

# From PES to iDES: Introduction to iDES and Recent Updates

- Japan/ETH/ECPE Power Electronics Workshop -

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## Self Introduction



### Takanobu Ohno, Postdoc

2022 Ph.D. at Tokyo University of Science

2022 – 2023 Visiting Researcher at PES ETHZ

2023 – Postdoc at Innsbruck University



### Spasoje Mirić, Ass. Prof.

2018 Ph.D. at University of Belgrade

2021 Second Ph.D. at ETH Zürich PES

2021 – 2023 Postdoc at PES ETHZ

2023 – Ass. Prof. at Innsbruck University



Power Electronic Systems  
Laboratory



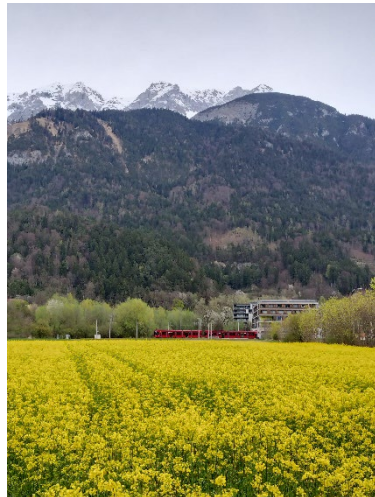
innsbruck Drive and  
Energy Systems Laboratory

# Innsbruck City





# Innsbruck University



## Universität Innsbruck – Campus Technik

- Faculty of - Architektur
- Biologie
- Mathematik
- Physik
- **Technische Wissenschaften**

Institute für

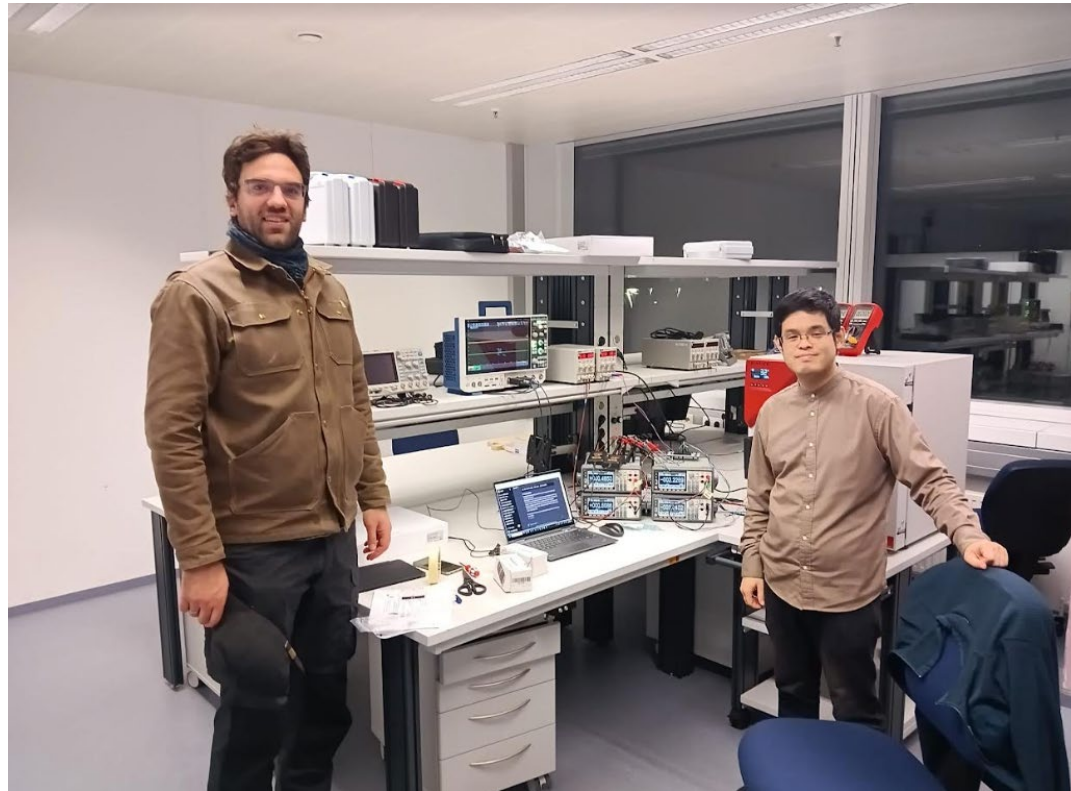
← Infrastruktur  
Konstruktion

← **Mechatronik (2020 –)**



# Innsbruck Drive and Energy Systems Laboratory (iDES)

Dec. 2023



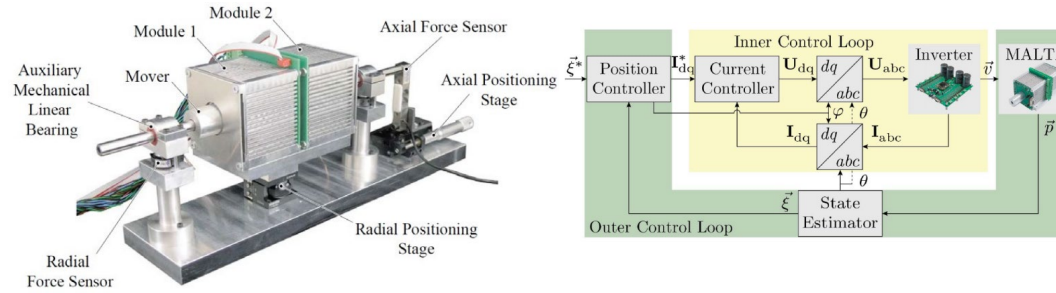
Nowadays



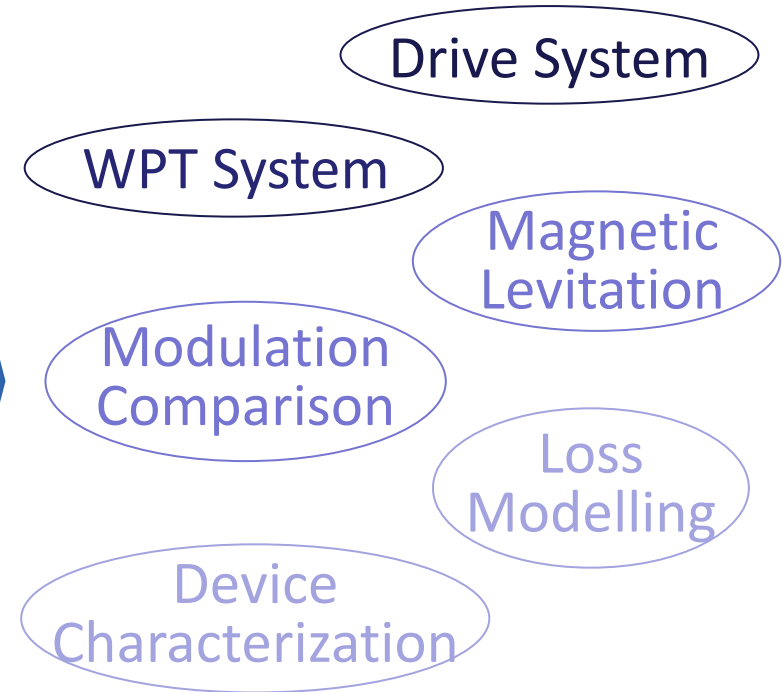
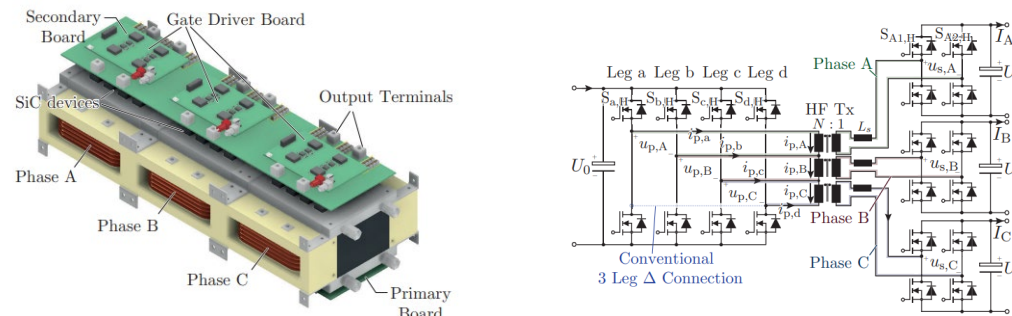
# Innsbruck Drive and Energy Systems Laboratory (iDES)



Spasoje Mirić, Mechatronics



Takanobu Ohno, Power Electronics

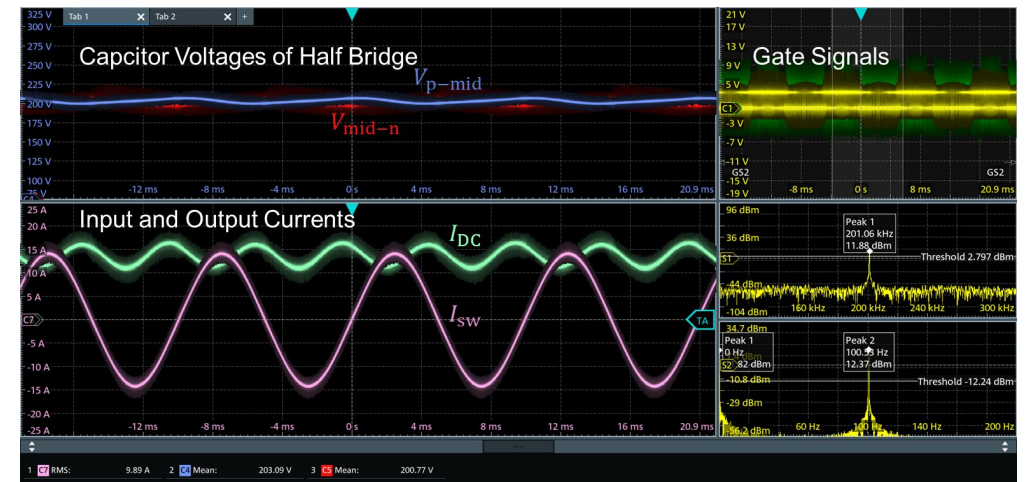


# Current Research

## Half Bridge Constant Duty Operation Test



## Half Bridge 5 kW Load Test





# Lectures

## Lectures Offered @iDES

### Sommer Semester

- 850708 VU Elektrische Maschinen (Prof. Mirić, Dr. Ohno)
- 850709 VO Elektrische Antriebstechnik (Prof. Mirić, Dr. Ohno)
- 850710 VU Regelung von Antriebssystemen (Dr. Ohno)
- 850715 VU Elektomechanische Aktuatorik (Prof. Mirić)
- 850720 VU Antriebsregelung (Prof. Mirić, Dr. Ohno)

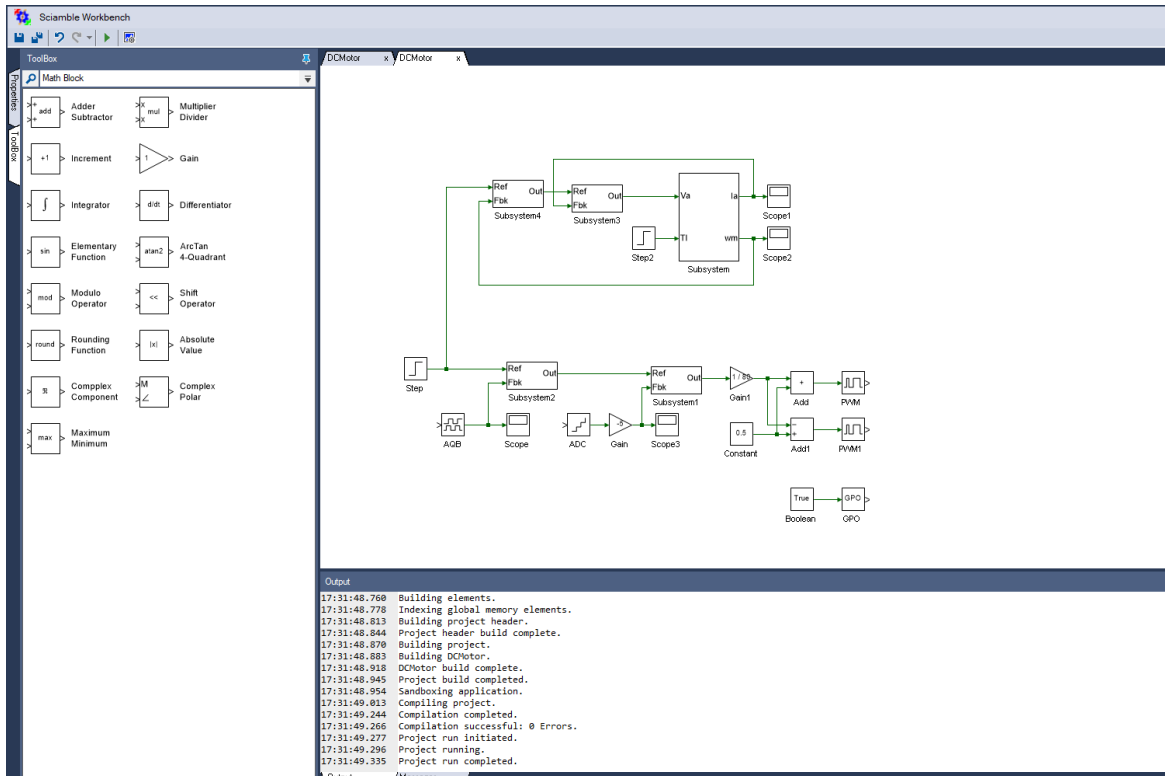
### Winter Semester

- 850620 VO Elektrische Antriebstechnik und Leistungselektronik (shared with iPEL)
- 850621 VO Elektrische Antriebstechnik und Leistungselektronik (shared with iPEL)
- 850711 PR Elektrische Antriebstechnik (Dr. Ohno)
- 850716 VO Elektrische Energie- und Antriebstechnik (Dr. Korbinian)
- 850717 VO Elektrische Energie- und Antriebstechnik (Dr. Korbinian)
- 850718 VU Spezielle Themen 1 (Prof. Mirić, Dr. Ohno)





# Lectures

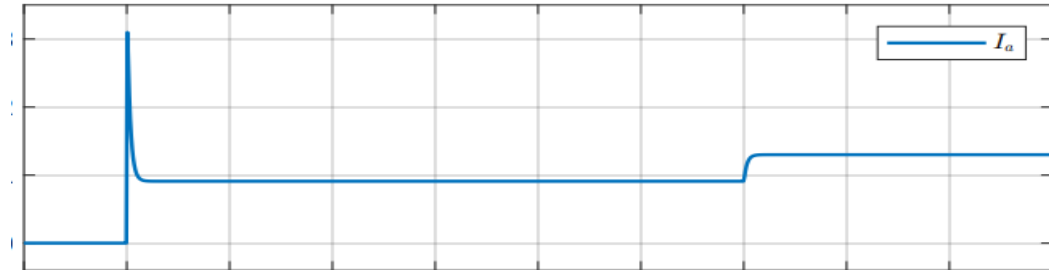


The screenshot shows the Simulink workspace for a DC motor control system. The model includes a feedback loop with a reference input, a controller (Subsystem4), a plant (Subsystem3), and a motor model (Subsystem). The output is measured by Scope1 and Scope2. The build log at the bottom shows the following steps:

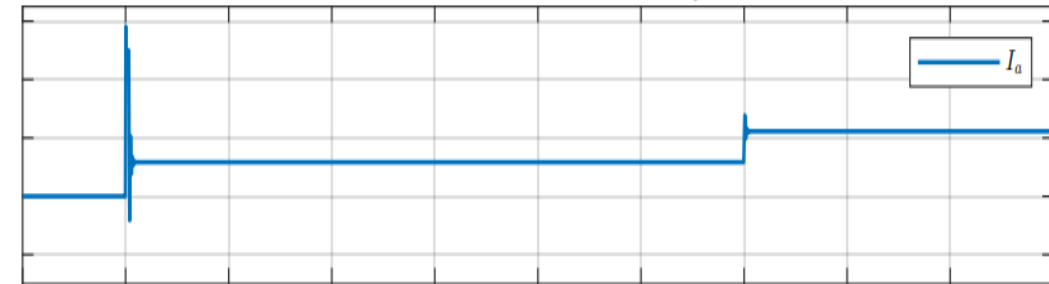
```

Output
17:31:48.768 Building elements.
17:31:48.778 Indexing global memory elements.
17:31:48.813 Building project header.
17:31:48.844 Project header build complete.
17:31:48.878 Building project.
17:31:48.883 Building DCMotor.
17:31:48.918 DCMotor build complete.
17:31:48.945 Project build completed.
17:31:48.954 Sandboxing application.
17:31:49.013 Compiling project.
17:31:49.244 Compilation completed.
17:31:49.266 Compilation successful: 0 Errors.
17:31:49.277 Project run initiated.
17:31:49.296 Project running.
17:31:49.335 Project run completed.
    
```

Simulation mode

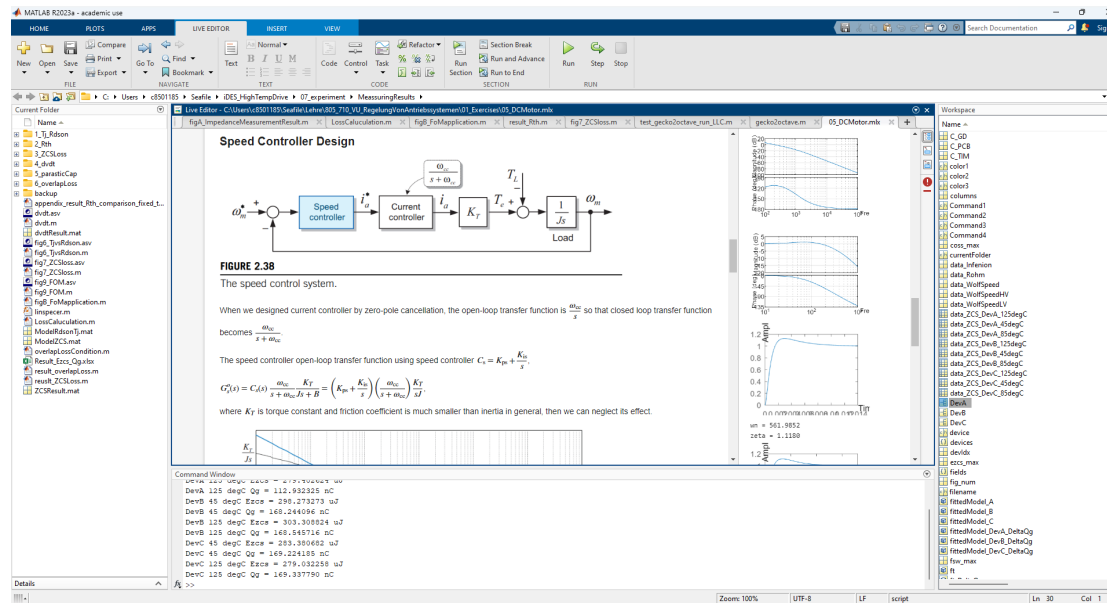


Hardware mode



# Lectures

## Elektrische Maschinen „Control of DC Machine“



**Speed Controller Design**

The speed control system.

When we designed current controller by zero-pole cancellation, the open-loop transfer function is  $\frac{\omega_m}{s}$  so that closed loop transfer function becomes  $\frac{\omega_m}{s + \omega_m}$ .

The speed controller open-loop transfer function using speed controller  $C_s = K_p + \frac{K_I}{s}$

$$G(s) = C(s) \frac{\omega_m}{s + \omega_m} K_T = \left( K_p + \frac{K_I}{s} \right) \left( \frac{\omega_m}{s + \omega_m} \right) \frac{K_T}{J s}$$

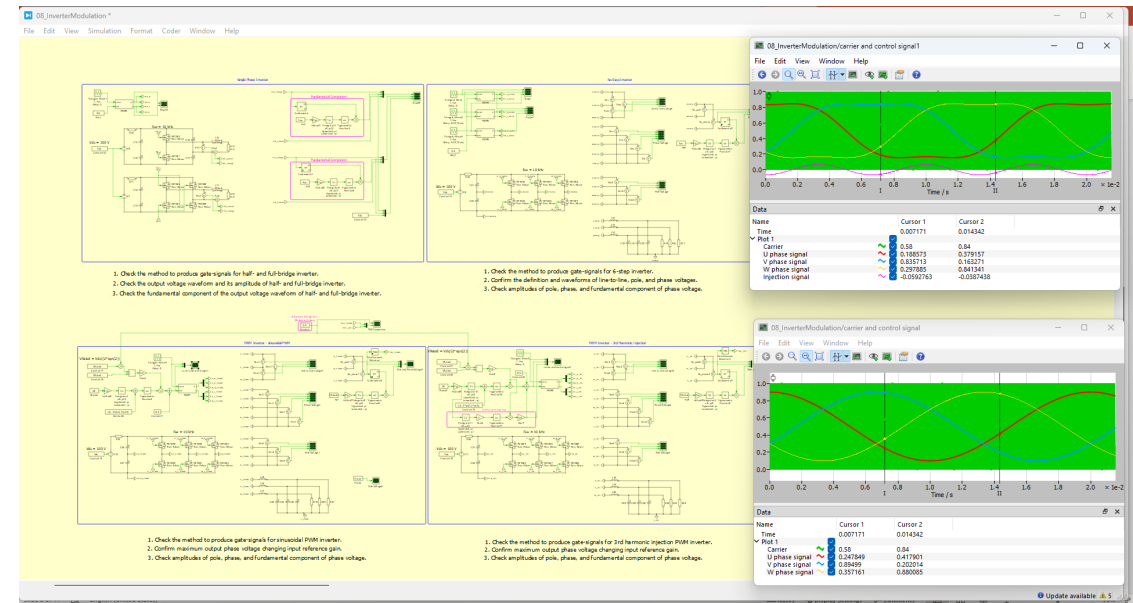
where  $K_T$  is torque constant and friction coefficient is much smaller than inertia in general, then we can neglect its effect.

Command Window:

```

>> % s = 11.7702247i
DevA 125 deg Qq = 112.922325 nC
DevB 45 deg Ezer = 290.273279 uJ
DevB 45 deg Qq = 168.244096 nC
DevB 120 deg Ezer = 303.308828 uJ
DevB 120 deg Qq = 168.848736 nC
DevC 45 deg Ezer = 283.300682 uJ
DevC 45 deg Qq = 169.224189 nC
DevC 120 deg Ezer = 279.032258 uJ
DevC 120 deg Qq = 169.937790 nC
    
```

## Regelung von Antriebssystemen „Modulation Technics“



**01\_InverterModulation**

1. Check the method to produce gate signals for half- and full-bridge inverter.

2. Check the output voltage waveform and its amplitude of half- and full-bridge inverter.

3. Check the fundamental component of the output voltage waveform of half- and full-bridge inverter.

1. Check the method to produce gate signals for 6-step inverter.

2. Confirm the definition and waveforms of line-to-line, and phase voltage.

3. Check amplitudes of pole, phase, and fundamental component of phase voltage.

1. Check the method to produce gate signals for sinusoidal PWM inverter.

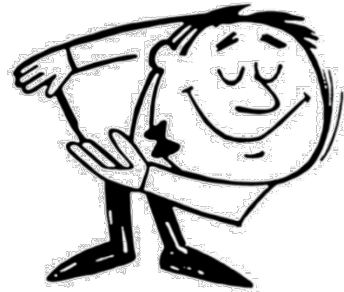
2. Confirm maximum output phase voltage charging and discharging gain.

3. Check amplitudes of pole, phase, and fundamental component of phase voltage.

1. Check the method to produce gate signals for 3rd harmonic injection PWM inverter.

2. Confirm maximum output phase voltage charging and discharging gain.

3. Check amplitudes of pole, phase, and fundamental component of phase voltage.



**Thank you!**