## ACCOMMODATION

Suggested hotels, close to the Engineering School are (early reservation is encouraged, as April is peak season in Sevilla):

Hotel Barceló Renacimiento *****

Isla de la Cartuja, s/n

41092 Sevilla

Phone. 954462222, Fax 954463383

http://www.barcelo.com/BarceloHotels/es-ES/Hotels/Spain/Seville/Renacimiento/Home

Hotel Tryp Macarena ****

C/ San Juan de Ribera, 2

41009 Sevilla

Phone. 954375700; Fax 954381803

http://es.solmelia.com/hotel/tryp-macarena.htm

Hotel NH Plaza de Armas ***

Avda. Marqués de Paradas, s/n

41001 Sevilla

Phone. 954901992; Fax 954901832

http://www.nh-hoteles.es/nh/es/hoteles/espana/sevilla/nh-plaza-de-armas.html

Hotel Eurostars Islacartuja ****

Isla de la Cartuja-Sector Norte, s/n

41092 Sevilla

Phone. 954081700; Fax 954081779

http://www.eurostarshotels.com/ES/hoteles-en-espana-sevilla-eurostars-isla-cartuja.html

## COURSE FEES

The course fees include lectures attendance, documentation, a copy of the book "Power System State Estimation: Theory and Implementation" by Ali Abur and Antonio Gómez-Expósito (Marcel Dekker, 2004), coffee breaks and lunches.

Members of the EES-UETP: **525 EUR**

University non members of the EES-UETP: **900 EUR**

Industry non members of the EES-UETP: **1500 EUR**

The Course Secretariat will send an invoice/receipt to each registered participant, after the reception of the filled Registration Form, together with the bank transfer.

Other information can be found at:

http://www.esi2.us.es/GIE/

or by phone

Mrs. Maria Álvarez Zambrana

+34 954481282

## INFORMATION, REGISTRATION AND COURSE LOCATION

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Instructor: eromero@us.es

Phone: +34 954 487287

Engineering School

Isla de la Cartuja

Avenida Camino de los Descubrimientos S/N

41092 Sevilla, Spain

**Electric Energy Systems**

**University Enterprise Training Partnership**

http://power.inescn.pt/EES-UETP/

# 2009 Course Program

## Power System State Estimation: Recent Trends and Future Needs

**April 22nd - 24th, 2009**

Engineering School

Isla de la Cartuja
Avenida Camino de los Descubrimientos S/N

41092 Sevilla, Spain

**Organized by**

Department of Electrical Enginnering

## OBJECTIVES

Power system state estimation (SE) constitutes one of the critical functions at the control centers. Since a majority of the applications use the real-time data base provided by the state estimator, its optimal performance is of ultimate concern, particularly in nowadays where any decision has economic relevance. The quality of its results will be dependent upon not only the measurements but also the assumed network model and its parameters. Hence, state estimators use various techniques to ensure validity of the results and to detect and identify sources of errors when the validity of results is questionable.

This course introduces the basic statistical concepts which are used in formulating the SE problem. It illustrates its solution by well known methods which are customized to take advantage of the special structure of power networks and measurements. The concepts of network observability, identification of observable islands and their significance in system operation are explained. Importance of measurement design in maximizing the benefits and effectiveness of state estimators is discussed and illustrated via numerical examples.

Synchronized phasor measurements which are rapidly populating substations worldwide are also being incorporated into the new generation of state estimators. The course will discuss their impact, benefits as well as the issues related to their proper placement in a given power system.

Other relevant topics covered in the course are related with the extension of the SE concept to very specific scenarios: distribution networks, characterized by a very limited amount of real-time information, as well as huge regional networks, like the European interconnected system, which call for hierarchical approaches.

Computer exercises will be used to illustrate the concepts and allow the attendees to interact with the course instructors during the hands-on part of the course.

## CREDITS

Course attendees from academic institutions enrolled in graduate or postgraduate programs will have the chance to get up to 3 ECTS credits. To do so, they will be required to carry out some homework within a month after the course ends, consisting in solving a set of selected exercises taken from the adopted textbook.

## COURSE DURATION

Two days and a half- 22d to 24th April 2009.

## CONTENTS / SCHEDULE

*Wednesday, April 22, 2009*

| | |
|---|---|
| 09:00-10:00 | *Introduction to Static Security Assessment and Role of SE (A. Abur)* |
| 10:00-11:00 | *Weighted Least Squares (WLS) State stimation (A. Abur)* |
| 11:00-11:30 | Break |
| 11:30-12:30 | *Network Observability: Theory and Formulation (E. Romero)* |
| 12:30-13:30 | *Observability Tests and Meter Placement (A. Abur)* |
| 13:30-15:00 | Lunch Break |
| 15:00-16:00 | *Numerical Issues: Handling Constraints, Ill-Conditioned Cases, Decoupling (A. Gómez)* |
| 16:00-17:30 | *Computer exercises (E. Romero and A. de la Villa)* |

*Thursday, April 23, 2009*

| | |
|---|---|
| 09:00-10:00 | *Bad Data Detection and Identification (E. Romero)* |
| 10:00-11:00 | *Robust Estimation (A. Abur)* |
| 11:00-11:30 | Break |
| 11:30-12:30 | *Incorporation of PMU measurements into SE (A. Abur)* |
| 12:30-13:30 | *Considerations and methods to determine best locations for placing PMUs (A. Abur)* |
| 13:30-15:00 | Lunch Break |
| 15:00-16:00 | *State Estimation for Distribution Networks: Classic and Fuzzy Techniques (J. Pereira)* |
| 16:00-17:30 | *Computer exercises (E. Romero and A. de la Villa)* |

*Friday, April 24, 2009*

| | |
|---|---|
| 09:00-10:00 | *Topology Error Identification (A. Gómez)* |
| 10:00-11:00 | *Parameter Estimation (A. Abur)* |
| 11:00-11:30 | Break |
| 11:30-12:30 | *Hierarchical State Estimation: A Solution to the European Needs (A. Gómez)* |
| 12:30-13:30 | *EMS/DMS State Estimation Dependent Applications (J. Pereira)* |

## INSTRUCTORS

**Prof. Ali Abur**
*– Northeastern University, Boston, USA*
**Prof. Antonio Gómez Expósito**
*–University of Sevilla, Sevilla, Spain*
**Prof. Jorge Pereira**
*–INESC, Porto, Portugal*
**Prof. Esther Romero Ramos**
*–University of Sevilla, Sevilla, Spain*
**Prof. Antonio de la Villa Jaén**
*–University of Sevilla, Sevilla, Spain*

## COURSE COORDINATOR

**Antonio Gómez Expósito**

Department of Electrical Engineering

University of Sevilla, Spain

*age@us.es*

**The number of attendees is limited.**