DC Number	DC12
Title of the PhD Project	Smart Control of Floating Wind Turbine with Grid Integration
Keywords	Nonlinear control, Power Systems, Artificial Intelligence
Recruitment organisation	Ecole Centrale de Nantes France
Supervisors names and contacts	M. A. Hamida mohamed.hamida@ec-nantes.fr , F. Plestan franck.plestan@ec-nantes.fr
Scientific context and objectives	Floating wind turbines are under-actuated and disturbed, with conflicting control objectives (motion limitation, power optimization, non-excitation of degrees of freedom, coupling). This calls for control algorithms that ensure turbine stability and maximized power. Regions II and III of operation are considered: Region II with a wind speed between the cut-in speed and the rated speed, and Region III with a wind speed above the rated speed. Control in Region III is well mastered [1], [2] by using advanced control strategies. However, these strategies have not been applied to the control of floating wind turbines in Region II [3], or in the transition between Regions II and III. In addition, the integration of power into the electrical grid must both meet demand and contribute to its stability in terms of frequency and voltage amplitude, despite variations in electromagnetic torque. The objectives of this PhD are: • Objective 1 to use robust adaptive sliding mode control techniques (developed at LS2N from a theoretical point of view, including AI tools) in Region II to optimize energy output and limit the movements of the floating structure. • Objective 2 is to develop control strategies for inter-region II-III by validating this solution on a Hardware in the Loop simulator combining digital simulator and power conversion systems. • Objective 3 is to study control architectures so that the power can respond to network demand by ensuring its stability in terms of frequency and voltage amplitude, despite variations in electromagnetic torque due, for example, to the movement of the floating platform.
Required skills	• Master degree in Systems and Control Engineering, Electrical Engineering with strong background on control of electrical systems • Proven experience in control theory with application to electrical systems. Experience with wind turbines/openFast tool would be desirable • Ability to work scientifically, independence, flexibility, teamwork and communication skills • Ability to work to deadlines and deliver high quality results on time. • Very good knowledge of English
References	[1] C Zhang, F Plestan, “Individual/collective blade pitch control of floating wind turbine based on adaptive second order sliding mode”, Ocean Engineering 228, 108897, 2021 [2] M.J. Mirzaei, M.A. Hamida, F. Plestan, Neural network-based supertwisting control for floating wind turbine in region III, IFAC-PapersOnLine 56 (2), 336-341, 2023 [3] E. Aslmostafa, M. A. Hamida, F. Plestan “Nonlinear control strategies for a floating wind turbine with PMSG in Region 2: a comparative study based on the OpenFAST platform”, Ocean Engineeering, second round 2024.

This project has received funding from the European Union’s
Horizon Europe Framework Programme (HORIZON) under the GA n. 101120278 - DENSE