

# edsvs

European Doctorate  
in Sound and Vibration  
Studies

Second Program: from October 2004 to September 2008



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European Doctorate in Sound and Vibration Studies

# OBJETIVES (I)

- a) To promote and provide doctoral programs for students from European Member and Associate States and from Third Countries, i.e. non European Member/Associate States, in highly qualified European Universities and Higher Education Centres working in the fields of noise, vibration and acoustics.
- b) To assist all types of “Early Stage Research Training” (i.e. first four years after a University degree that enables to register for a PhD) carried out at the EDSVS Institutions. This will include MPhil programmes, Masters courses, Modular Courses, Training Workshops, etc.
- c) To attract first class young students from Third Countries.



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**European Doctorate in Sound and Vibration Studies**

## OBJETIVES (II)

- d) To bring together the unique teaching and research features of highly qualified European University Centres with complementary expertise working on noise, vibration and acoustics related topics.
- e) To create a link between academic and industrial bodies in Europe.
- f) To assist the development of less favoured regions in Europe by offering training to young students from these regions and by allowing industries to co-operate with the Universities through the doctorate programmes.
- g) To contribute to the implementation of the “European Research Area” (ERA) and the “European Higher Education Area”.



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**European Doctorate in Sound and Vibration Studies**

# TOPICS I : Fundamental disciplines (rows) and application subjects (columns) of the EDSVS programme

	Vibration & noise problems in civil transportation vehicles	Vibro-acoustic problems in aero & space vehicles and equipment	Architectural and environmental acoustics	Noise in working environments	Transducers and sensors	Diagnostic and condition monitoring	Smart structures and active noise and vibration systems
Physical acoustics	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Mechanical vibration	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Signal and speech processing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Numerical methods vibration acoustics	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Vibro-acoustics and sound radiation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Fluid- and aero-acoustics	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Acoustic and vibration measurement	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Perception and psychoacoustics	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Human factors	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>




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## TOPICS II : Fundamental disciplines training duties

	University of Southampton ISVR	Università di Ferrara Dipartimento di Ingegneria	Institut National des Sciences Appliquées de Lyon	Katholieke Universiteit Leuven Dept. Mech. Engineering	Trinity College Dublin Mech Engineering Department	Technical University of Denmark Acoustic Tech.	Technical University of Berlin, Inst. of Tech. Acoustics	Royal Institute of Technology Dept of Vehicle Engineering
Physical Acoustics	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Mechanical Vibration	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Signal and speech Processing	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Numerical methods in vib. and acoustics	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Vibro-acoustics and sound radiation	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Fluid- and aero-acoustics	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Acoustic and vibration measurement	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Perception and psychoacoustics	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Human factors	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>



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## TOPICS III : Application subjects training duties

	University of Southampton ISVR	Università di Ferrara Dipartimento di Ingegneria	Institut National des Sciences Appliquees de Lyon	Katholieke Universiteit Leuven Dept. Mech. Engineering	Trinity College Dublin Mech Engineering Department	Technical University of Denmark Acoustic Tech.	Technical University of Berlin, Inst. of Tech. Acoustics	Royal Institute of Technology Dept of Vehicle Engineering
Vibration & noise problems in civil transportation vehicles	X		X	X	X	X	X	X
Vibro-acoustic prob in aero & space vehicles & equipment	X		X	X	X	X	X	X
architectural and environmental acoustics	X	X				X	X	
noise in working environments	X	X	X	X			X	X
Transducers and sensors			X			X		
Diagnostic and condition monitoring		X		X			X	
Smart structures and active noise and vibration systems	X			X			X	



European Doctorate in Sound and Vibration Studies

# HOSTING INSTITUTES



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European Doctorate in Sound and Vibration Studies

Up to present, **126 students**, from nearly all EU member and associate states, have taken part in the program

**~ 25% Female ~75% Male Students**

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<b>EU</b>		<b>Associate-EU</b>	<b>Third Countries</b>
Austria	Greece	Croatia	Argentina
Belgium	Hungary	Romania	Australia
Czech Republic	Italy	Turkey	Brasil
Denmark	The Netherlands		China
Eire	Poland		Colombia
England	Portugal		India
Estonia	Slovakia		Russia
Finland	Slovenia		
France	Spain		
Germany	Sweden		

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**European Doctorate in Sound and Vibration Studies**



# EDSVS web site with project descriptions

The EDSVS web site contains 107 project descriptions <http://www.isvr.soton.ac.uk/edsvs/projects.htm> with:

- Scientific and technical material
- Pictures of students in office or lab
- Pictures of experimental rigs
- Plots of results





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# European Doctorate in Sound and Vibration Studies



" Otoacoustic emissions and small changes in auditory function"

**Fellow:** Marta Parazzini

**Home Institute:**

Istituto di Ingegneria Biomedica ISIB-CNR, Dipartimento di Bioingegneria, Politecnico di Milano, Milano, Italy

**Hosting Institute:**

Institute of Sound and Vibration Research University of Southampton, Southampton UK

**Home Supervisor:**

Dr. P. Ravazzani

**Hosting Supervisors:**

Prof. M.E. Lutman

The overall aim of this project is to investigate the sensitivity of distortion product otoacoustic emissions (DPOAE) to detect small changes in hearing function, with particular emphasis on DPOAE phase data analysis. When the ear is stimulated by two continuous pure tones at frequency  $f_1$  and  $f_2$  and levels  $L_1$  and  $L_2$  presented simultaneously, acoustic distortion products at frequencies not present in the acoustic stimuli can be recorded in the outer ear canal. DPOAE arise from a frequency-selective compressive nonlinearity in basilar membrane mechanics in the region of the cochlea due to overlap of the primary tones. This nonlinearity is mainly due to the outer hair cell system (OHC), which is thought to amplify the basilar membrane motion especially at low input levels. This so-called cochlear amplifier increases the sensitivity of the inner ear and its frequency resolution ability. Thus, DPOAE are suitable for a frequency-specific diagnostic measurement of OHC function. Because each component of the DPOAE is calculated as the result of a Fourier transform from a time series, not only amplitude, but also phases of DPOAE can be measured. It is known that significant reductions in DPOAE amplitude are a sign of functional or structural damage in OHC cells. However, the relationship between DPOAE phase and cochlear status is still not well understood. Theory suggests that the gradient of the phase with increasing frequency is related to the bandwidth of the filtering process of the basilar membrane.

The two pictures below show the DPOAE measurement system used. An Etymotic ER-10B microphone probe and pre-amplifier (+40 dB) are used for recording ear canal sound pressure. Two Etymotic ER-2 insert earphones are used to deliver the primary tone stimuli to the subject via the probe. The amplified microphone signal is digitised (16-bit resolution, 32-kHz sample rate) by an external A/D and D/A converter unit that also generates the primaries. Signal processing by custom software running on a DSP card converts 62.5 ms epochs of the microphone signal to the frequency domain by performing FFT. The complex FFT is averaged after rejection of epochs containing excess noise in the DP frequency region and hence improved the SNR with successive averages. This apparatus uses a signal averaging technique that allows recording down to a lower noise floor than other available equipment.



Figure 1: DPOAE measurement system used;

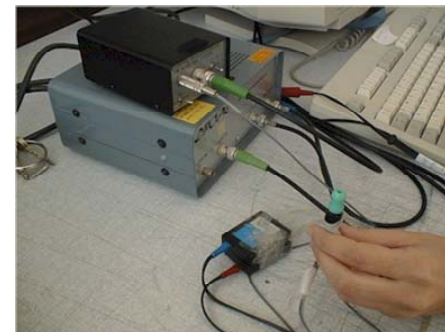


Figure 2: Etymotic ER-10B microphone probe with a standard tympanometry probe tip to be inserted into the ear canal.



Marie Curie EST fellowships

Doctoral Training Projects

Research Training Projects

# European Doctorate in Sound and Vibration Studies

# EDSVS Doctoral Certificate

EDSVS students registered in a European Higher Education Institution can apply for the “European Doctorate in Sound and Vibration Studies” certificate

In order to obtain the EDSVS certificate, there are two principal requirements:

- 1) the subject of the PhD thesis must be part of the Sound and Vibration topics;
- 2) the final thesis has to be examined and defended in accordance with the four criteria laid down by the “Confederation of European Union Rectors’ Conferences”; i.e.:
  - a) **criterion on PhD thesis:** the PhD thesis defence will be accorded if at least two professors from two higher education institutions of two European countries, other than the one where the PhD thesis will be defended, have given their judgement concerning the manuscript;
  - b) **criterion on PhD viva:** at least one member of the jury should come from a higher education institution in European Countries, other than the one, where the PhD thesis will be defended;
  - c) **criterion on language:** part of the defence must take place in one of the official languages, other than the one(s) of the country, where the PhD thesis will be defended;
  - d) **criterion on mobility:** the PhD thesis must partly have been prepared as a result of a period of research of at least one trimester spent in another European Country

# Procedures to apply, approve and certify an EDSVS PhD

[http://www.isvr.soton.ac.uk/edsvs/doctorate\\_certificate.htm](http://www.isvr.soton.ac.uk/edsvs/doctorate_certificate.htm)



## European Doctorate in Sound and Vibration Studies

### EDSVS DOCTORAL CERTIFICATE

EDSVS students registered in a European Higher Education Institution can apply for the "European Doctorate in Sound and Vibration Studies" certificate

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- 2) the final thesis has to be examined and defended in accordance with the four criteria laid down by the "Confederation of European Union Rectors' Conferences"; i.e.:
  - a) **criterion on PhD thesis:** the PhD thesis defence will be accorded if at least two professors from two higher education institutions of two European countries, other than the one where the PhD thesis will be defended, have given their judgement concerning the manuscript;
  - b) **criterion on PhD viva:** at least one member of the jury should come from a higher education institution in European Countries, other than the one, where the PhD thesis will be defended;
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  - d) **criterion on mobility:** the PhD thesis must partly have been prepared as a result of a period of research of at least one trimester spent in another European Country.

The onus is on the candidate to organise the PhD examination and PhD viva according to the four criteria laid down by the "Confederation of European Union Rectors' Conferences" and to ensure that the documents required by the following procedures are supplied to the EDSVS registrar.

### PROCEDURE

When the thesis has reached the final draft, the applicant should discuss with her/his supervisor the aspiration of applying for the EDSVS certificate and then jointly plan the PhD defence in such a way as to comply both to the local rules for the award of the PhD title and to the four criteria laid down by the "Confederation of European Union Rectors' Conferences" necessary for the award of the EDSVS certificate.

The applicant should then send by e-mail ([EDSVS-registrar@isvr.soton.ac.uk](mailto:EDSVS-registrar@isvr.soton.ac.uk)) a scanned copy of the [EDSVS certificate application form](#) to the EDSVS registrar.

After examination of the form, the EDSVS registrar will notify by e-mail the applicant whether or not the candidature for the EDSVS certificate has been accepted. In case of minor problems, the EDSVS registrar will make suggestions for the necessary changes to be made to the application form.

When the PhD degree examination is successfully passed, the newly appointed Doctor will send by e-mail to the EDSVS registrar ([EDSVS-registrar@isvr.soton.ac.uk](mailto:EDSVS-registrar@isvr.soton.ac.uk)) scanned copies of the following documents.

- 1) Copy of the signed examiners reports on the PhD thesis.
- 2) Copy of the PhD viva chairman statement outlining:
  - a) the name of the member(s) of the jury coming from a higher education institution in European Countries, other than the one, where the PhD thesis has been defended and
  - b) the extent to which a language other than an official language of the home institution has been used in the examination process. This may refer to usage in: printed passages in the thesis; published papers included as part of the thesis; questioning; verbal presentation; supplementary material presented as part of the PhD examination; written or oral examinations taken prior to the final examination; some other mode.
- 3) Copy of the PhD title issued by the Home Institution.
- 4) Copy of a letter written by the Host Institution visited by the candidate during his PhD stating the period of her/his visit.
- 5) PDF copy of the thesis for the EDSVS electronic archive.
- 6) Short abstract of the PhD thesis written in English to be displayed in the EDSVS official web site public registry.

In case one or more of these documents are not submitted within six months from the scheduled date of the PhD viva, the application for the EDSVS title will be disregarded.

Upon receipt of **all documents** listed above, the EDSVS registrar will:

- 1) archive all documents relative to the EDSVS certification;
- 2) the thesis details and short abstract will be entered in the EDSVS official web site public registry;
- 3) the PDF copy of the thesis will be stored in the EDSVS electronic archive;
- 4) a signed and stamped EDSVS certificate will be sent to the candidate.

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# EDSVS

## Doctoral

### Certificate

EUROPEAN DOCTORATE IN SOUND  
AND VIBRATION STUDIES



**Smart Panels for Active Structural Acoustic Control**

**by Name Surname**

**4th February 2003**

This doctorate was carried out as part of the EDSVS program with Home Institute

*Institut National des Sciences Appliquées de Lyon, Laboratoire Vibrations-  
Acoustique (INSA)*

and Hosting Institute(s):

*Kungliga Tekniska Högskolan, The Marcus Wallenberg Laboratory for Sound  
and Vibration Research (KTH)*

*Università di Ferrara – Dipartimento di Ingegneria (DIUF)*

The doctoral degree has been awarded by the Home Institute, INSA, following the local rules and procedures for the thesis dissertation and degree award.

Also the thesis was examined and defended in accordance with the criteria laid down by the "Confederation of European Union Rectors' Conferences"

# EDSVS web site with ALUMNI pages

The EDSVS web site contains 19 alumni descriptions <http://www.isvr.soton.ac.uk/edsvs/alumni.htm> with:

- Data of PhD and EDSVS certificate award
- Abstract of their PhD thesis
- Testimony of their EDSVS experience
- Curriculum





# European Doctorate in Sound and Vibration Studies

## "Nonlinear System Identification for Otoacoustic Emissions"

**Alumnus:** Dr James Harte

Dr James Harte began his doctoral studies at the Institute of Sound and Vibration Research (ISVR), University of Southampton, United Kingdom in June 2000. He visited the Department of Mechanical and Manufacturing Engineering, Trinity College, University of Dublin, Ireland, for 6 months between 2003 and 2004 within the EDSVS programme [\[more...\]](#). Under the programme he also visited the Centre for Applied Hearing Research (CAHR), within the Acoustic Technology Section, in the Technical University of Denmark, for 6 months in 2004 [\[more...\]](#). Dr Harte received his PhD from the Institute of Sound and Vibration Research, University of Southampton in 2004.

After completing his PhD, in December 2004 Dr Harte continued to work in the ISVR as a Post Doctoral Researcher for seven months. After this he was appointed an Assistant Professor at the Centre for Applied Hearing Research (CAHR), in the Technical University of Denmark, in July 2005.

### Short CV

July 2005 to present  
Dec 2004 to Jun 2005  
Jun 2000 to May 2004

Assistant Professor at the CAHR.  
Research Fellow at the ISVR.  
PhD student at ISVR (Thesis 'Nonlinear System Identification for Otoacoustic Emissions', supervisor Prof. S.J. Elliott).  
Visiting student at the CAHR under the EDSVS programme (Project 'Models for Compressive Nonlinearities in the Cochlea' Host supervisors Prof T. Dau).  
Visiting student at the Department of Mechanical and Manufacturing Engineering, Trinity College under the EDSVS programme (Project 'The Compressive Curves of Different Models of Cochlear Nonlinearity' Host supervisor Assoc. Prof H.J. Rice).

(Jun 2004 to Dec 2004)

(Dec 2003 to Jun 2004)

### Testimony about the EDSVS Marie Curie programme

I have found the EDSVS programme to be a very important stepping stone for helping to get started in a research career. It gave me the opportunity to work in two world class research institutions, and develop contacts and new ideas that greatly aided my PhD. After completion of my PhD I was able to obtain a good position at the Centre of Applied Hearing Research, and am now recommending one of my students to take up the EDSVS programme as well. I have also had the great fortune of making some excellent friends during my two stays under the scheme.

### Abstract of PhD thesis

This thesis is concerned with the identification of a nonlinearity within the cochlea, which is at the heart of its fine frequency selectivity and its massive dynamic range. The source of the nonlinearity is believed to be an active process, which has a compressive response and also generates otoacoustic emissions (OAEs), that are acoustic signals produced within the cochlea and recorded in the ear canal. They exhibit similar nonlinear compression characteristics to that of the response of the cochlea, and as such can be used as a non-invasive research tool to characterise the nonlinearity.

A physiologically reasonable model is developed for the generation and emission of OAEs, based on a cascade structure with two linear elements surrounding a nonlinear block. A technique for decoupling and identifying the components of this type of nonlinear model, under certain conditions, has been developed. Two types of potential cochlear nonlinearity have been investigated, one with a static, instantaneous, power-law, and the second with a level-dependent nonlinearity known as an automatic gain control (AGC). These are both shown to be capable of producing physiologically realistic compression curves. The best way of distinguishing between these models appears to be in terms of their instantaneous input-output characteristics. A comparison of simulation results with previous experimental measurements suggests that the AGC model may be more appropriate for modelling cochlear nonlinearity.

A series of experiments, carried out on human subjects, is also presented which investigates the level-dependence of transient- and derived noise-evoked otoacoustic emissions. These experiments provide further support for the theory that the inherent nonlinearity in the cochlea is level-dependent. This was partly achieved through the use of a higher-order correlation test for adequate model fitting, where it has been shown that a first order 'linear' transfer function is sufficient to model derived noise-evoked OAEs

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# European Doctorate in Sound and Vibration Studies

# EDSVS outcomes

- ✓ For the students this is an important opportunity to enlarge their horizons; both at personal and professional levels.
- ✓ For Universities as well, it is an extremely valuable tool as the 'bottom-up' approach taken by the Commission allows them to determine research priorities independently of immediate results or applications. This has allowed the EDSVS Institutions to undertake some very important basic research projects in collaboration with their partner Institutes and the visiting fellows.
- ✓ The exchange of knowledge generated by this exchange has been very enriching. Working together in such a multinational environment has given access to a much wider pool of knowledge and expertise than if the EDSVS Institutions all worked individually and there is a definite cross-pollination effect from the visiting fellows.



# EDSVS outcomes

- ✓ As well as reinforcing links between the existing partners of the EDSVS program, receiving students from other institutions has also encouraged closer relations with a wider network and created links which last beyond the period of the fellowship itself.
- ✓ Exchanges generated by the project are not just of a scientific nature, but are also important on an academic level