

Co-supervised Master thesis, 2024-2025

Practical control schemes of a POLARIS system

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Context

CERN is the well-known international research centre on physics of particles with one of the most important particle colliders in the world (27 km). Active research is preparing the next generation of accelerators for the discovery of new particles and matter. In particular, new power electronics converter are developed with higher modularity, high current, fast dynamics and very high accuracy.

The POLARIS converter is a new generation of power converter for particle testing in the North Area which needs more than 400 converters. It is composed of an elementary block that can be connected in series and/or in parallel to achieve the different power converter of the North Area

Since 2015, collaboration between L2EP and CERN has developed inversion-based control from the EMR (Energetic Macroscopic Representation) formalism: SIRIUS FP22S and POPS. A new collaboration has been initiated in 2023 on the POLARIS system. L2EP and CERN have developed the EMR and MCS (Maximal Control Scheme of the POLARIS elementary block).

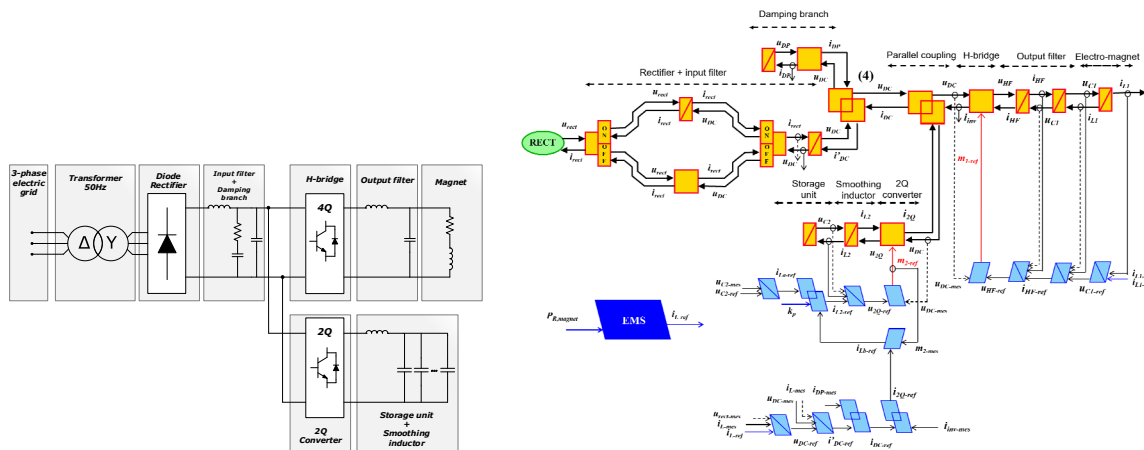


Figure 1 : POLARIS elementary block and its maximal control scheme

Objective

In order to continue the collaboration, different practical control schemes of the POLARIS elementary block will be studied from the maximal control structure. Moreover, in a second step, the extension to series and parallel connection of elementary blocks will be studied.

A 4-month research stay at CERN is expected.

References

[Bouscayrol 2012] A. Bouscayrol, J. P. Hautier, B. Lemaire-Semail, "Graphic Formalisms for the Control of Multi-Physical Energetic Systems", Systemic Design Methodologies for Electrical Energy, tome 1, Analysis, Synthesis and Management, Chapter 3, ISTE Willey editions, October 2012, ISBN: 9781848213883.

[Horrein 2020] J L. Horrein, J. M. Cravero, P. Delarue, A. Bouscayrol, D. Aguglia, C. Ortega-Perez, "Dead-Time influence on fast switching pulsed power converters design – A high current application for accelerator's magnets", *EPE'20 ECCE Europe*, Lyon (France), September 2020 (common paper of L2EP Univ Lille and CERN).

[Baziz 2024] A. Baziz, "EMR-based control of a POLARIS converter", Master thesis report, Univ. Lille, September 2024 (under the supervision of L2EP Univ. Lille and CERN)