



EXAMENSBEVIS  
DEGREE CERTIFICATE

*Miguel Castano Arranz*

*1981-12-31-4755*

HAR PÅ FORSKARNIVÅ AVLAGT/  
HAS BEEN AWARDED THE THIRD CYCLE

TEKNOLOGIE DOKTORSEXAMEN

DOCTOR OF PHILOSOPHY (PHD)

INOM ÄMNET REGLERTEKNIK  
IN THE SUBJECT AUTOMATIC CONTROL

Luleå tekniska universitet/*Luleå University of Technology*

Examensdatum/*Date of Graduation*

29 november 2012 / 29 November 2012

Johan Sterte  
Rektor/*Vice-Chancellor*



# EXAMENSBEVIS

## DEGREE CERTIFICATE

MIGUEL CASTANO ARRANZ

1981-12-31-4755

Har den **29 november 2012**

avlagt **teknologie doktorexamen** på forskarnivå omfattande **240 högskolepoäng** i enlighet med bestämmelserna i högskoleförordningen (SFS 1993:100 med ändring 2006:1053)

Has on **29 November 2012**

been awarded the third cycle **Doctor of Philosophy (PhD) 240 credits**, in accordance with the regulations governing Swedish Higher Education (SFS 1993:100 and the amendment 2006:1053)

Inom ämnet  
In the subject

**Reglerteknik**  
Automatic Control

Och har författat och vid en offentlig disputation muntligen försvarat en vetenskaplig avhandling med titeln/

**Practical tools for the configuration of control structures**

And has written and publicly defended a doctoral dissertation with the title

Practical tools for the configuration of control structures

Handledare/Supervisor

**Biträdande professor/Associate Professor Wolfgang Birk**

Biträdande handledare/Assistant Supervisor

**Professor/Professor Thomas Gustafsson**

<b>Prov</b> <i>Examination</i>	<b>Högskolepoäng</b> <i>Credits</i>	<b>Examinator</b> <i>Examiner</i>
Olinjära och optimala system <i>Nonlinear and Optimal Systems</i>	7.5	Docent/Associate Professor Andreas Johansson
Neuronnät <i>Artificial Neural Networks</i>	7.5	Professor/Professor Lennart Gustafsson
Cellulosa och pappersteknik <i>Cellulose and Paper Technology</i>	4.0	Forskarassistent/Research Assistant Mattias Grahn
Statistiska metoder och försöksplanering <i>Statistical methods and experimental design</i>	7.5	Professor/Professor Kerstin Vännman
Measuring, Modelling and Simulation of (Non)linear Dynamic Systems <i>Modellering och simulering av icke linjära dynamiska system</i>	10.0	Professor/Professor Johan Schoukens, Vrije Universiteit, Brussel, Belgien/Vrije University, Brussel, Belgium
Design av regulatorstrukturer för multivariabla system <i>Control Configuration Selection for Multivariable Plants</i>	3.5	Professor/Professor Thomas Gustafsson
Intelligent övervakning av kritiska infrastrukturer <i>Intelligent Monitoring of Critical Infrastructure Systems</i>	1.5	Professor/Professor Thomas Gustafsson
Handledning av examensarbete <i>Supervision of Master's thesis students</i>	4.0	Universitetslektor/Senior Lecturer Wolfgang Birk
Assisterande lärare i reglerteknik <i>Teaching assistance in automatic control</i>	7.0	Universitetslektor/Senior Lecturer Wolfgang Birk
Kursutveckling reglerteknik <i>Course development in automatic control</i>	8.0	Universitetslektor/Senior Lecturer Wolfgang Birk
Objektorienterade paradigmer för utveckling av reglertekniska verktyg <i>Object oriented paradigms for the design of automatic control oriented software tools</i>	7.5	Biträdande Professor/Associate Professor Wolfgang Birk

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## DEGREE CERTIFICATE

MIGUEL CASTANO ARRANZ 1981-12-31-4755

Prov <i>Examination</i>	Högskolepoäng <i>Credits</i>	Examinator <i>Examiner</i>
Konvex optimering <i>Convex Optimization</i>	7.5	Professor/Professor Thomas Gustafsson
Högskolepedagogik <i>Pedagogy in higher education</i>	7.5	Professor/Professor Eva Alerby
Multivariabla och robusta reglersystem <i>Multivariable and Robust Control Systems</i>	7.5	Docent/Associate Professor Andreas Johansson
Avhandlingspoäng <i>Dissertation</i>	149.5	Professor/Professor Thomas Gustafsson Biträdande Professor/Associate Professor Wolfgang Birk
Summa/ <i>Total sum</i>	240.0 högskolepoäng/ <i>Credits</i>	

Luleå 29 november 2012 / 29 november 2012



Ann-Sofie Andersson  
Examenshandläggare/*Degree Evaluation Officer*

60 högskolepoäng motsvarar ett års heltidsstudier.  
*60 credits are equivalent to one academic year of fulltime studies.*

**Betygsgrad/ The Grades:**  
För detta prov ges endast betyget Godkänd/ *The only grade awarded is Pass.*

Prägel/*University Stamp*  
(Framträder ej på kopia)/  
(*Does not appear on the copy*)



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Sign

## DIPLOMA SUPPLEMENT

*This Diploma Supplement follows the model developed by the European Commission, Council of Europe and UNESCO/CEPES. The purpose of the supplement is to provide sufficient independent data to improve international "transparency" and fair academic and professional recognition of qualifications (diplomas, degrees, certificates etc.). It is designed to provide a description of the nature, level, context, content and status of the studies that were pursued and successfully completed by the individual named on the original qualification to which this supplement is appended. It should be free from any value judgements, equivalence statements or suggestions about recognition. Information in all eight sections should be provided. Where information is not provided, an explanation should give the reason why.*

### 1. INFORMATION IDENTIFYING THE HOLDER OF THE QUALIFICATION

- 1.1 **Family name:**  
Castano Arranz
- 1.2 **Given name:**  
Miguel
- 1.3 **Date of birth (day/month/year):**  
31 December 1981
- 1.4 **Student identification number or code (if available):**  
811231-4755

### 2. INFORMATION IDENTIFYING THE QUALIFICATION

- 2.1 **Name of qualification and (if applicable) title conferred (in original language):**  
Teknologie doktorsexamen
- 2.2 **Main field(s) of study for the qualification:**  
Automatic Control
- 2.3 **Name and status of awarding institution (in original language):**  
Luleå tekniska universitet, (state higher education institution with status of university)
- 2.4 **Name and status of institution (if different from 2.3) administering studies (in original language):**  
Not applicable.
- 2.5 **Language(s) of instruction/examination:**  
Mainly English

### 3. INFORMATION ON THE LEVEL OF THE QUALIFICATION

- 3.1 **Level of qualification:**  
Third cycle  
  
For more information on higher education in Sweden, please see point 8.
- 3.2 **Official length of programme:**  
A Doctor requires 240 credits.

The scope of the education is to be indicated in credits, with full-time studies for a normal 40-week academic year corresponding to 60 credits.

(HEO Chapter 6, Section 2)

### 3.3 Access requirement(s):

The requirements (after 1 July 2007) for admission to doctoral studies

(HEO Chapter 7, Section 39)

A person has basic eligibility for third cycle if he or she

- has taken a second cycle qualification,
- has completed course requirements of at least 240 credits, including at least 60 credits at second cycle, or
- has acquired essentially corresponding knowledge in some other way in Sweden or abroad.

The faculty board may permit an exemption from the requirement of basic eligibility in the case of an individual applicant, if there are special grounds.

The requirements (before 1 July 2007) for admission to doctoral studies

1. has basic eligibility and the special eligibility that the faculty board may have prescribed, and
2. is deemed to have the ability in other respects that is needed to benefit from the education.

For admission to doctoral programme undergraduate qualifications of at least 120 credit points are required. Furthermore, the appropriate faculty board may stipulate additional requirements for admission.

Admission to postgraduate studies after 1 July 2007 can be accepted according to the requirements above (before 1 July 2007) until year 2015.

Local requirements

The specific eligibility for every subject, in which post-graduate studies are offered, is made clear in a general study plan that is determined by the Faculty Board at Luleå University of Technology.

## 4. INFORMATION ON THE CONTENTS AND RESULTS GAINED

### 4.1 Mode of study:

Full-time equivalent.

### 4.2 Programme requirements:

Scope

A Doctor of Philosophy is awarded after the student has completed a study programme of at least 240 credits in a subject in which third-cycle teaching is offered

Outcomes

Knowledge and understanding

For the degree of Doctor of Philosophy the third-cycle student shall have:

demonstrated broad knowledge and systematic understanding of the research field as well as advanced and up-to-date specialised knowledge in a limited area of this field, and demonstrated familiarity with research methodology in general and the methods of the specific field of research in particular.

Competence and skills

For the degree of Doctor of Philosophy the third-cycle student shall have:

- demonstrated the capacity for scholarly analysis and synthesis as well to review and assess new and complex phenomena, issues and situations autonomously and critically
- demonstrated the ability to identify and formulate issues with scholarly precision critically, autonomously and creatively, and to plan and use appropriate methods to undertake research and other qualified tasks within predetermined time frames and to review and evaluate such work
- demonstrated through a dissertation the ability to make a significant contribution to the formation of knowledge through his or her own research
- demonstrated the ability in both national and international contexts to present and discuss research and research findings authoritatively in speech and writing and in dialogue with the academic community and society in general
- demonstrated the ability to identify the personal need for further knowledge
- demonstrated the capacity to contribute to social development and support the learning of others both through research and education and in some other qualified professional capacity.

**Judgement and approach**

For the degree of Doctor of Philosophy the third-cycle student shall have:

-demonstrated intellectual autonomy and disciplinary rectitude as well as the ability to make assessments of research ethics, and

-demonstrated specialised insight into the possibilities and limitations of research, its role in society and the responsibility of the individual for how it is used.

**Research thesis (doctoral thesis)**

For the degree of Doctor of Philosophy the third-cycle student shall have been awarded a pass grade for a research thesis (doctoral thesis) of at least 120 credits.

**Miscellaneous**

Specific requirements determined each higher education institution itself within the parameters of the requirements laid down in this qualification descriptor shall also apply for a degree of Doctor of Philosophy with a defined specialisation. Ordinance (2008:132).

**Local requirements**

A doctorate is attained upon completion of a programme of at least 240 credits in a subject. The goals for a doctorate are to have been attained and an academic thesis of a least 120 credits shall have been approved. The doctoral thesis shall have been orally defended in public.

There shall be a general study programme determined by the Faculty Board for every subject in which post-graduate studies are offered (HEO Chapter 6, Section 34). This general study programme shall state the programmes contents and arrangement, the specific admission requirements, the bases for assessment that apply in respect of selection for admission to the programme, the examinations included in the programme, and whether it is possible conclude part of the programme with a licentiate degree.

**4.3 Programme details (e.g. modules or units studied), and the individual grades/marks/credits obtained:**

See Degree Certificate

**4.4 Grading scheme and, if available, grade distribution guidance:**

See Degree Certificate

**4.5 Overall classification of the qualification (in original language):**

Not applicable for Swedish Degrees.

**5. INFORMATION ON THE FUNCTION OF THE QUALIFICATION****5.1 Access to further study:**

Not applicable.

**5.2 Professional status (if applicable):**

No special information is indicated; gives access to employment.

**6. ADDITIONAL INFORMATION****6.1 Additional information:**

None.

**6.2 Further information sources:**

Luleå University of Technology  
SE-971 87 Luleå  
Phone: +46(0)920-49 10 00  
Fax: + 46(0)920-49 13 99  
<http://www.ltu.se>


Swedish National Agency for Higher Education  
the Swedish ENIC/NARIC Office  
Box 7851  
SE-103 99 Stockholm  
<http://www.hsv.se>

**7. CERTIFICATION OF THE SUPPLEMENT**

**7.1 Date:**

29 November 2012

**7.2 Signature**

  
Ann-Sofie Andersson



**7.3 Capacity:**

Degree Evaluation Officer

**7.4 Official stamp or seal**

**8. INFORMATION ON THE NATIONAL HIGHER EDUCATION SYSTEM**

Information on the Swedish higher education system cf enclosure

# The Swedish Higher Education System

(The following description is approved by the Swedish National Agency for Higher Education)

## General

Higher education institutions have great autonomy in the organization of studies, use of resources and general administration. The Government may award the status of *universitet* to higher education institutions that meet certain criteria. Independent higher education providers may apply for recognition by the Government, obtain degree awarding powers and receive state subsidies. Qualifications from all higher education institutions that are recognized by the Government have equal official value. The same law governs all state higher education institutions. All Swedish degrees are issued in accordance with the same qualifications ordinance.

## Quality assurance

The Swedish National Agency for Higher Education is responsible for quality assurance system for higher education. All study programmes have been evaluated since 2001.

The Swedish National Agency for Higher Education has also completed two rounds of quality audits of higher education institutions. Evaluation reports are public.

## Access and admission to higher education

Higher education within all cycles has two strata of entry requirements: general and (additional) specific requirements. General eligibility to the first cycle is the same for all higher education.

General eligibility is attained either by completing an upper-secondary school programme, completed adult education at upper secondary school level or having the potential to benefit from the education, by virtue of other education, practical experience or other circumstances. The specific requirements vary according to the field of higher education and are in general expressed in terms of upper-secondary school qualifications in specific subjects. Restrict-

ed admission is used for all study programmes and courses.

## Degree awarding powers

Universities have the right to award general qualifications at first, second and third cycle. A small number of university colleges have been awarded the general right to award first and second cycle qualifications, as well as the right to award third cycle qualifications in specific domain/s. Other state university colleges have the right to award first cycle qualifications and *magisterexamen* but must apply to the Swedish National Agency for Higher Education for the right to award *masterexamen* and third cycle qualifications.

University colleges that are self-governing and independent, as well as the Swedish University of Agricultural Sciences (SLU) and the Swedish National Defence College, must apply to the Government for the entitlement to award all qualifications.

With regard to vocational or professional qualifications at first and second cycle, both state universities and university colleges must apply to the Swedish National Agency for Higher Education for degree awarding powers.

## Qualifications

All courses and study programmes are placed within one of three cycles: the first, second or third cycle. All qualifications are placed within one of the three cycles. Higher education within the first and second cycles is provided in the form of courses. Courses may be grouped together into programmes with varying levels of individual choice. Students themselves are also able to combine different courses towards a degree. A course syllabus is required for each course within the first and second cycle and a programme syllabus for each study programme. Educational cycle and intended learning out-

comes have to be specified for each course. Sweden has a system of credits (*högskolepoäng*); a normal 40-week academic year corresponds to 60 credits. The system is compatible with ECTS credits.

In the qualifications ordinance, the Government has laid down which qualifications may be awarded and the objectives as well as intended learning outcomes for these qualifications. In the Swedish higher education system there are generally no intermediate qualifications. All qualifications are regarded as final, even if there is a possibility to continue studying. There are three categories of qualifications: qualifications in the arts, social science and sciences, in fine, applied and performing arts and professional qualifications. Translations into English of all titles of qualifications are regulated at the national level. An institution of higher education may decide that a discipline precedes a qualification title e.g. *filosofie kandidatexamen* or *medicine doktorsexamen* or/and add a major field of studies e.g. *civilingenjörsexamen i maskinteknik*.

## Qualifications in the arts, social science, science and in fine, applied and performing arts

### First cycle:

1. *Högskoleexamen* (Higher Education Diploma) requires 120 credits and a diploma project. The corresponding degree in fine, applied and performing arts is *konstnärlig högskoleexamen* (Higher Education Diploma).
2. *Kandidatexamen* (Bachelor of Arts/ Bachelor of Science) requires 180 credits with a defined main field of studies determined by each higher education institution itself. At least 90 credits with increasingly in-depth studies including a diploma project of 15 credits have to be completed in the main field of study. The correspond-







Jag vill med detta brev framföra mina hjärtliga gratulationer till din examen. Du har kommit till målet på en resa mot delvis okänt mål, en resa som ofta är förknippad med stor osäkerhet men, framför allt, med hårt arbete.

Samtidigt hoppas jag att det har varit en trevlig tid. Det är ju något av en förmån att få ägna så mycket kraft åt att grundligt penetrera forskningsfrågor inom ett område som man är djupt intresserad av och att inom sitt område få bidra till att utöka den samlade kunskapsmassan och nå resultat som ingen annan tidigare uppnått. Det har säkert också varit värdefullt att få arbeta nära tillsammans med andra som delar detta intresse och som på olika sätt är ett stöd i forskarutbildningen. Jag är övertygad om att Du skaffat både ett antal goda vänner vid Luleå tekniska universitet och ett stort och brett nätverk inom din disciplin.

Nu är det dags för dig att söka nya vägar, antingen genom en fortsatt akademisk karriär eller genom att dra nytta av dina kunskaper i någon annan del av arbetslivet. Om Du väljer att lämna LTU hoppas jag att Du inte glömmer ditt gamla universitet. Vi behöver ha goda förbindelser med olika verksamheter utanför LTU för att även i fortsättningen kunna hålla en hög kvalitet på vår utbildning och forskning. Jag ber dig därför att registrera dig i vår Alumndatabas ([www.ltu.se/alumn](http://www.ltu.se/alumn)).

Jag önskar dig allt gott, både i arbetslivet och i livet.



Johan Sterte

**REKTOR/VICE-CHANCELLOR**

Luleå tekniska universitet/Luleå University of Technology

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