- R&D for industrial partners in the field of electrical drives and digital control systems
- Consulting activities for complex drives systems
- Medium voltage drives firmware algorithm development
- Development of Complex control structures for specific drives applications
- Tailor made solutions for special industrial electric drives system applications
- Special drives development (active magnetic bearings)
- Advanced active front end control structures with selective harmonic elimination
- Complete drive construction process from idea to the prototype
- Upgrade, modernization and optimization of the existing drives for the customers

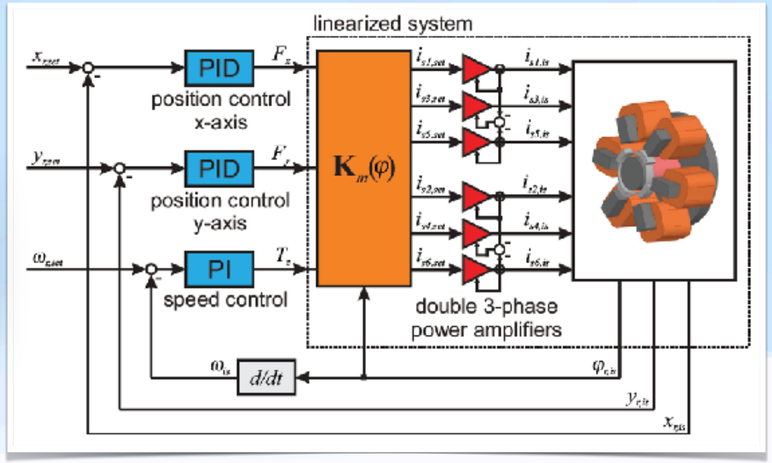
Case study examples

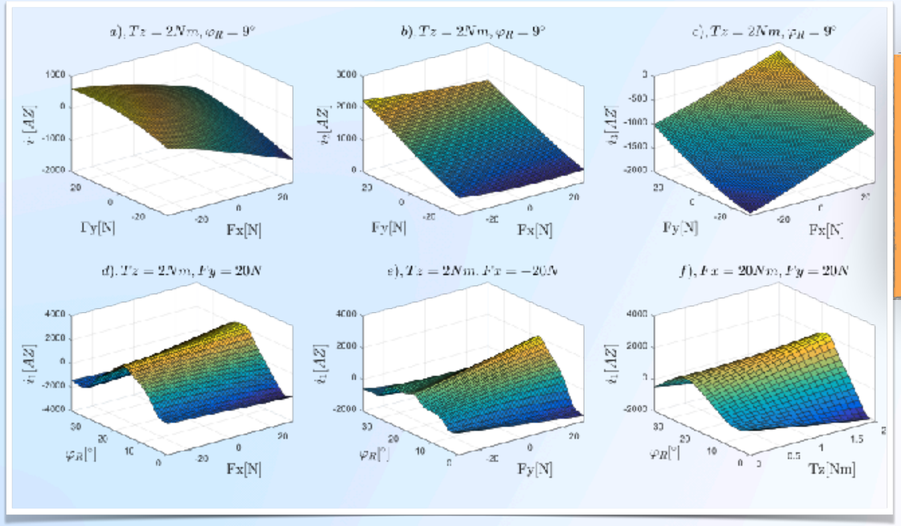
- Nonlinear Control of a Bearingless Flux-Switching Slice Motor With Combined Winding System



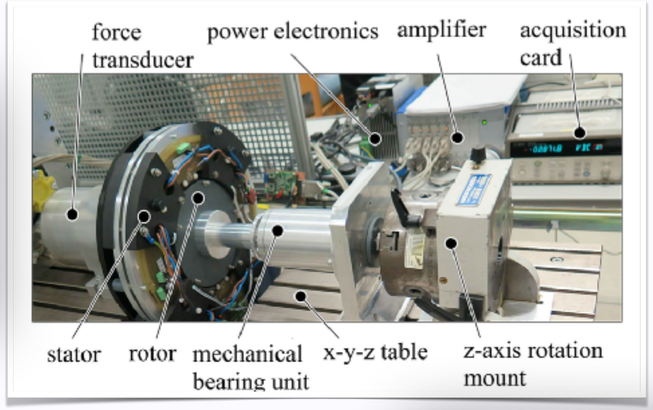
·Drive model

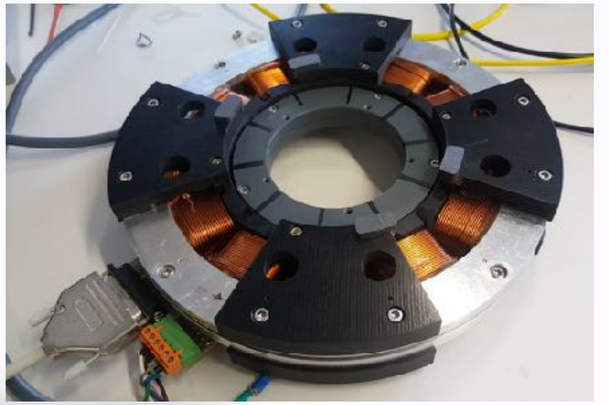
· Control structure





· Model simulation and optimization

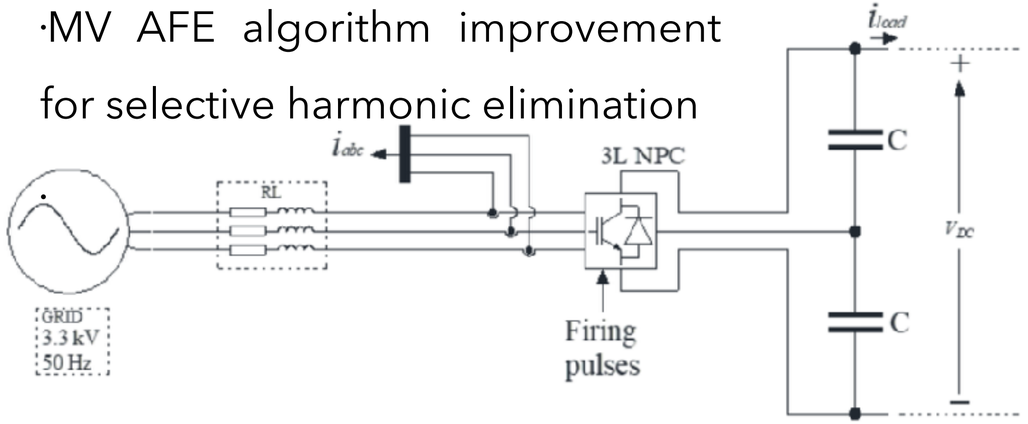




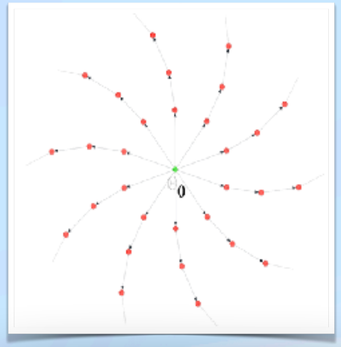
· Prototype validation

Pulse Pattern optimization based on Brute Force Method for Medium Voltage Three Level NPC Converter with Active Front End

·MV AFE algorithm improvement for selective harmonic elimination



·AFE model



· Tailor made solver for pulse pattern calculation

1. Initialization
   - calcluation of initial solution Eq. (9)
   - calculation of Jacobian matrix Eq. (14)
   - calculation of Null space matrix Eq. (19)

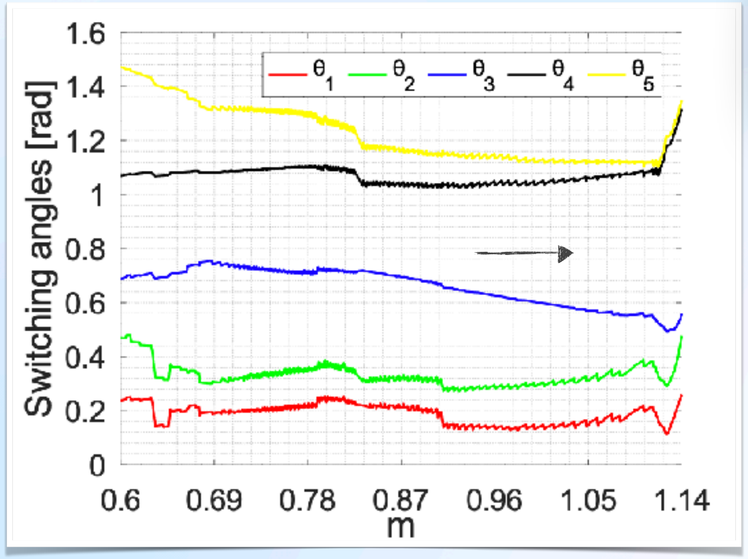
2. Initial radial directions
   - calculation of initial radial directions Eq. (28)

3. Movement in initial radial directions
   - calculation of new point in each of the the radial directions Eq. (24)

4. Further movements in radial directions
   - calculation of new point in each of the the radial directions Eq. (24)
   - this step is repeated until stop criteria of each of radial directions is met

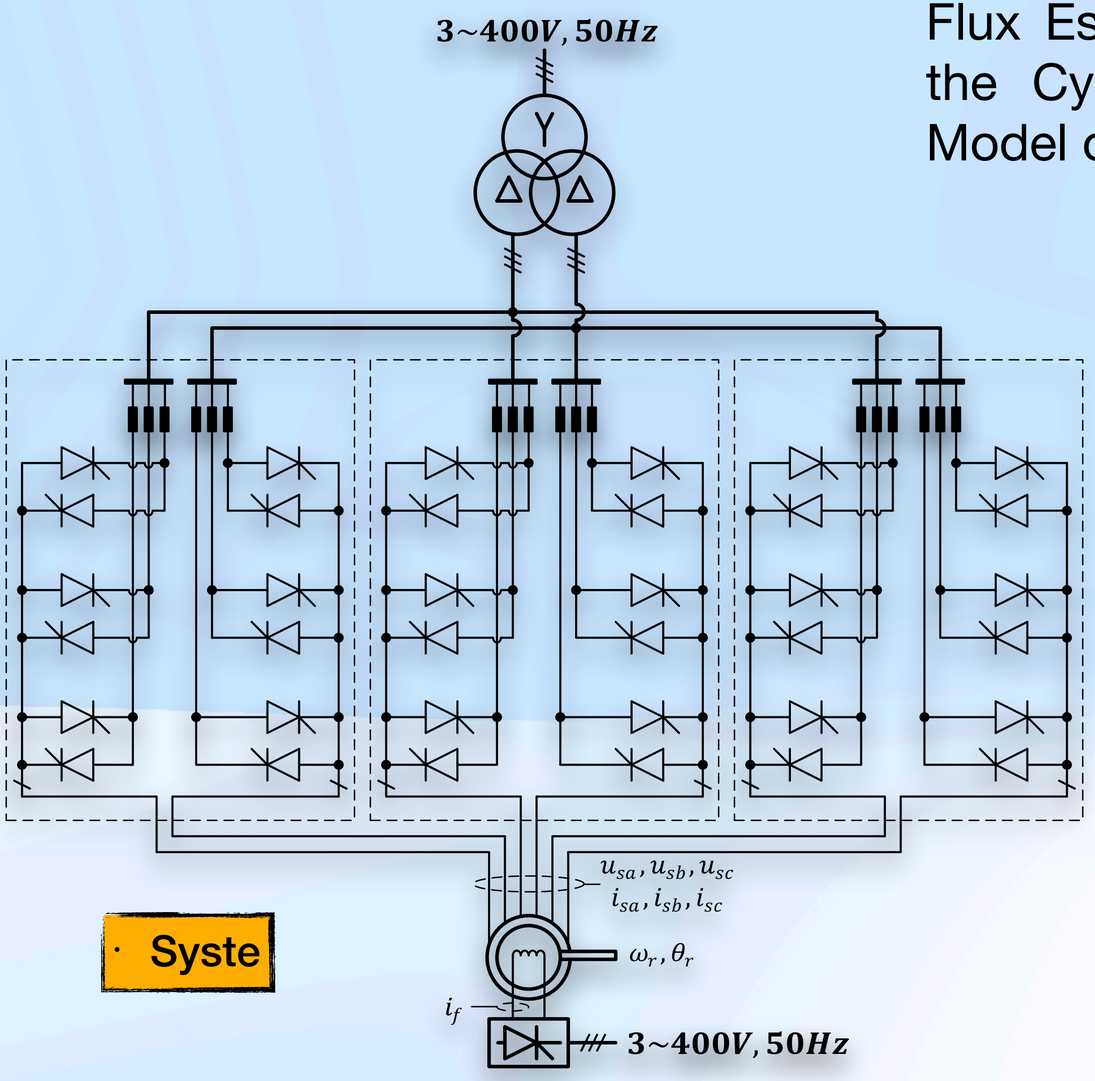
5. Results analysis
   - determining the final solution for given modulation index (solution with lowest $L1$ norm is chosen)

· Pulse pattern verification



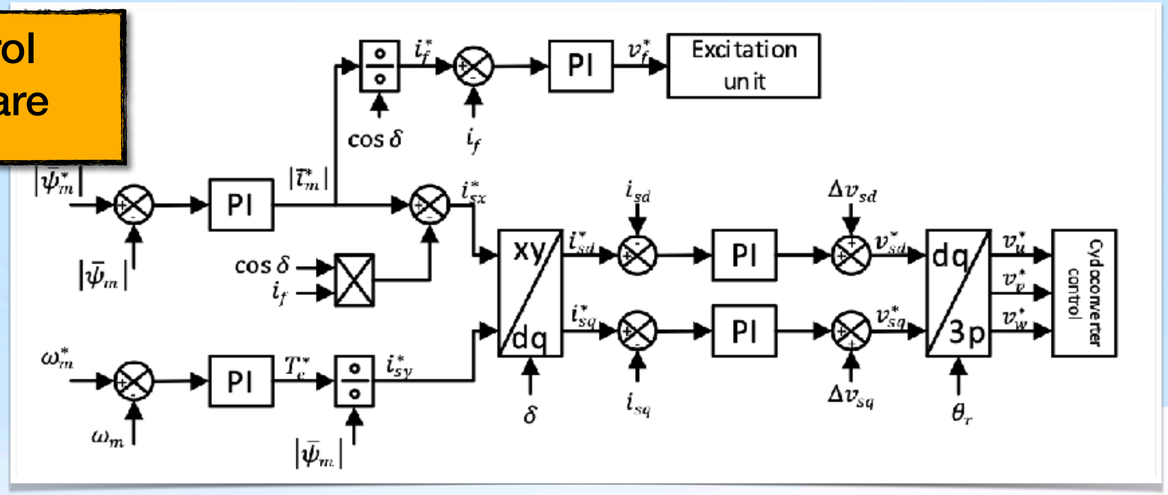
· Implementation in MV drive and commissioning

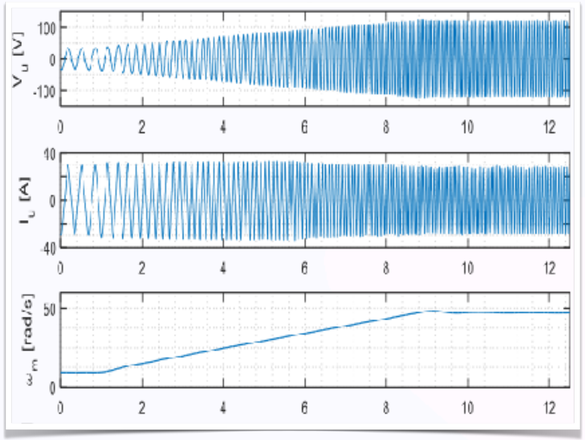
Flux Estimator for Salient Pole Synchronous Machine Driven by the Cycloconverter Based on Enhanced Current and Voltage Model of the Machine with Fuzzy Logic Transition



· Syste

· Control firmware

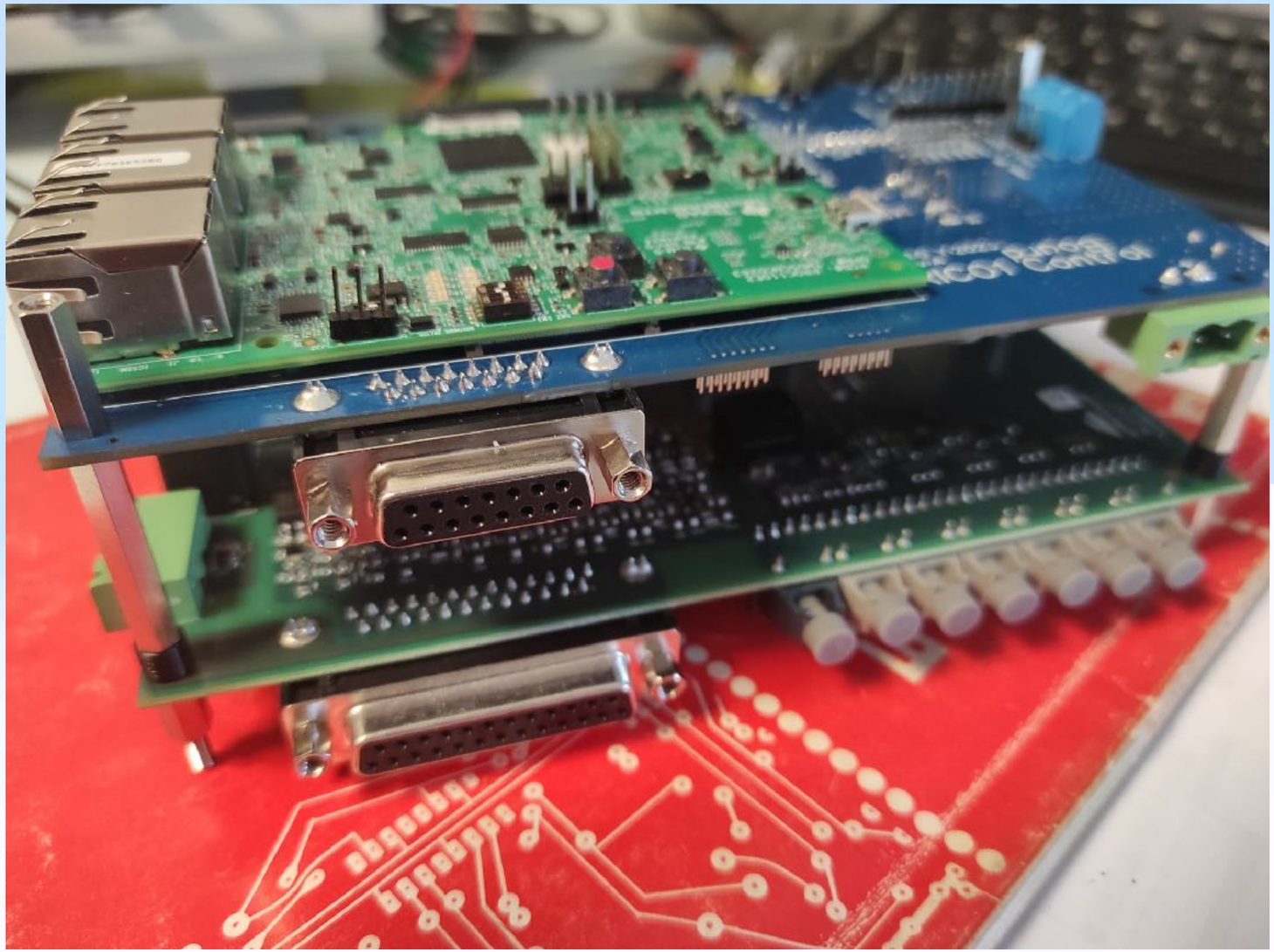




· System behavior verification and laboratory testing

What next ?

- Further advancement in algorithm development for LV and MV drives
- A new generation of multi-core digital control system for low and medium-voltage drives and power converters based on latest high performance multi core microcontrollers



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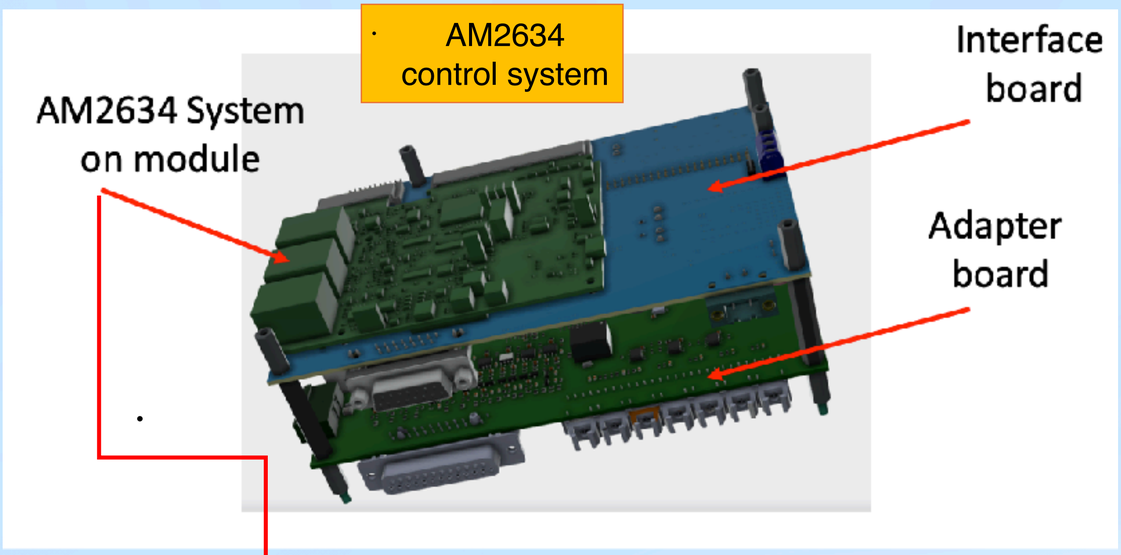
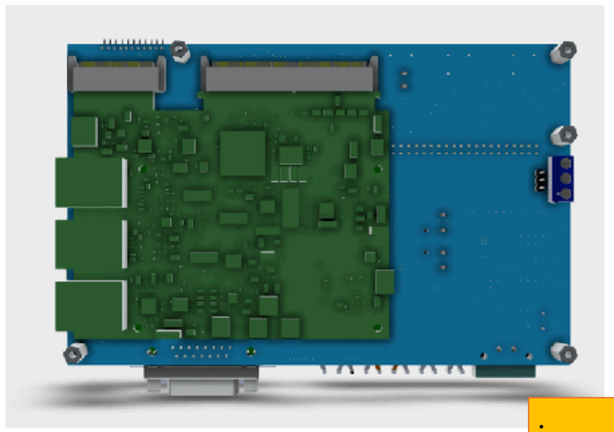
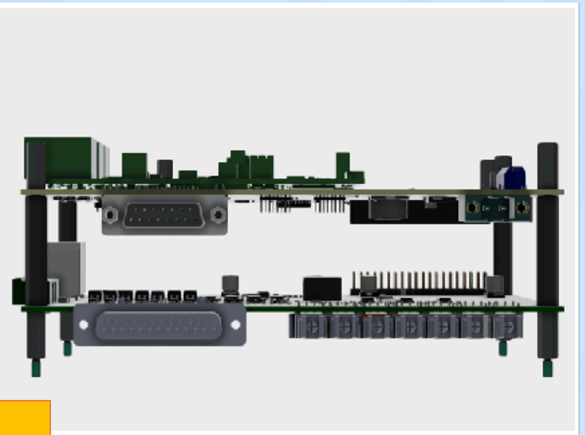
Control system structure – prototyping stage

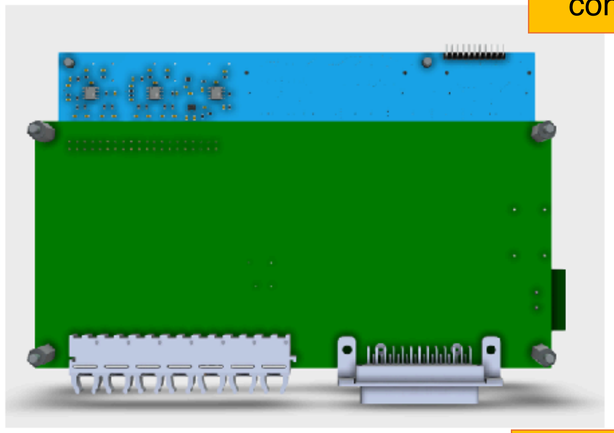
- AM2634 control system

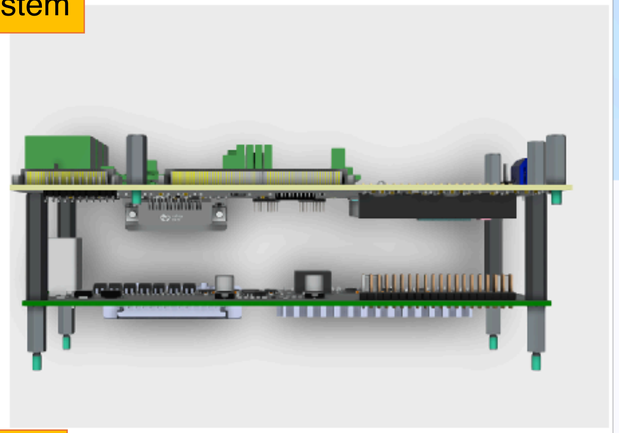




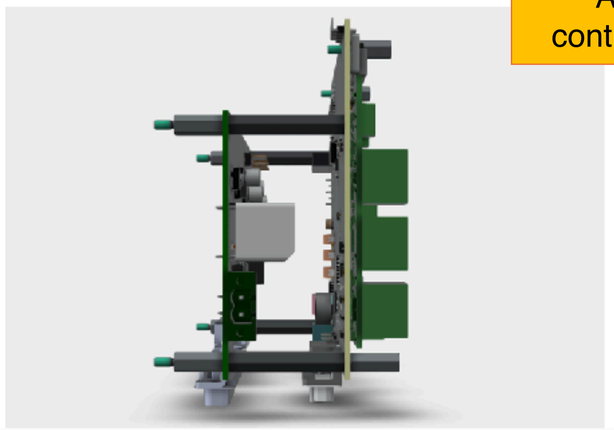


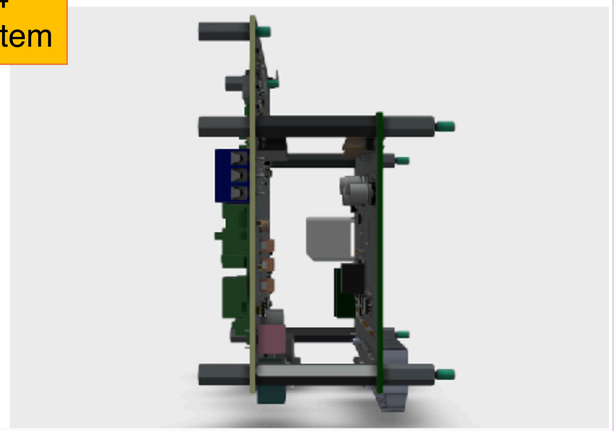
- AM2634 control system

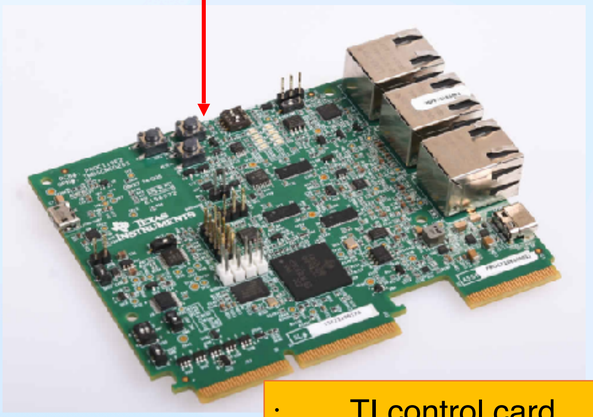




- AM2634 control system

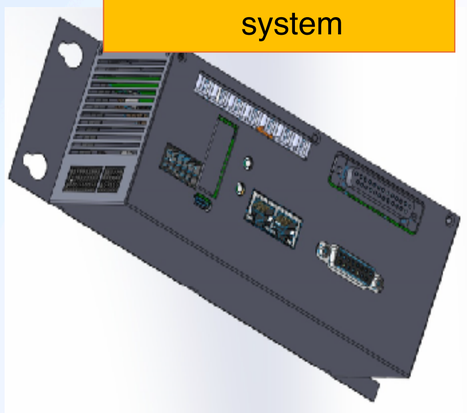




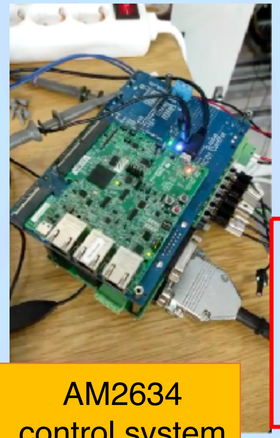


- TI control card module with AM2634

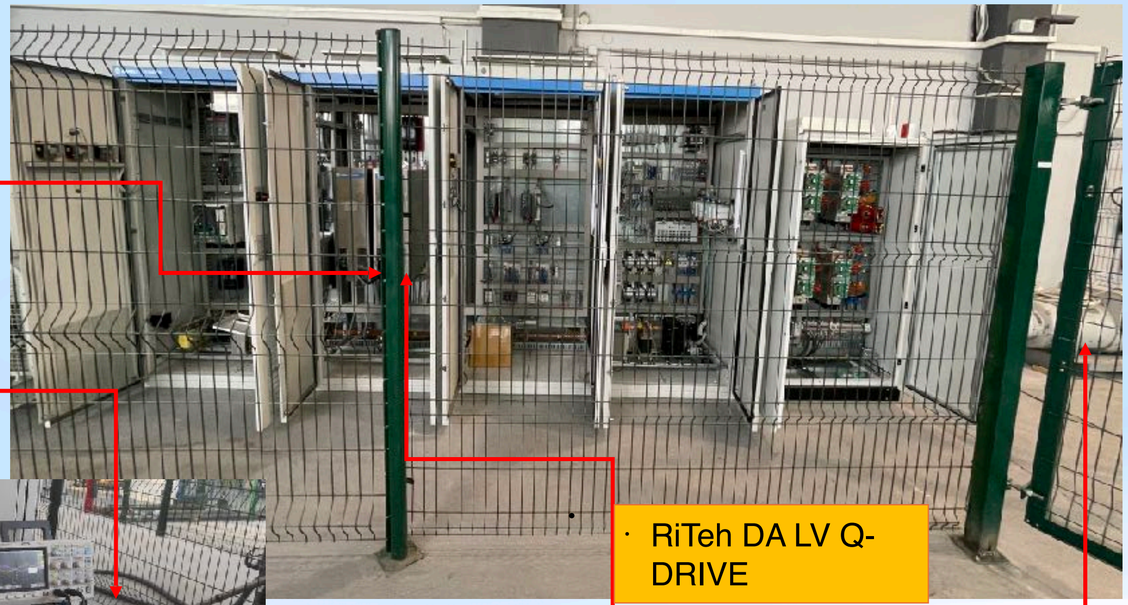
- Enclosure for AM2634 control system



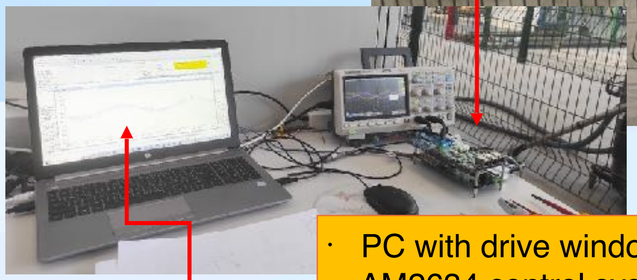
RiTeh – Prototype Lab Testings done on LV Q-DRIVE



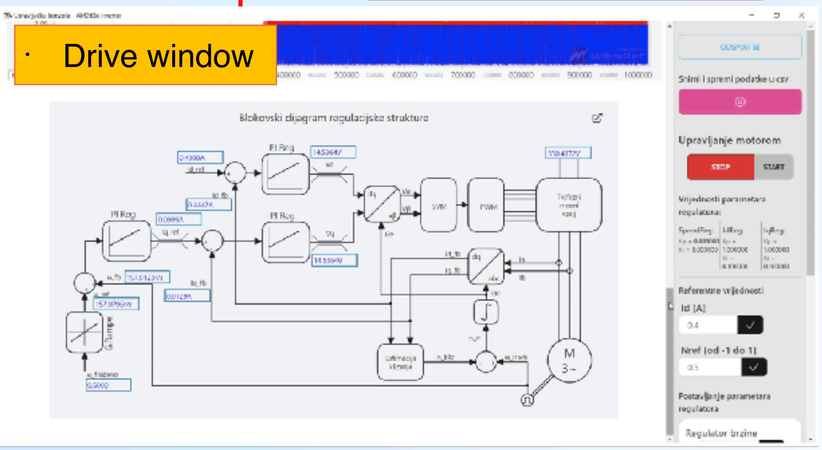
- AM2634 control system



- RiTeh DA LV Q-DRIVE



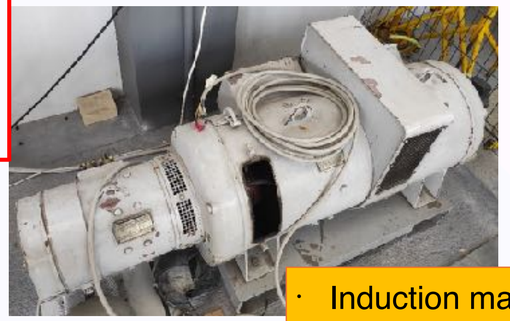
- PC with drive window + AM2634 control system



- Drive window

- DA LV Q-DRIVE F3E and inverter module

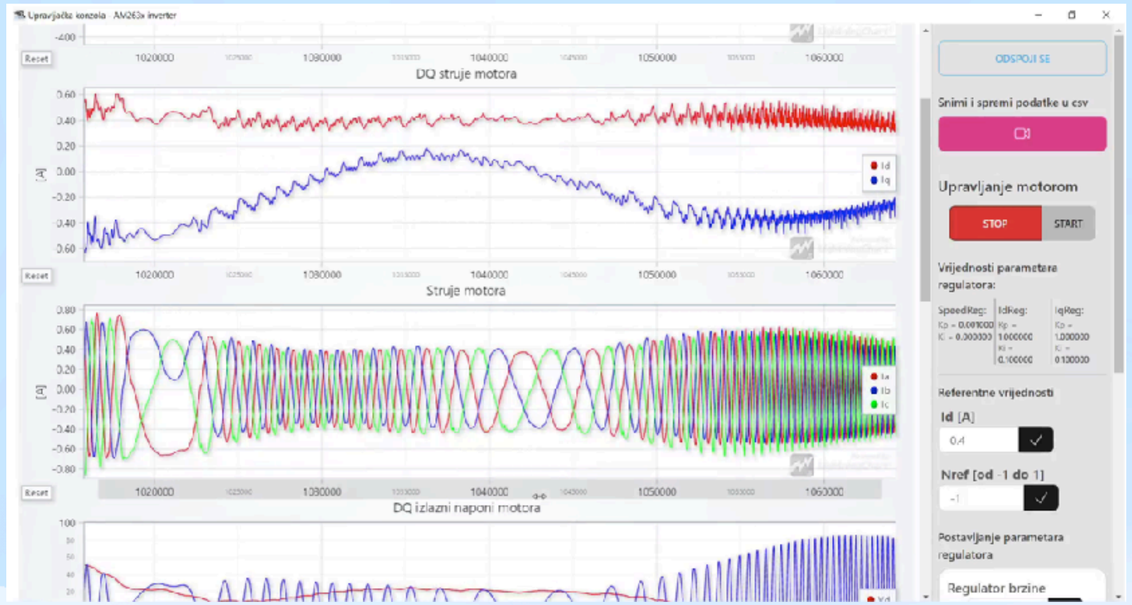
- RiTeh DA LV Q-DRIVE

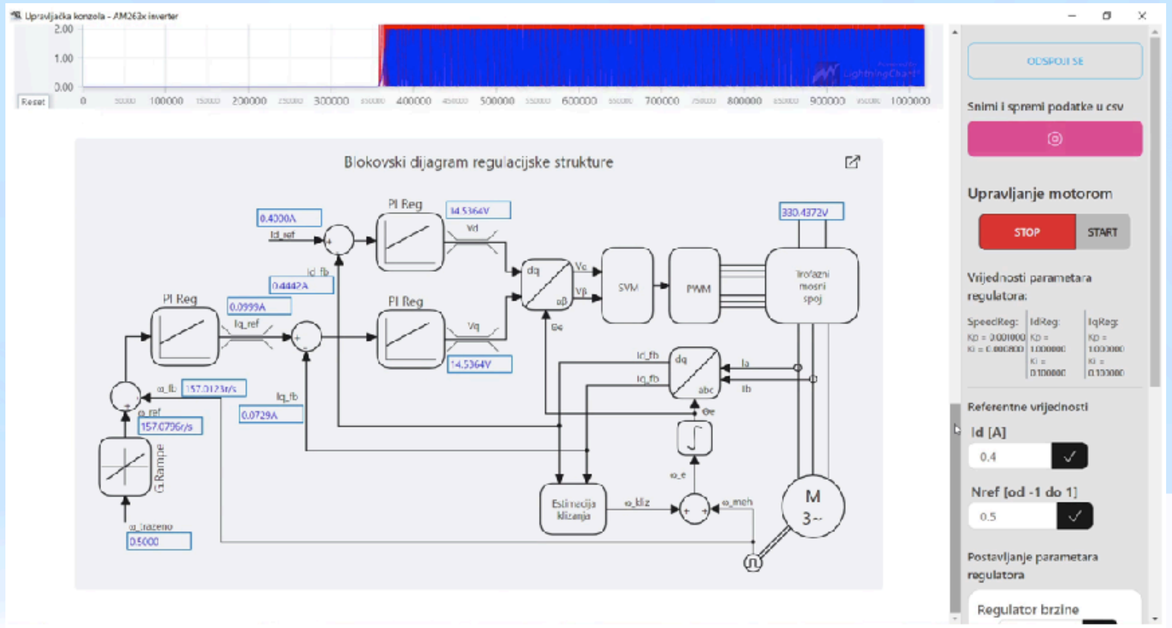


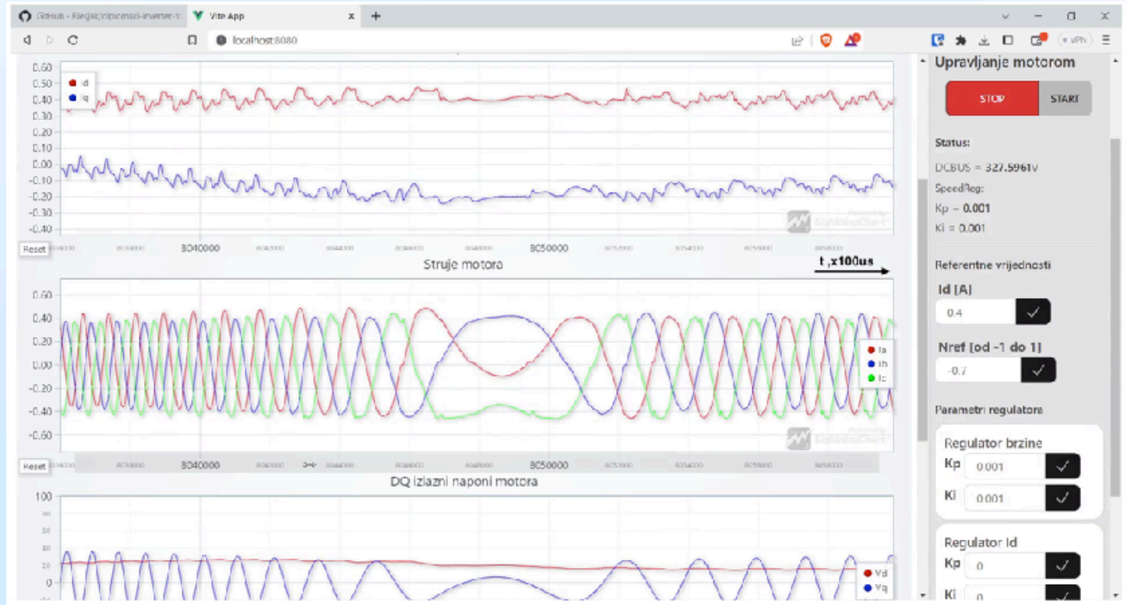
- Induction machine + DC machine for loading

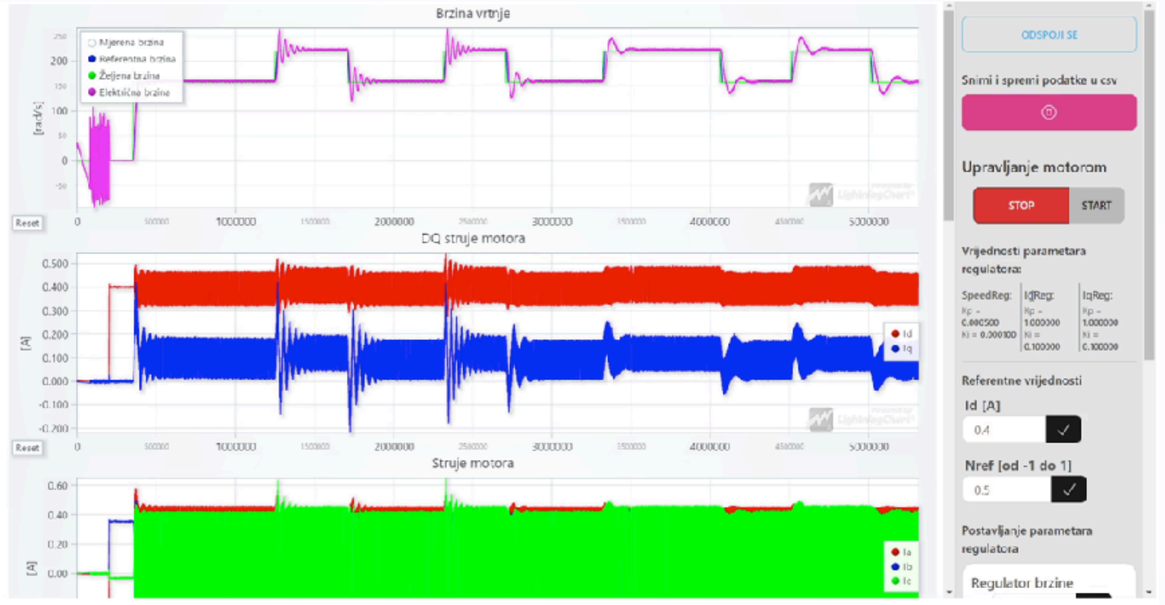
- System behaviour was tested on induction machine in lab environment
- Full vector control algorithm was implemented inside one R5F core
- Control system based on AM2634 was connected over optical fibre connection to the LV Q-DRIVE inverter module
- Drive window application for parametrisation and recording was developed
- Communication between drive window and control system was done over Ethernet link
- One core of AM2634 was hosting small web server for communication with drive window

Drive Configurator Window



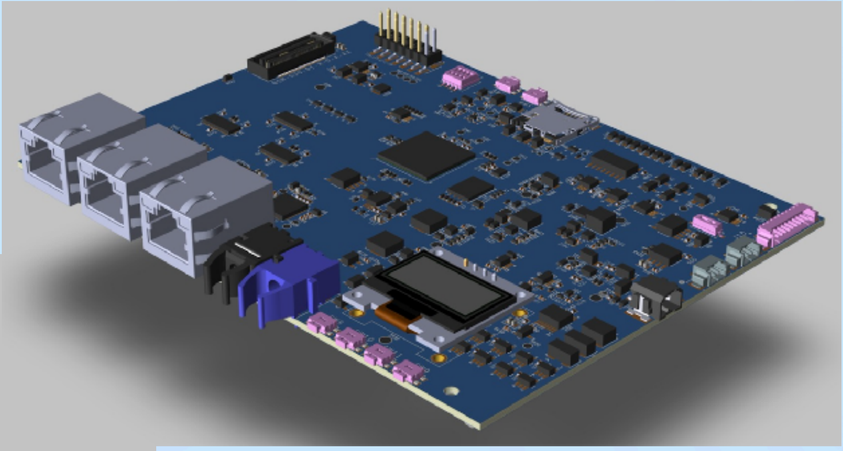


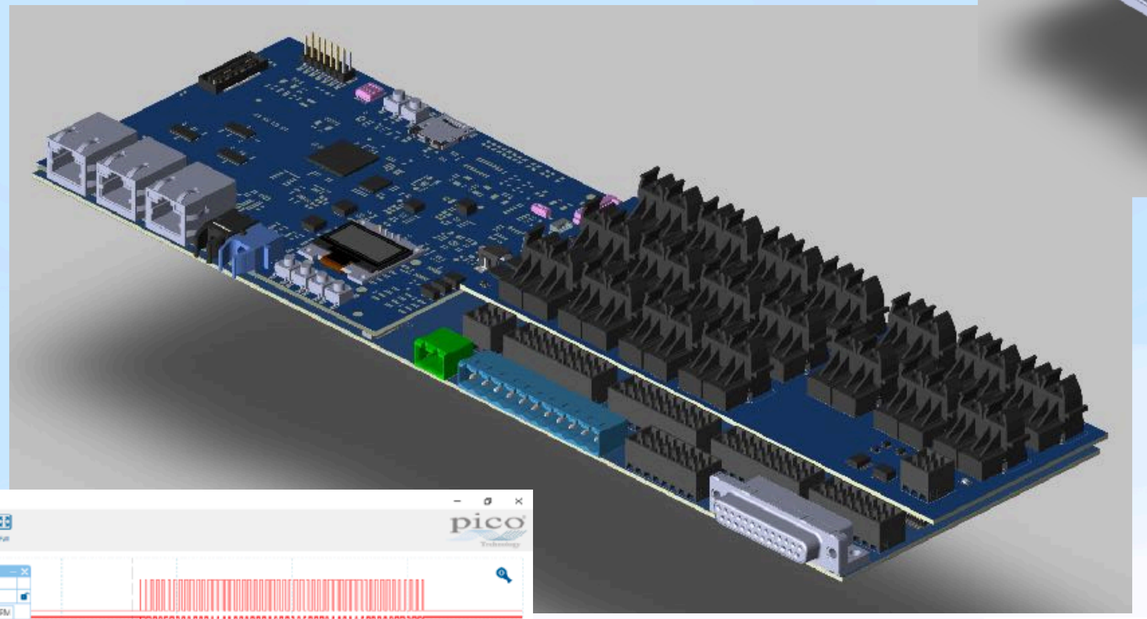


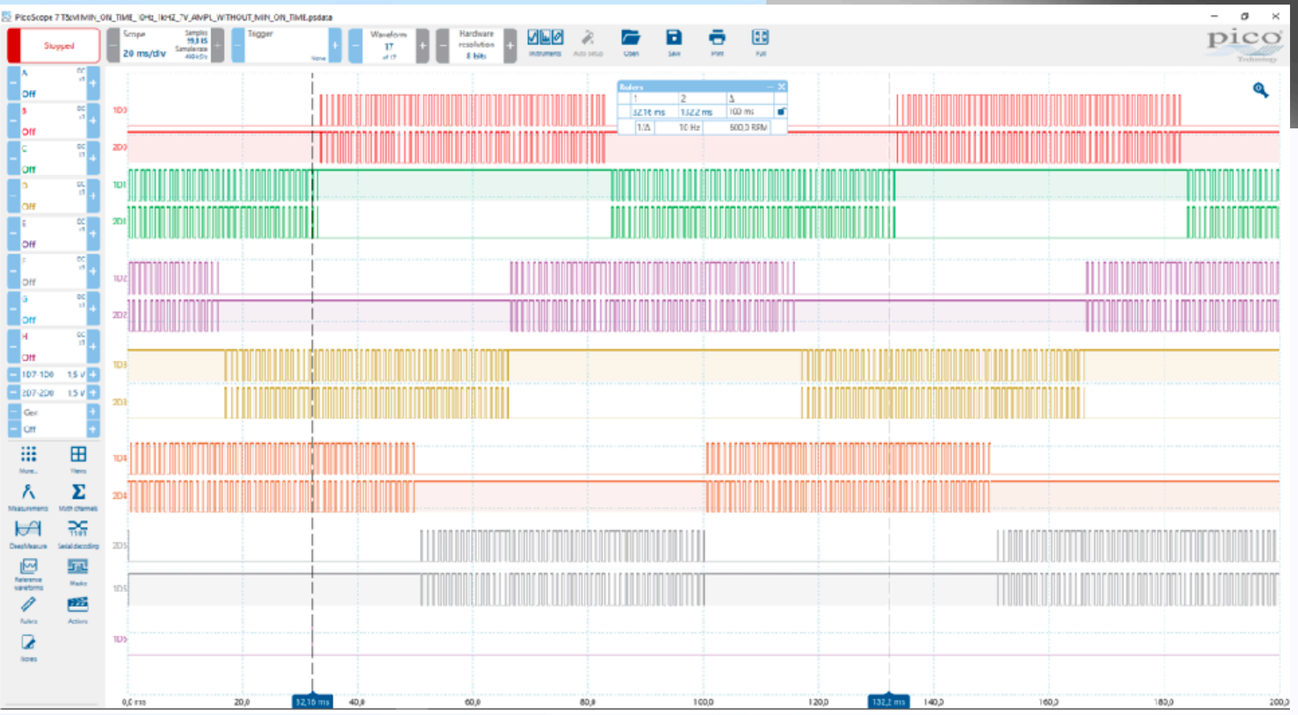


AM2634 System development

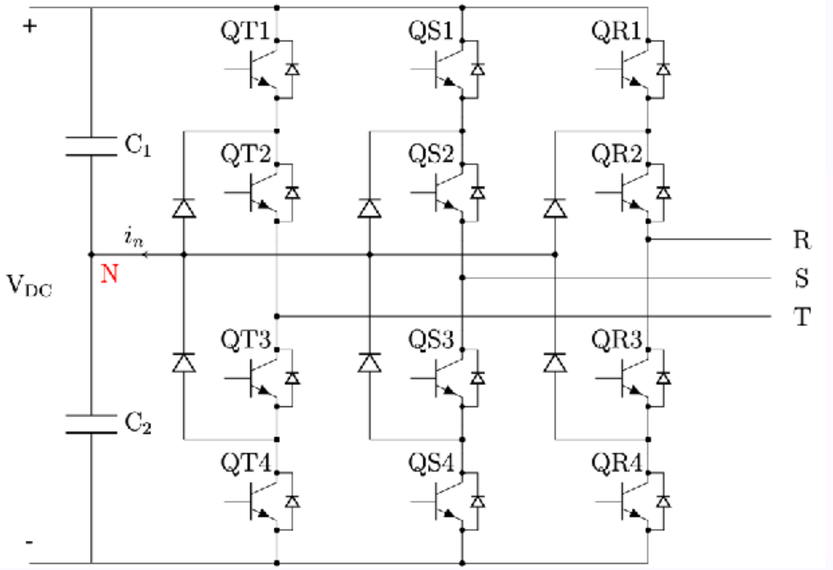
- AM2634 based control and application board development for control of electrical drives





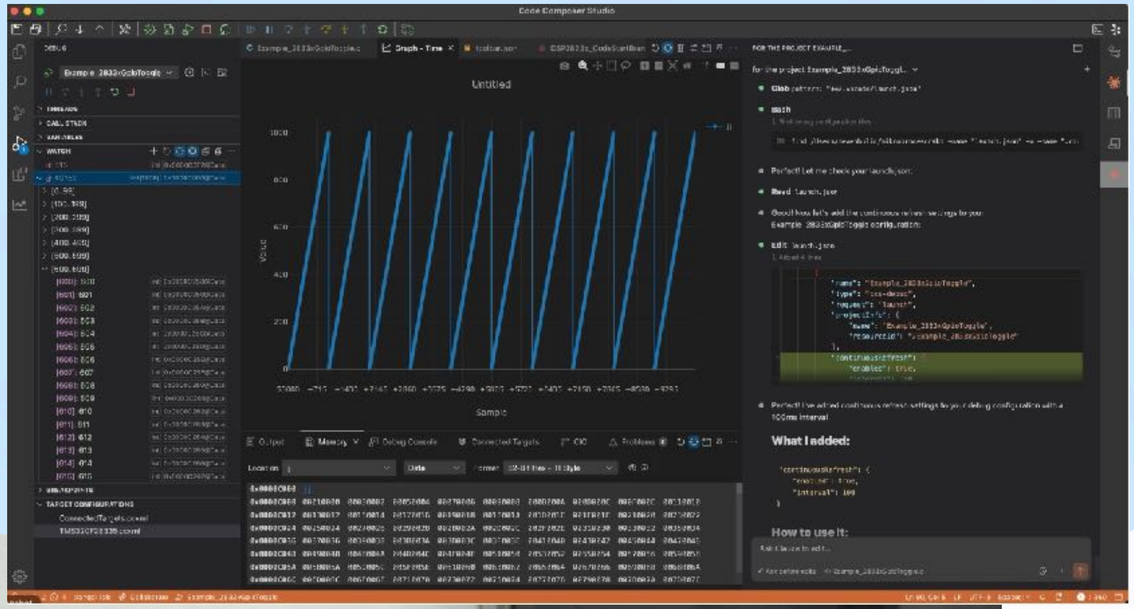


- Full 3L NPC modulator implemented

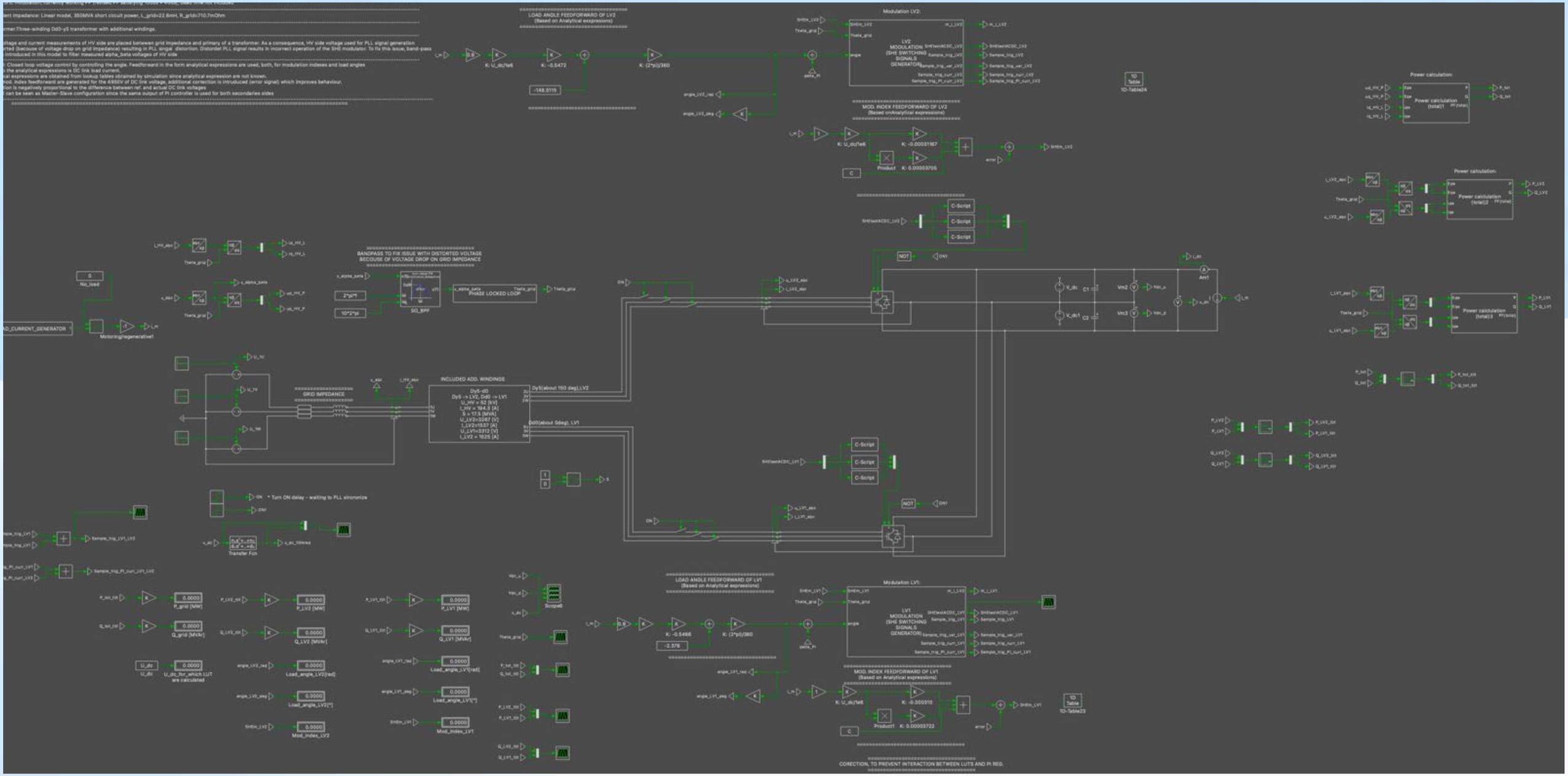


AM2634 System prototype

- Developed 1st prototype based on AM2634
- Hardware design verified
- 3L NPC modulator implemented and tested on Imperix system
- TCP/IP communication developed
- board level firmware developed
- production documentation updated



Full PLECS™ model for 3L NPC and 2L converters with AFE



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