UCLouvain

lelme2313

2021

Dynamic modelling and control of electromechanical converters

5.00 crédits	30.0 h + 30.0 h	Q1

Enseignants	De Jaeger Emmanuel ;Dehez Bruno ;
Langue d'enseignement	Anglais
Lieu du cours	Louvain-la-Neuve
Thèmes abordés	- Dynamic models of DC machines - Dynamic models of synchronous machines - Dynamic models of asynchronous machines - Space phasors and variable transformations (Concordia, Park and Clarke) - Control of DC and BLDC machines - Vector and scalar control of asynchronous machines - Vector control of synchronous machines
Acquis d'apprentissage	**A la fin de cette unité d'enseignement, l'étudiant est capable de :** 1 **Contribution of the course to the program objectives (N°)** Axis 1 (1.1, 1.2, 1.3), Axis 3 (3.3), Axis 5 (5.6) **Specific learning outcomes of the course** At the end of the course, the student will be able to : - Derive the dynamic model of electromechanical converters (DC and brushless DC machines, synchronous and asynchronous machines) in order to control them, in particular by exploiting the variable transformations (Concordia, Park and Clarke). - Describe the main control strategies of these converters (scalar V/f control of asynchronous machines, vector and direct torque control for asynchronous and synchronous machines) and choose them according to the application. - Use the adapted dynamic models in order to simulate the dynamic behaviour of these converters - Use the adapted dynamic models in order to synthesize type P, PI or PID controllers. - Use the adapted dynamic models in order to check the robustness and performance of a controller regarding modelling simplifications, external disturbances, changes in the machine parameters, ...
Modes d'évaluation des acquis des étudiants	- Homework reporting (40%) - Closed book oral examination (60%)
Méthodes d'enseignement	Teaching is organized in the form of: - Lectures; - Homework on modelling and control of the various electromechanical converters seen during the lectures. The homework are performed in groups of 2 or 3 students and lead to a synthesis report, which is evaluated and is involved in the final evaluation of the course.
Contenu	- Introduction (1 hour): motivations, types of models, general structure of an electrical drive system, factors of development of electrical drive systems - DC machine model (2h): structure of the machine; excitation mode, dynamic equations in the time domain and in the Laplace domain; model simplifications (mechanical, electrical and electromechanical time constants); model improvements (armature resistance, saturation) - Space phasors and variable transformations (2 hour): Concordia Clarke and Park transformations - Synchronous machine model (4h): equations of the machine in 'abc', 'ab' and 'dq' coordinate systems; round rotor and salient pole machines; particularization to permanent magnet machines - Asynchronous machine model (4h): equations of the machine in 'abc', 'ab' and 'dq' coordinate systems - DC machine control (2h): general principle, main types of power supply, control with emf compensation, control with and without current measurement for low power machines - Synchronous machine control (4h): general principle of vector control in the 'dq' coordinate system; control with emf compensation, taking into account the inverter and the digital controller; flux weakening; particularization to surface mounted and interior permanent magnet machines, salient pole and wound inductor machines; brushless DC machines

	- Asynchronous machine control (4h): equations in the rotor flux coordinate system; general principle of vector control in this coordinate system; vector control with emf compensation; scalar V/f control - Electromechanical converters control concepts applied to electricity generation, with special emphasis on wind conversion (2h)
Ressources en ligne	https://moodle.uclouvain.be/course/view.php?id=1272
Bibliographie	- Slides - Books (available online via the intranet UCL): • Wach, P., Dynamics and control of electrical drives, Springer, 2011, 456 p. • Veltman, A., Pulle, D. W., De Doncker, R. W., Fundamentals of electrical drives, Springer, 2007, 346 p. • De Doncker, R. W., Pulle, D. W., Veltman, A., Advanced electrical drives: Analysis, Modeling, Control, Springer, 2011, 462 p.
Autres infos	Concerning the homework: - Supervised sessions are organized weekly in a computer classroom - The software used is Matlab/Simulink
Faculté ou entité en charge:	ELME

Programmes / formations proposant cette unité d'enseignement (UE)

Intitulé du programme	Sigle	Crédits	Prérequis	Acquis d'apprentissage
Master [120] : ingénieur civil électricien	ELEC2M	5		
Master [120] : ingénieur civil électromécanicien	ELME2M	5		