Doctoral Program in Electrical and Computer Engineering
PDEEC

FEUP

Director: Jose C. Principe

Scientific Council: Artur P. Alves, Aurelio Campilho, Vladimiro Miranda

June 6, 2007

Why a Doctoral Program at DEEC?

* Higher education has become a global affair
* In order to compete at the international scene (i.e. attract foreign students and retain your very best Ph.D. candidates), DEEC must develop a high quality Ph.D. program on par with the ones found in top Universities across the world.
* The large faculty body and a few strong groups places DEEC on a relatively small group of departments, increasing the chances of creating a top notch Ph.D. program.
* However, the present doctoral studies need to be modified and structured.

General guidelines

* The offering of doctoral degrees at the DEEC is proliferating (PDEEC, ProDEI, MAP, MIT, CMU, UT Austin).
* Primarily for the students this will be very confusing.
* But it also may create duplication of efforts and uneven requirements, which we should avoid at all costs.
* Need a structure to centralize, deliver and update the information and orchestrate all the programs.
* I requested from the Chair an Administrative Assistant towards this goal.

General guidelines

* The scientific direction of each program can be autonomous, with their own set of courses (hopefully some will be shared among programs!)
* But the doctoral degree from DEEC should have a **single unique "value". PDEEC** will be here to stay when all the other programs have a limited time span. Their true value is to help bootstrap the quality and organization.
* And for efficiency, they should all share a common core administrative infra structure, regulations and "student interface".
* The answer is **accreditation and cross listing** of graduate courses.

PDEEC Organization

⁜ The PDEEC has a
- Director,
- Scientific Committee
- An office with an Administrative Assistant to produce, maintain, centralize and receive all information about the PDEEC.

PDEEC Organization

⁜ The PDEEC is a large spectrum doctoral degree organized in 8 scientific themes

QUADRO N.º 1

ÁREA CIENTÍFICA	SIGLA	CRÉDITOS	
		OBRIGATÓRIOS	OPTATIVOS
Matemática	M		
Física	F		
Ciências Fundamentais e da Electrotecnia	CFE		
Automação, Controlo e Sistemas de Produção Industrial	ACSPI		
Electrónica e Sistemas Digitais	ESD		
Energia	E		
Informática	I		
Telecomunicações	T		
Outras áreas técnicas	OAT		
TOTAL		150	30 (1)

PDEEC Organization

⁜ In each theme there is at least one, 2 semester course sequence (1st semester)

UNIDADES CURRICULARES	ÁREA CIENTÍFICA
(1)	(2)
Energy Markets: Markets and regulation	E
Power system dynamics and control: Signals, dynamics and control	E
Digital Communications: Special topics in digital communications	T
Communication technology: Mobile communications systems	T
Systems and control: Vector space methods	ACSPI
Discrete event and hybrid systems: Discrete event systems	ACSPI
Computer Science: Model driven/aspect oriented software	I
Signal Processing: Signal analysis, classification and processing	CFE
Microelectronics and Microsystems: Microelectronic and microelectromechanical technologies	ESD
Operations Research: Optimization and decision support techniques	M

PDEEC Organization

⁜ In each theme there is at least one 2 semester course sequence – 2nd semester

UNIDADES CURRICULARES	ÁREA CIENTÍFICA
(1)	(2)
Energy Markets: Market simulation	E
Power system dynamics and control: Systems with renewables	E
Digital Communications: Communication networks and multimedia	T
Communication technology: Advanced pptical communications cystems	T
Systems and control: Measure theory and stochastic processes	ACSPI
Discrete event and hybrid systems: Hybrid Systems	ACSPI
Computer Science: Grid computing	I
Signal Processing: Digital signal processing systems architectures	ESD
Microelectronics and Microsystems: Advanced microelectronic systems design	ESD
Operations Research: Decision and optimization	M

PDEEC Organization

✳ There is also a list of topical courses beyond the sequences

UNIDADES CURRICULARES	ÁREA CIENTÍFICA
(1)	(2)
Decision and optimization	M
Optimal control	M
Introd. Tutorials in Optimization and Decision Support	M
Sensor Networks/ Embedded Systems	ACSPI
Industrial Integration	ACSPI
Advanced Topics in Robotics	ACSPI
Systems Identification	ACSPI
Non Linear Control	CFE
Robust and Multivariable Control	CFE
Adaptive Control	CFE
Signal Processing for Communicat. and Sensing Systems	CFE
Forecasting	E
Methods for Optimal Power Flow	E
Advanced Reliability	E
Computational Intelligence and Power Systems	E
Optical Communications Laboratory	T
Advanced Signal Processing	T
RF Engineering	T
Audio and Video Analysis	T
Special Topic (a definir pela Comissão Científica do curso)	todas
Qualquer uma das incluídas nas sequências	todas

Course Requirements

✳ Students are required to take two sequences and several topics to make up 180 credit hours ECTS.

✳ Included in these hours are two Individual Work themes (15 hours) that are designed to construct a research theme and the preparation of the research proposal to be presented and approved for admission to candidacy.

✳ The research hours are also counted in the ECTS up to 120 hours

Ph.D. Degree Requirements

✳ Besides the successful completion of the course work, the student must:
  ● Elaborate a research proposal
  ● Conduct the proposed research
  ● Write a Ph.D. thesis and defend it successfully

Establishing and Elaborating Courses

✳ The goal of graduate courses is to help students read the literature as an expert (i.e. they will be able to understand the material or know where to find the information they need).

✳ The courses you have are Place Holders... Content needs to evolve.

✳ Contents should be presented in a standardized manner

Establishing and Elaborating Courses

- Example
- **EEL 5701 - Foundations of Digital Signal Processing** (3 credits) Analysis and design of digital filters for discrete signal processing; spectral analysis; fast Fourier transform.
- **EEL 5717 - Fundamentals of Computer Hardware** (3 credits)
- Prereq: EEL 4712C, 4713C, or equivalent. Systematic study of components of a computer system; organization and realization of arithmetic, control and data paths.
- **EEL 5718 - Computer Communications** (3 credits) Prereq: EEL 4514. Design of data communication networks: modems, terminals, error control, multiplexing, message switching, and data concentration.

Course Design

- There are two different types of graduate courses:
  - Course sequences
  - Special topics
- A special topic covers the material in a narrow application domain with all the depth that is needed to fully understand and further research work in the same area.

Course Design

- A graduate course in a Ph.D. sequence should address the **scientific foundations** that are needed beyond the "licenciatura".
- To create the course contents in a sequence:
  - Spell out very clearly the pieces of information that should complement the student preparation in the licenciatura.
  - Create no more than four, preferably only one or two, important topics that you want the student to know.
  - Since sequences are built from two courses think the best way to break these topics down in two courses.

Course Design

- Therefore, the course description would be a handful of well thought topics that translate the new material to be covered.
- This description should also be structuring to the student and enable an easy selection.
- Go back and compare what you have proposed with the result of this exercise!

Course Design

- Example: graduate sequence in signal processing:
- Students know basic filtering, Fourier analysis techniques and have experience in programming DSPs.
- For a graduate knowledge in DSP one needs:
  - Stochastic Processes
  - Spectral Analysis
  - Detection and Estimation
  - Adaptive Filtering
- Therefore, the graduate sequence in DSP should cover these four topics divided in two courses.

Course Accreditation

- A graduate course should be science based and be of the highest quality.
- Professors willing to teach new graduate courses should have them approved by the PDEEC Scientific Committee.
- A web form will be created to help you develop and get new courses accredited in the PDEEC.

Course Accreditation

- Basically you have to show that you have the expertise to teach the course (CV).
- Need to say why topic is important and timely.
- Should specify how it is related with the other special topics or course sequences.
- Should indicate pre-requisites.
- Should indicate the resources (man power/lab equip) needed to teach the course.

Launching the PDEEC

- PDEEC is not approved yet, but the starting date is Fall 2007!
- The breath of the PDEEC, the limited time and resources do not allow an across the board start.
- Therefore only a minimum of three themes will be launched in the Fall 2007.

Launching the PDEEC

- Our goal is to maximize impact of the themes w.r.t. the other Ph.D. programs and also to minimize overlap.
- The committee will start the review of the
  - Energy
  - Communications
  - What else?

Procedures

- I found out that the website (FEUP-> alunos-> doutoramento) has very little information about what the students should do. It is basically a copy of the legislation, while it should be a "why/how/where/when" manual.
- I will develop a set of procedures written from the student perspective with the core information.
- There is also a lot of missing information to help faculty develop common procedures and open up the program to accreditation in partner universities and international students….

Procedures: General

- All courses and class discussions should be in English
- Graduate student progress should be evaluated once a year.
- A course will function if at least 5 students register for the course.
- All tests, homeworks, exams should have a pledge of honesty for the students to sign. "Pledge: I declare that I have not received help nor helped others during the test".
- All graduate instructors/courses will be evaluated by students at the end of semester.

Procedures: Course Syllabus

- How: one page description of instructor, pre requisites, course content, adopted book, grading policy, homeworks/ tests projects
- When: available at the end of previous semester
- Where: on the web, bulletin board and professor office.
- Example

Course Syllabus

EEL 6502 ADAPTIVE SIGNAL PROCESSING
Fall 2006

Instructor: Jose Principe
Office: EB 451
Phone: 352-392-2662
Email   principe@cnel.ufl.edu
Office Hours: Tu 10th , We 9-10th.

TextBook: *Adaptive Filter Theory, Simon Haykin, Prentice-Hall, 2002, ISBN 013-090126-1*

References:
    Adaptive Signal Processing, Bernie Widrow and Stearns, Prentice Hall
    Fundamentals of Adaptive Filtering, Ali Sayed, Wiley, 2003

Course Goals:
The goal is to present the theory of adaptive signal processing and cover several engineering applications. The major topics will be the concept of adaptation, performance measures and the implementation of adaptive algorithms. Both the LMS and the RLS will be covered in detail. Adaptation of the signal bases will also be covered, such as eigendecompositions with on-line algorithms, and adaptation of generalized feedforward filters.

Topics:
Adaptation as function approximation	Frequency domain LMS
Filters as Function approximators	Eigendecompositions
Wiener Filter Theory	Temporal PCA
Iterative algorithms	Generalized PCA
Theory of adaptation:	Whitening transforms
properties,	Adaptation in signal spaces:
search,	Generalized Feedforward Filters
measures	Laguerre, Gamma
Adaptive algorithms	Lattice structures
LMS	Applications
RLS	

Grading:
	Homework	25%
	Project I	25%
	Project II	25%
	Exam	25%

Computer Projects:
Several application areas will be outlined. During the course students will have the opportunity to program adaptive algorithms in MATLAB and test them in real world data.

Procedures: Web Posting

※ A webpage should be created for the course with a link available in the FEUP website.

※ The professor notes, the homeworks, the solutions, the projects and the data, the exams should all be there for consultation.

Note: Examples of student work should be kept for accreditation and quality control

---

Open questions

※ Budgets to invite international expert to teach modules

※ Scholarships for Ph.D.

※ Teaching Assistants (TA) stipends

※ How to copyright Thesis

Handbook

※ Minimum admission requirements (both for FEUP students and others)

※ Course requirements (OK)

※ Supervisory committee appointment (and dates)

※ Annual evaluation of ph.d. students

※ Breadth requirements

※ Leave of absence policy

※ Official minor (optional)

※ Written qualifying exam

※ Oral qualifying exam

※ Final examination

※ Probation policy

※ Transfer of credits

※ Financial aid

※ Readmission policy

※ Elaborate a check list

PH.D. Student Meeting

- New Model of doctoral degree
- How to integrate current Ph.D. students
- Handbook
- Open Discussion

What is a Ph.D. degree

- It is the highest <u>scientific</u> degree offered.
- A Ph.D. student must learn the *methodology* and *ethics* of science and become an *autonomous thinker* capable of furthering the scientific enterprise.
- So the PDEEC must enforce quality at the highest standards (no compromises).

Value of Ph.D.s

- Above all, they help create/sustain the push of our technology driven society
- They also create the next generation of science leaders in universities
- They are the research enablers at the university

Ph.D. Degrees

Several schools of thought, but for efficiency:
- Advanced course work in more than one area of engineering.
- Focused research.

Note: Courses are <u>efficient ways</u> of conveying advanced information, but they do not substitute reading the literature

Doctoral Degree Organization

❊ The PDEEC is a large spectrum doctoral degree organized in 8 scientific themes

QUADRO N.º 1

ÁREA CIENTÍFICA	SIGLA	CRÉDITOS	
		OBRIGATÓRIOS	OPTATIVOS
Matemática	M		
Física	F		
Ciências Fundamentais e da Electrotecnia	CFE		
Automação, Controlo e Sistemas de Produção Industrial	ACSPI		
Electrónica e Sistemas Digitais	ESD		
Energia	E		
Informática	I		
Telecomunicações	T		
Outras áreas técnicas	OAT		
	TOTAL	150	30 (1)

Organization

❊ In each theme there is at least one 2 semester course sequence (1st semester)

UNIDADES CURRICULARES	ÁREA CIENTÍFICA
(1)	(2)
Energy Markets: Markets and regulation	E
Power system dynamics and control: Signals, dynamics and control	E
Digital Communications: Special topics in digital communications	T
Communication technology: Mobile communications systems	T
Systems and control: Vector space methods	ACSPI
Discrete event and hybrid systems: Discrete event systems	ACSPI
Computer Science: Model driven/aspect oriented software	I
Signal Processing: Signal analysis, classification and processing	CFE
Microelectronics and Microsystems: Microelectronic and microelectromechanical technologies	ESD
Operations Research: Optimization and decision support techniques	M

Organization

❊ In each theme there is at least one 2 semester course sequence – 2nd semester

UNIDADES CURRICULARES	ÁREA CIENTÍFICA
(1)	(2)
Energy Markets: Market simulation	E
Power system dynamics and control: Systems with renewables	E
Digital Communications: Communication networks and multimedia	T
Communication technology: Advanced optical communications cystems	T
Systems and control: Measure theory and stochastic processes	ACSPI
Discrete event and hybrid systems: Hybrid Systems	ACSPI
Computer Science: Grid computing	I
Signal Processing: Digital signal processing systems architectures	ESD
Microelectronics and Microsystems: Advanced microelectronic systems design	ESD
Operations Research: Decision and optimization	M

Organization

❊ There is also a list of topical courses beyond the sequences

| UNIDADES CURRICULARES	ÁREA CIENTÍFICA
(1)	(2)
Decision and optimization	M
Optimal control	M
Introd. Tutorials in Optimization and Decision Support	M
Sensor Networks/ Embedded Systems	ACSPI
Industrial Integration	ACSPI
Advanced Topics in Robotics	ACSPI
Systems Identification	ACSPI
Non Linear Control	CFE
Robust and Multivariable Control	CFE
Adaptive Control	CFE
Signal Processing for Communicat. and Sensing Systems	CFE
Forecasting	E
Methods for Optimal Power Flow	E
Advanced Reliability	E
Computational Intelligence and Power Systems	E
Optical Communications Laboratory	T
Advanced Signal Processing	T
RF Engineering	T
Audio and Video Analysis	T
Special Topic (a definir pela Comissão Científica do curso)	todas
Qualquer uma das incluídas nas sequências	todas

Course Requirements

* Students are required to take two sequences and several topics to make up 180 credit hours ECTS.
* Included in these hours are two Individual Work themes (15 hours) that are designed to construct a research theme and the preparation of the research proposal to be presented and approved for admission to candidacy.
* The research hours are also counted in the ECTS up to 120 hours

Degree Requirements

* Besides the successful completion of the course work, the student must:
  * Elaborate a research proposal
  * Conduct the proposed research
  * Write a Ph.D. thesis and defend it successfully

Current Ph.D. Distribution at DEEC
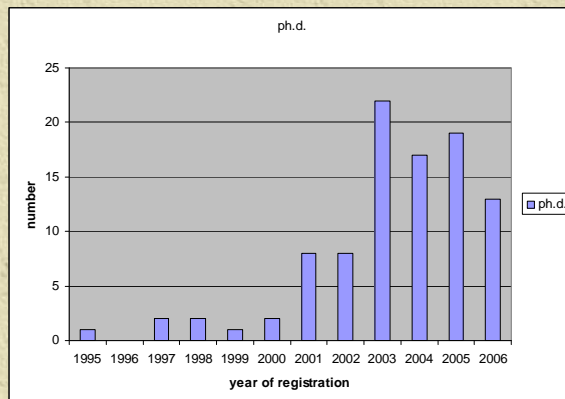
Transition of current Ph.D.s

* The current Ph.D. students will automatically transit to the new program.
* The Scientific Committee recommends that the Ph.D. students who started in 2006 be advised to take the course requirements of the new PDEEC.
* Credit will be given to work already accomplished.

PDEEC Information

* I found the information available in the website insufficient and not centered in the student needs.
* I will draft a set of guidelines aimed at
  * Providing the regulations of the PDEEC.
  * Helping students plan for the decisions they need to make regarding courses.
  * Stating best practices and checklists.

Handbook

* Minimum admission requirements (both for FEUP students and others)
* Course requirements (OK)
* Supervisory committee appointment (and dates)
* Annual evaluation of ph.d. students
* Breadth requirements
* Leave of absence policy
* Official minor (optional)
* Written qualifying exam
* Oral qualifying exam
* Final examination
* Probation policy
* Transfer of credits
* Financial aid
* Readmission policy
* Elaborate a check list