Modeling and Control of Voltage Source Converters and AC Drives

Industrial/PhD Course, ET-AAU, 03/2016

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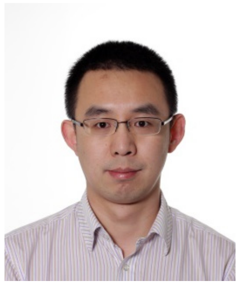
Lectures

Lennart Harnefors is currently a Senior Principal Scientist there as well as a part-time Professor with KTH. His interests are in dynamic analysis and control of power electronic systems. He received the PhD degree from KTH Royal Institute of Technology in 1997. He was a Professor with Mälardalen University and a part-time Professor with Chalmers University of Technology until 2005, when he joined ABB. His current research interests include analysis and control of power electronic systems, in particular, grid-connected converters and ac drives. He is the author of more than 100 papers. Dr. Harnefors is an Associate Editor of the IEEE Transactions on Industrial Electronics and a member of the Editorial Board of IET Electric Power Applications. He is a member of the International Scientific Committee and the Executive Council of EPE. He was the recipient of the 2000 ABB Gunnar Engstrom Energy Award and the 2002 IEEE Transactions on Industrial Electronics Best Paper Award.



Xiongfei Wang is currently an Assistant Professor with the Department of Energy Technology, Aalborg University, Denmark. His research interests include modeling and control of grid-connected converters, passive and active filters, and stability of power-electronic-based power systems. He has authored and co-authored more than 80 papers on the analysis and control of voltage-source converters. Dr. Wang received Ph.D. degree from Aalborg University, Denmark. He serves as the Associate Editor for IEEE Transactions on Industry Applications, and the Associate Editor for IEEE Journal of Emerging and Selected Topics in Power Electronics. He received the IEEE Power Electronics Transactions prize paper award in 2014.

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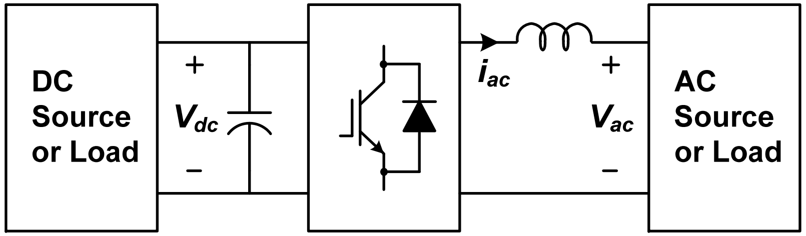
Voltage Source Converters

- **Voltage Source (dc-link): invariant voltage polarity**

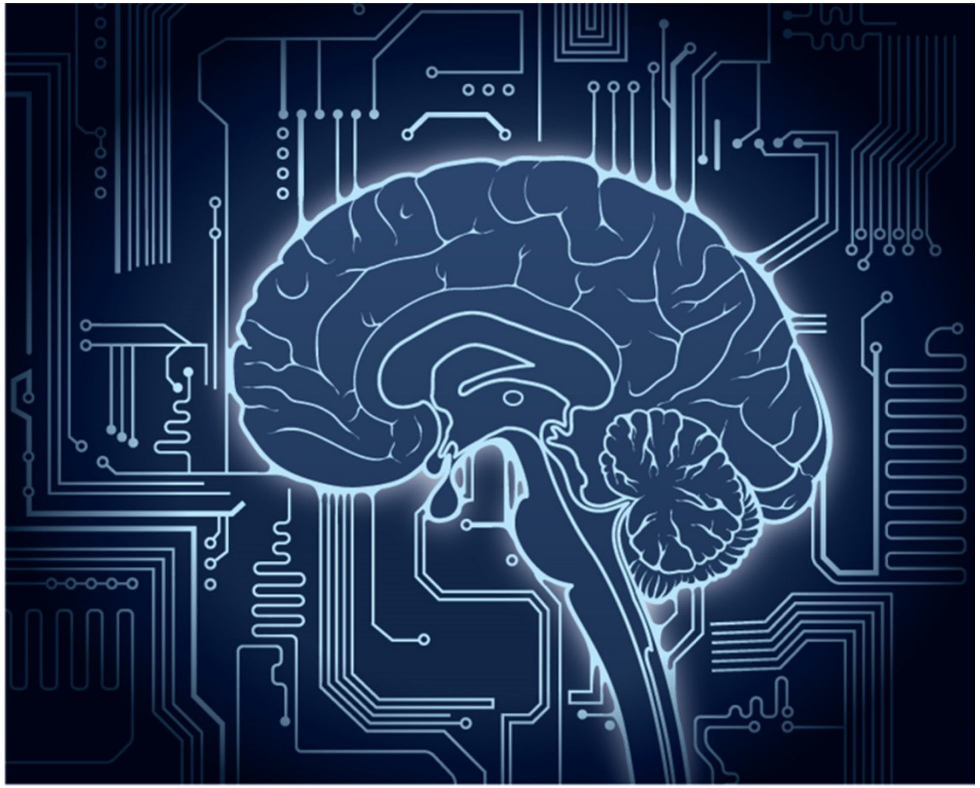


- **Widely used in different energy sectors**

(Source: ABB)

(Source: Bombardier)

Think Practical



Simple yet adequate modeling and control tools for voltage source converters to be stable and compatible in electrical grids and drives.

Scope

- **Fundamental**
  - Linear systems, space vectors, symmetric linear systems
  - Voltage source converters and modulations
  - Induction and permanent-magnet motor models

- **Implementation**
  - Current control, harmonic compensation, active damping
  - DC-link voltage control, synchronization
  - Sensor-less speed control

- **Characterization**
  - High-frequency stability issues with current control, delay effects
  - Low-frequency oscillations with power control and synchronization
  - Impedance shaping

Schedule

- **Day 1**

L1 Review of linear systems theory

L2 Space vectors, and symmetrical linear systems

L3 Voltage source converters and pulse-width modulations

L4 Current control: delay effect, model-based design

L5 Current control: harmonics, anti-windup

E1 Design of current control for L-filtered VSCs

Schedule

- **Day 2**

L6	Grid synchronization and its destabilizing effect
L7	DC-link voltage and power control
L8	Power synchronization control and fault ride-through
L9	Induction and permanent-magnet motor models
L10	VSC-fed drives and grid- VSCs: similarities and differences
E2	Design of dc-link voltage control and phase-locked loop
E3	Modeling and line start of an induction motor drive

Schedule

- **Day 3**

L11	Vector control of induction motor
L12	Current model
L13	Voltage model
L14	Flux estimators
L15	Sensor-less control and stability issues
E4	Vector control of an induction motor drive

Schedule

- **Day 4**

  L16 Stability of current control with LCL-filter

  L17 Frequency-domain passivity theory

  L18 Passivity-based current controller design

  L19 Virtual impedance based control

  L20 Active damping

  E5 Design of virtual-impedance-based active damping