

ELECTRICAL, ELECTRONICS AND COMMUNICATIONS ENGINEERING

Fincantieri/DENERG - Innovative integrated electrical power systems for the new generation of naval propulsion systems

Funded By	FINCANTIERI S.P.A. [P.iva/CF:00629440322] Dipartimento DENERG
Supervisor	BOJOI IUSTIN RADU - radu.bojoi@polito.it
Contact	RUBINO SANDRO - sandro.rubino@polito.it
Context of the research activity	<p>The objective of the doctoral thesis is the development of innovative electrical power systems for the new generation of naval propulsion systems based on medium voltage DC networks. The adoption of direct current power will allow an increase in efficiency and power density, a drastic reduction in weight and consequently a notable reduction in energy consumption. The use of WBG semiconductors will allow a further increase in power density thanks to the decrease in the weights and volumes of the reactive components required by the converters.</p>
Objectives	<p>The electrification of 3D mobility (land, air, water) represents today a key strategic action in reducing pollution in a sustainable society. In particular, the electrification of naval transport is a process still under development, with numerous technological challenges resulting from the high powers (tens of MW) required by naval propulsion systems.</p> <p>Currently, naval electricity distribution networks are predominantly low voltage alternating current (voltages lower than 1000V), while the technologies used by power conversion systems are obsolete and based on traditional silicon-based semiconductors.</p> <p>Based on recent developments in power electronics such as the advent of wide bandgap semiconductor technologies (SiC and GaN), future integrated power electrical systems for naval applications will be based on medium voltage DC networks, with voltages above 1 kV.</p> <p>The objective of the doctoral thesis is the development of innovative electrical power systems for the new generation of naval propulsion systems based on medium voltage DC networks. The adoption of direct current power will allow an increase in efficiency and power density, a drastic reduction in weight and consequently a notable reduction in energy consumption. The use of WBG semiconductors will allow a further increase in power density thanks to the decrease in the weights and volumes of the reactive components required by the converters.</p>

Research activities include the following tasks:

- Study and analysis of integrated electrical system architectures with medium voltage DC power supply.
- Design and control of multilevel and multiphase WBG power electronic converters for naval propulsion drives with high power density, high efficiency and low impact from the point of view of electromagnetic compatibility.
- Integrated multi-phase medium voltage electric propulsion drives and related fault-tolerant control techniques.
- Prototyping small-scale drives and hardware-in-the-loop (HIL) testing.

The doctoral thesis will be carried out at the Power Electronics Innovation Center of the Polytechnic of Turin in collaboration with Fincantieri Spa.

Skills and competencies for the development of the activity

The research activity needs the following skills:

- Excellent background in static power conversion (power electronic devices, converter topologies and control techniques) and electrical drives with multiphase motors.
- Very good knowledge of simulation software for power electronics and electrical drives.
- Teamwork mindset and ability to work in multi-disciplinary environment.
- Good logical and analysis capability, including good self-organizational mindset.