



Wydział Elektryczny Politechniki Wroclawskiej zorganizował w dniu 23.11.2021r. Seminarium Międzynarodowe, którego gościem był dr. inż. Karol Kyslan, profesor na Technical University of Košice, Faculty of Electrical Engineering, Slovak Republic.

Temat spotkania:

Selected problems in methods for dynamic emulation of mechanical loads and in methods for sensorless control of PMSM

Seminarium odbyło się w formie zdalnej (gość wraz częścią pracowników znajdowali się w laboratorium napędów bezczujnikowych w Katedrze Maszyn, Napędów i Pomiarów Elektrycznych), prowadziła je Pani Profesor Teresa Orłowska Kowalska.

Wykład połączony był z zajęciami z przedmiotu Automatyka Napędów Elektrycznych prowadzonym na kierunku **Automatyka Przemysłowa** i uczestniczyli w nim także studenci tego kierunku.

Charakter spotkania był otwarty dla studentów, pracowników, doktorantów PWr.

Całość wydarzenia prowadzona była w języku angielskim i dotyczyła zagadnień związanych z badaniami naukowymi realizowanymi w zespole Profesora Karola Kyslana – napędów bezczujnikowe z silnikami PMSM.

Uczestnikami spotkania byli pracownicy, doktoranci oraz studenci Politechniki Wroclawskiej. Po spotkaniu odbyła się dyskusja dotycząca przedstawionych zagadnień, w trakcie której omawiano aspekty techniczne zaprezentowane podczas wykładu.

W Seminarium wzięło udział łącznie 27 osób (4 kobiety, 23 mężczyzn), 7 doktorantów, 5 pracowników i studenci kierunku Automatyka Przemysłowa.

Sylwetka prelegenta

Karol Kyslan was born in 1984 in Humenné, Slovak Republic. He received the MSc. and PhD. degrees in electrical engineering from Technical University of Košice, Faculty of Electrical Engineering, Slovak Republic, in 2009 and 2012.

In 2011, he spent 3 months with University of Maribor under tutoring of Dr. Miran Rodič. In 2015, he spent 1 month with Technical University of Liberec under tutoring of prof. Aleš Richter. In 2017 he spent 1,5 month with University of Novi Sad under tutoring of Dr. Vlado Porobić on ERASMUS+ teaching and training exchanges, respectively. In 2020, he received habilitation degree from the Technical University of Košice and since then, he has been working as Associate Professor at the Department of Electrical Engineering and Mechatronics, teaching courses on electrical drives and servodrives.

His research interests include dynamic emulation of mechanical loads, control of electrical drives, sensorless and predictive control of PMSM drives and hardware-in-the loop systems. He has published 28 scientific papers in refereed conference proceedings and journals and he holds one national patent. He is a programme chairmen of conference series Electrical Drives and Power Electronics (EDPE) and member of IEEE.



Short abstract:

The lecture will be divided into two separate parts. The first part will introduce an approach called dynamic emulation of mechanical loads. This method is suitable for testing electrical drives by an electrical dynamometer. The reference torque for the dynamometer is generated in a way that a mathematical model of mechanical load to be emulated is included in the control structure. Various methods will be presented together with experimental results obtained by emulation of selected mechanical loads. The second part of the lecture will deal with sensorless control of permanent magnet synchronous machines. The classification of the sensorless control methods and selected problems in sensorless control for medium and high-speed PMSM drives will be presented and discussed.

The screenshot displays a video lecture interface. At the top left, a box contains the text "MAJOR TECHNICAL UNIVERSITIES IN SLOVAK REPUBLIC". Below this, a map of Slovakia is shown with red arrows pointing to "University of Žilina" and "Technical University of Košice". A legend on the map identifies Bratislava as the National Capital and lists other cities by population. The Slovak coat of arms is also visible. On the right side, a vertical list of participants includes: Dykówni Mateusz, Karol Kozak, Orpovska-Kowalska Teres, Tarchala Grzegorz, Freus Monika P., Freus Monika Paulina, Gorla Adam, and Gorla Adam. The bottom portion of the image shows a close-up of a man wearing a headset, looking down and touching his forehead.



Motivation for PMSM Sensorless Control

- cooperation with industrial company **Spinea Technologies** located in Slovakia
- establishment of **joint industry-academia laboratory**
- **Spinea is the 4th world biggest producer of very precise gearboxes (zero-backlash)**
- established test bench for very precise actuators measurement
- measurement of nonlinearities of precise gearboxes (<10 arcsec)
- testing of new control approaches (sensorless control)



Actuators produced by Spinea company



Sliding mode observer for high- and medium-speed sensorless control of PMSM

2. step – extract position value

Easy way – use arctg function:

$$\hat{\theta}_e = \arctan\left(\frac{-\hat{e}_\alpha}{\hat{e}_\beta}\right) \quad \text{Problem nr. 3:}$$

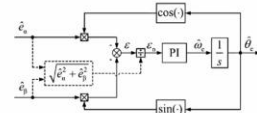
Division by zero here.

3. step – calculate actual

Easy way – use derivation of position:

$$\hat{\omega}_e = \frac{d\hat{\theta}_e}{dt}$$

If you want to complicate your life
– use phase locked loop (PLL)



Problem nr. 3:
PLL paramters (inside block PI) depends on disturbance torque and moment of inertia.

