CENTRALE NANTES

EES-UETP
Electric Energy Systems
University Enterprise Training Partnership

COURSE PROPOSAL – EES UETP

Advanced controls for power systems with high penetration of renewables

Profile of expected attendees: The fields of applications are: power grids, renewable generators control and connection to the grid, power electronics control in general (for example, for grids, microgrids, stand alone and embedded systems).
Course duration: 2.5 days
Course dates: 17th to 19th june 2019.
Course location and venue: Ecole Centrale de Nantes, 1 Rue de la Noë, 44300 Nantes, France.

Overall course aims:

The general objective of the training is to give a "system view" (i.e., model-based analysis and control) of the massive integration of renewables into modern power systems, to the trainees.

Skills and output of the course:

- To explain modern and future power systems with high penetration of renewable require complex dynamic models.
- To discover how dynamics essential to power oscillations can be extracted from an overall model into a small-size control model.
- To fulfill high performance renewable grid connection specifications, advanced control methods which take into account uncertainties of the models will be explained.

Course schedule:

Time	Day 1	Day 2	Day 3
9-10:30		Robustness (B. Marinescu, Centrale Nantes)	Robust design of damping controllers (B. Marinescu)
10:30-11:00		Coffee	Coffee
11:00-12:30		Model reduction (B. Marinescu)/Identification (L. Rouco, IIT Madrid)	Control of wind generators connected to weak grids (E. Saiz, Siemens Gamesa)
12:30-14:00		Lunch	Lunch
14:00-15:30	Introduction (F. Xavier, RTE)	Modal analysis (L. Rouco)	Modeling and Control of Wind Turbines (H. Schulte, HTW Berlin)
15:30-16:00	Coffee	Coffee	Coffee
16:00-17:30	Modeling (B. Marinescu)	Eigenvalue sensitivity approach to damping controller tuning (L. Rouco)	Wind Power Plants and Wind Farm Integration (H. Schulte)

Content of the course:

Control model for robust control: how to capture the dynamics of interest into a small-size model? How to account for the neglected dynamics? Advanced damping control which takes into account the uncertainty quantified into a good control model

Identification of power system components. Models, tests, parameter estimation, examples of identification of excitation and speed-governing systems

Modal Analysis: Eigenvalues, eigenvectors, modal controllability and observability factors, residues, participation factors, eigenvalue sensitivities, single machine and multimachine system examples

Eigenvalue sensitivity approach to damping controller tuning: Two step approach (phase compensation and gain calculation), single step approach (dynamic gains approach), single machine and multimachine system examples

Modelling and Control of Wind turbines (WTs): Reduced modelling of WTs for control design, Control objectives and assessment criteria (Power and rotor speed fluctuation, mechanical loads, fault diagnoses, fault tolerance), Base-line control design in the frequency domain, Advanced wind turbine control using LMI Approach, Controller validation with FAST.

Pedagogicals and technicals means:

- From the engineering point of view, concrete grid situations of ENSTO-E will be treated.
- From the pedagogical point of view, simple example will be worked-out by the trainees.

Evaluation:

Evaluation forms will be filled out at the end of the training.

The registration fees (for 2,5 days):

The course fees include lectures attendance, documentation, coffee breaks and lunches.

- Members of the EES-UETP: 306.25 EUR
- Members of the EES-UETP (industrial members, of a large size : > 250 employees) : 625 EUR
- University non-members of the EES-UETP (small companies, up to 50 employees, or individuals) : 750 EUR
- Industry non-members of the EES-UETP: 1250 EUR

Registration: send an email to executive-education@ec-nantes.fr with email subject « EES UETP » .

More information on https://bit.ly/ECN_EES_UETP

Course organizer and pedagogical team:

Centrale Nantes, France.

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Speakers:

Florent Xavier is the Head of the Group "Integration of New Technologies" inside RTE's R&D Direction, with 7 years of experience in the field of power systems. Graduated engineer from the Ecole Superieure d'Electricite; M.Sc in electrical and electronical engineering from the Swiss Federal Institute of Technology in Lausanne (EPFL)
RTE representative in ENTSO-E groups: System Protection and Dynamic group (SPD), Research Development and Innovation Committee (RDIC) on System Stability working group and PG UA/MD.

Bogdan Marinescu was born in 1969 in Bucharest, Romania. He received the Engineering degree from the Polytechnical Institute of Bucharest in 1992, the PhD from Université Paris Sud-Orsay, France in 1997 and the "Habilitation à diriger des recherches" from Ecole Normale Supérieure de Cachan, France in 2010.
He is currently a Professor and Head of the chair "Analysis and control of power grids" in Ecole Centrale Nantes and LS2N laboratory. In the first part of his carrier, he was active in R&D divisions of industry (EDF and RTE) and as a part-time professor (especially from 2006 to 2012 in Ecole Normale Supérieure de Cachan). His main fields of interest are the theory and applications of linear systems, robust control and power systems engineering, especially insertion of power electronic based elements into AC grids.

Luis Rouco obtained MSc and PhD degrees from the Polytechnic University of Madrid in 1985 and 1990 respectively. He is Professor of Electrical Engineering in the School of Engineering of Universidad Pontificia Comillas. He has served as Head of the Department of Electrical Engineering from 1999 through 2005. Professor Rouco develops his research activities at Instituto de Investigación Tecnológica (IIT). His areas of expertise are modelling, analysis, simulation and control of the steady - state, dynamic and transient behaviour of electric power systems He has led a number of research projects for Spanish public administrations, Spanish electric utilities and other Spanish engineering and industrial companies. He has also developed research projects for foreign companies and institutions. Professor Rouco is associate editor of the IEEE Transactions on Power Systems. Professor Rouco is Senior member of IEEE and Distinguished Member of Cigré, pastPresident of the Spanish Chapter of IEEE Power Engineering Society del IEEE and Member of the Executive Committee of the Spanish National Committee of CIGRE. He has been visiting scientist at Ontario Hydro (Toronto, Canada), MIT (Cambridge, Massachusetts, USA) y ABB Power Systems (Vasteras, Sweden).

Elena Sáiz Marin was born in Madrid, Spain in 1987. She recieved the Electrical Engineer degree and PhD from Universidad Pontificia Comillas in 2010 and 2015. Her PhD was awarded with Eolo innovation prize by Spanish wind association (AEE). She has worked as a Researcher at the Instituto de Investigación Tecnologica (IIT) from Universidad Pontificia Comillas and in Endesa. Currently she works in the Technological Development section of Siemens Gamesa where her areas of interest includes wind turbines integration into weak grids.

Horst Schulte received the diploma degree in Electrical Engineering from TU Berlin and the Ph.D. degree in Control Engineering from University Kassel (Germany). He joined the Bosch Group in 2005 where he worked in R&D projects in the field of modeling, optimization and advanced control of actuators, power systems and drive trains. Since November 2009, he has been a full Professor at the University of Applied Sciences HTW Berlin. His research interests include nonlinear controller and observer design with Takagi-Sugeno (TS), LPV and sliding-mode techniques, robust control system design, active fault-tolerant
control (FTC) system design with applications in the field of sustainable power systems and Cyber-physical systems.
He is the author of more than 110 scientific publications including international journal papers, book chapters, patents, and conference papers. Prof. Schulte is in the management board of Federation of German wind power and other renewable energies (FGW e.V.), a member of IFAC TC 6.4 Fault Detection, Supervision & Safety of Technical Processes, 7.1 Automotive Control and a member of the IEEE CIS Task Force on "Fuzzy Systems in Renewable Energy and Smart Grids".