

Unit of Reactors and Nuclear Safety

MISSION

The Research Unit on Reactors and Nuclear Safety (URSN) houses the Portuguese Research Reactor (RPI), a 1 MW pool-type research reactor, operating since 1961. For over 50 years, the RPI has served as a nucleation centre to develop and maintain expertise in the broad areas of nuclear engineering, nuclear safety, and neutron sciences. The RPI supports activities for groups in all the Research Units of IST/ITN, as well as in several Universities.

The URSN also houses the Neutron Activation in Environment, Nutrition and Epidemiology (NANE) group, the main user of the reactor, as well as the Applied Dynamics Laboratory (ADL) group, mainly devoted to research on the vibratory and acoustic behaviour of mechanical components in nuclear facilities. However, the techniques developed by this group can and have been used to solve problems, both of industrial and fundamental nature, outside the realm of power generation.

Staff from the URSN routinely acts as advisor to the Government in specialized commissions and working groups, as well as national experts in international organizations.

OBJECTIVES

The main objective of the Operation and Exploitation of the Portuguese Research Reactor (OE/RPI) is to be able to satisfy the users' needs while conducting all tasks with the assurance that the reactor is operated in a safe and reliable manner by a highly competent and motivated staff. The work of the team ensures that the reactor is available for its users at least 200 days per year on a routine basis and, at the same time, that it is available for circa 50 public visits per year. Besides the tasks that are essential for the operation of the RPI, the researchers of the OE/RPI pursued in 2012 several objectives, from which we highlight:

- Study of conservation problems in cultural heritage objects using neutron tomography.
- Development and test of superheated droplet detectors and their use in dark matter search.
- Development and expertise in deterministic and Monte Carlo calculations, in particular neutronics, plus simulation tools for ion beam interactions.

The research in NANE group is focused on the development of the INAA (Instrumental Neutron Activation Analysis) methodologies and on their application to environment, nutrition and epidemiology studies. The most important objectives in 2012 were:

- Evaluation and improvement of INAA quality assurance and quality control (QA/QC) through participation in international proficiency tests.
- Research on air pollution assessment, aerosol characterization, identification of emission sources with receptor models and evaluation of air pollution impacts using dispersion models and biomonitoring techniques.
- Research on the exposure of susceptible groups - children, elders and sportsmen – to pollutants and assessment of the associated health impacts.
- Research on selenium supplementation of bread and durum wheat.
- Collaboration with the industry within research projects and services;
- General services on elemental characterization of samples by INAA and specialized services on energy and indoor air quality certification of buildings;

The activities of the ADL group are mainly devoted to research in nuclear engineering, with an emphasis on the vibratory and acoustic behaviour of mechanical components in nuclear facilities. On the other hand, research projects connected with dynamical problems of more fundamental nature are also pursued, in order to develop modelling and system identification methods and computational tools relevant for the problems addressed. The objectives of the ADL group for 2012 were connected with the research projects pursued under contract with CEA (France) and FCT, namely: (1) Flow excited steam generator tubes and fuel rods; (2)

Dynamical characterization and tuning of the Mafra carillons; (3) Dynamical modelling of the Portuguese guitar; and (4) Fault detection in machinery. Under this framework, the main objectives for 2012 were:

- Development of a new method for accurate simulation of the flow turbulence excitation of tubular bundles;
- Development of new techniques for identification of flow excitation features from the system vibratory responses;
- Full experimental characterization of the current tuning state of the Mafra carillons;
- Development of a technique for attempting the modal identification of bells which have been constrained by additional supporting fixtures;
- Development of a detailed analytical model for worn guitar strings;
- Development of a model for the vibrations of multiple strings coupled to a complex resonating structure;
- Development of a new inverse technique for the remote identification of vibro-impact forces from the dynamical responses of beams with clearance supports.

MAIN ACHIEVEMENTS

A total of 561 irradiations were performed in the RPI in 2012, corresponding to 1503 h of reactor time. This value is 21% higher than the average value during the period 2007-2011. The main users of the RPI are described in Table 1. The largest sustained activity supported by the RPI is neutron activation analysis (NAA) in the URSN and UCQR Research Units, which accounts for approximately 50% of the use of the reactor.

User	Area	% Time
URSN	Dosimetry	0.9
	NAA	42.4
	Radiation effects	0.6
	Tomography	23.0
	Education and Training	0.4
UCQR	NAA	8.2
Univ. Lisboa	Isotope Production	8.0
Univ. Coimbra	Isotope Production	0.1
U. Heidelberg	Dating	15.4
IVIA (Spain)	Radiation effects	0.6
USC (Spain)	Radiation effects	0.4

Table 1: Main users of the RPI in 2012

The potentialities of neutron tomography were demonstrated in the study of an ax from the British Islands Bronze Age. This technique has easily shown the existence of a void in the structure, with the shape of the comet, as illustrated in Fig. 1. Due to the thickness of the material, it would not be possible to obtain this information using conventional radiography.

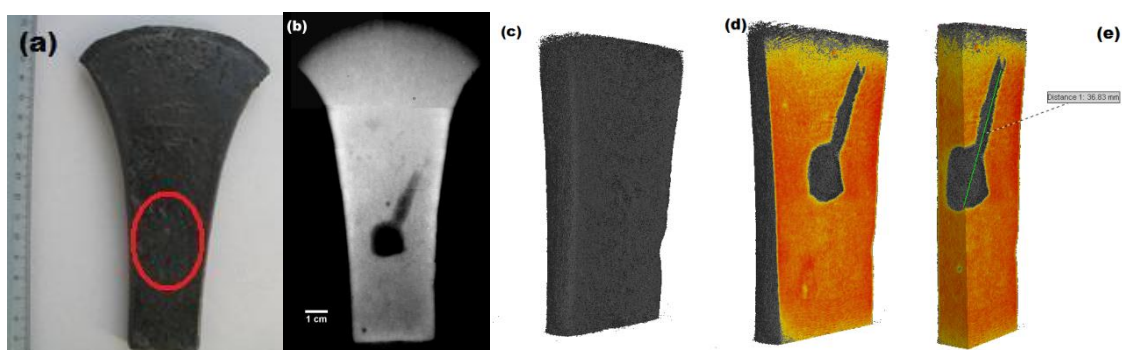


Fig. 1: (a) Photography, (b) neutron radiography, and neutron tomography images: (c) reconstructed neutron tomography of interest ax area, (d) front cut with the surface (about 4mm), (e) frontal and transversal cuts with internal measurements, (e) Void shown with grey colour, while the red/yellow represent the core material (colours added).

Within the SIMPLE Dark Matter search project, improvements were made in the determination and reduction of the background using both simulation tools and analytical techniques available at CTN. Monte Carlo simulations of the neutron-induced background signal were done for stage II of the experiment, already completed, using detailed model of the set-up, with updated estimates of alpha and neutron emissions from the setup components. It was found that the major contribution (98%) for the background of stage II originates from the borosilicate glass used as detector container, due to the simultaneous occurrence of significant emitter levels and the high boron content in the material. A substantial background reduction for the subsequent SIMPLE Phase III is being planned based on low-activity containers and improved water radio-purity.

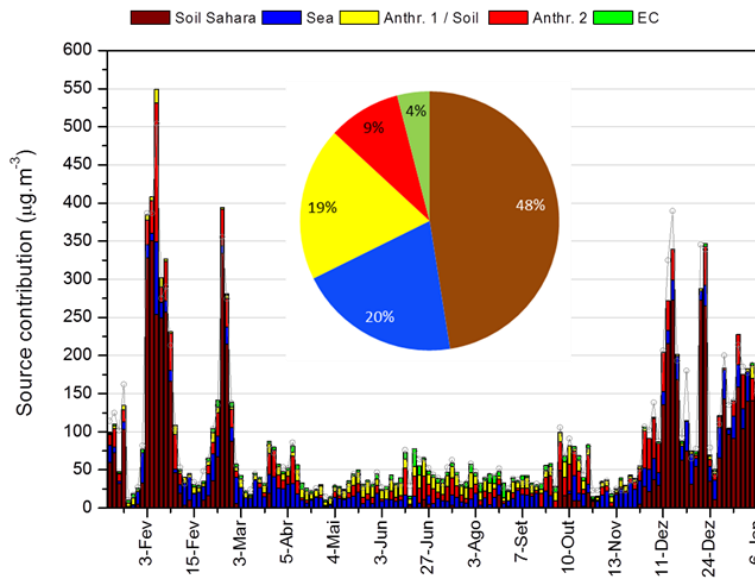


Fig. 2: Source contribution for PM10 concentrations measured in Cape Verde.

Particulate matter (PM10) sampled in Cape Verde within the CV-Dust project was chemically characterized (elements, water soluble ions and carbonaceous aerosols) and the identification of the main sources and origins of the particles were carried out by integrating complementary tools including Principal Component Analysis, Multilinear Regression Analysis, Positive Matrix Factorization and Cluster Analysis of Air Mass Back trajectories. The results showed that Cape Verde aerosol is affected principally by natural sources: dust coming from Sahara desert contributes on average to 48% of the total PM10 mass and sea salt spray contributes on average to 20%. During trajectories from Sahara, dust contribution increases to more than 60% and PM10 concentrations reach very high concentrations (10 times higher than the EC limit values and WHO guidelines). Fig.2 shows the source contribution for PM10 concentrations measured in Cape Verde.

The Mafra carillons bells form the largest surviving 18th century carillons in Europe. The ADL group is part of a multidisciplinary research project in partnership with the Music Department from the Universidade Nova de Lisboa. We developed suitable multi-reference identification techniques to extract the bell vibration modes from experiments, and devised optimal strategies to infer their tuning status and tuning errors with respect to historical tempered scales.

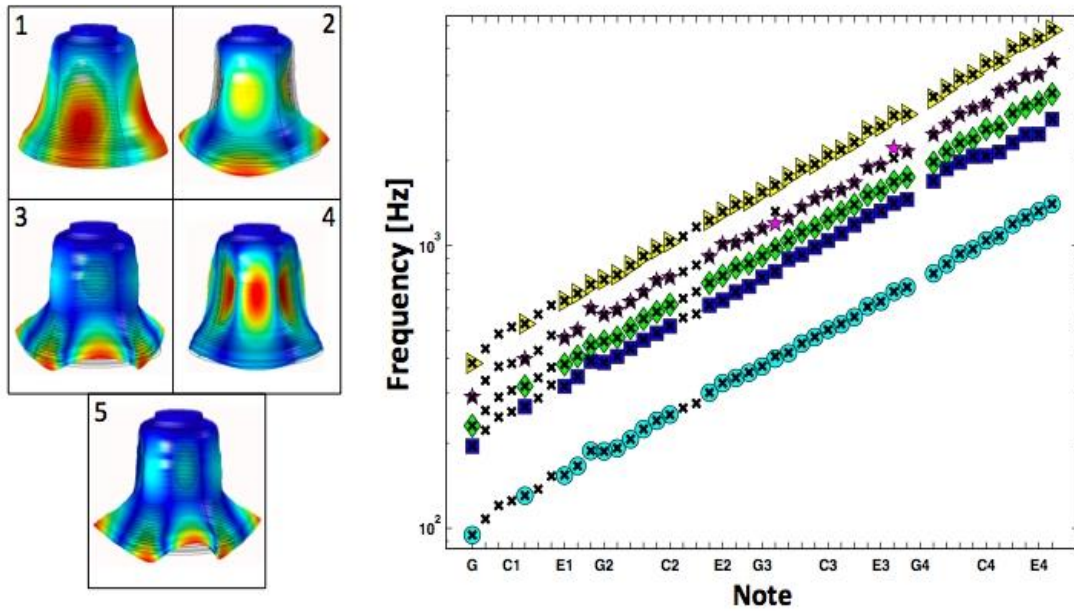


Fig. 3: Experimentally identified bell modal frequencies of the North tower Mafra carillon:
 First bell modal shapes (left); Identified tuning of the first bell modes (right).

Another aspect of the problem was to identify the original modes of several large bells, which for security reasons were lowered from their mounts, becoming provisionally supported by scaffolds securing the bell rim at several locations, leading to very different constrained modes. To infer the original bell resonances from the constrained bell modes is a very difficult inverse problem, which we attempted to solve using suitable structural modification formulations coupled with an optimization scheme. Our new method for this identification problem has been successfully tested using numerical simulations and we are now developing a laboratory experiment to validate our identification technique.

Groups – R&D Activities

Operation and Exploitation of RPI Group

TEAM

Name	Category	R&D
José Gonçalves Marques	Principal Researcher with habilitation	100%
Nuno Barradas	Principal Researcher with habilitation	100%
António Nazaré Falcão	Principal Researcher	100%
Andreas Kling	Auxiliary Researcher with habilitation	100%
Ana Rita Lopes Ramos Wahl	Auxiliary Researcher	100%
Ana Cristina Palma Fernandes	Auxiliary Researcher (<i>Ciência 2008</i>)	100%
Daniel Beasley	Auxiliary Researcher (<i>Ciência 2008</i>)	100%
Marco António Stanojev Pereira	Auxiliary Researcher (<i>Ciência 2008</i>)	100%
Thomas A. Girard	Auxiliary Researcher (U. Lisboa)	50%
Miguel Felizardo	PhD Grant (FCT)	100%
Ignacio Lazaro Roche	Erasmus (U.P. Valencia)	100%
Joana Santos	Graduated Technician	100%
André Rodrigues	Assistant Technician	--
Francisco Barreira Gomes	Assistant Technician	--
Joaquim António Ribeiro	Assistant Technician	--
José Carlos Roxo	Assistant Technician	--
Maria Teresa Fernandes	Assistant Technician	--
Nuno Serrote	Assistant Technician	--
Rodolfo Pombo	Assistant Technician	--
Rogério Santos	Assistant Technician	--

OBJECTIVES

The main objective of the Operation and Exploitation of the Portuguese Research Reactor (OE/RPI) is to be able to satisfy the users' needs while conducting all tasks with the assurance that the reactor is operated in a safe and reliable manner by a highly competent and motivated staff. The implementation of such objectives demands a variety of activities, some of which are repetitive in objective and variable in content, while others address specific aspects of the same end situation. The work of the team ensures that the reactor is available at least 200 days per year on a routine basis.

The RPI is prepared to handle a large number of long irradiations in positions close to the reactor core, with thermal neutron fluxes as high as $2.5E13$ n/cm²/s. Short irradiations, of the order of a few seconds, are also supported for the cases when the isotopes under study have a very short half-life. The RPI also supports neutron tomography and irradiation of electronic components and systems in two dedicated beam lines.

Besides the tasks that are essential for the operation of the RPI, the researchers of the OE/RPI are involved in several activities, from which we highlight:

- Study of conservation problems in cultural heritage objects using neutron tomography. The main objectives for 2012 were to continue the studies within the RADIART project and to extend gradually to other types of objects, in combination with other non-destructive techniques.
- Improvements to existing irradiation infrastructures, to provide a better support to users and install new analytical techniques.
- Development and test of superheated droplet detectors and their use in dark matter search within the SIMPLE project. The main objectives were to finish the analysis of the Phase II of data taking in the LSBB tunnel in Rustrel, France, and to develop a prototype detector for Phase III.
- Development and expertise in deterministic and Monte Carlo calculations for the RPI, in particular neutronics, also including safety analyses, thermohydraulics and others. Simulation tools for ion beam interactions are also developed.

Public visits to the RPI are an important part of our work. One of our objectives is to host at least 50 visits per year, continuing to maintain the RPI as the most visited infrastructure of the Campus.

MAIN ACHIEVEMENTS

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User	Area	% Time
URSN	Dosimetry	0.9
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IVIA (Spain)	Radiation effects	0.6
USC (Spain)	Radiation effects	0.4

Table 1: Main users of the RPI in 2012

An ax from the British Islands Bronze Age was studied using the neutron tomography setup installed in the terminal column of the reactor. This technique has easily shown the existence of a void in the structure, with the shape of the comet, as illustrated in Fig. 1. Due to the thickness of the material, it would not be possible to obtain this information using conventional radiography.

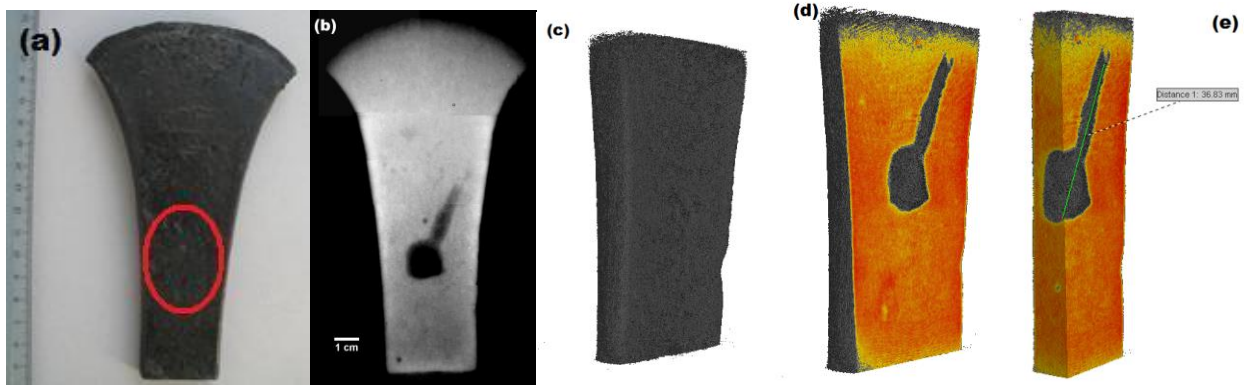


Fig. 1: (a) Photography, (b) neutron radiography, and neutron tomography images: (c) reconstructed neutron tomography of interest ax area, (d) front cut with the surface (about 4mm), (e) frontal and transversal cuts with internal measurements, (e) Void shown with grey color, while the red/yellow represent the core material (colors added by VG Studio software).

Prompt Gamma Neutron Activation Analysis (PGNAA) is seen as a technique with added value to the activities based at the RPI. However, the background at the Ge detector position of the as built structure is too high, preventing the practical use of this technique. An MCNP model of the epithermal neutron beam (Fig.1) has been developed to support the installation of a modified irradiation facility. The validation of the model involves a comparison with neutron measurements using activation foils. However, significant inconsistencies between calculated and measured neutron fluence rates were initially found. The main source for inconsistencies has been found to be a significant shift (>1 cm) between the beam central axis and that of the shutter, previously assumed to be coincident. The updated model is now able to calculate neutron fluence profiles and absolute values of thermal and epithermal fluence rates relevant for the modified PGNAA facility.

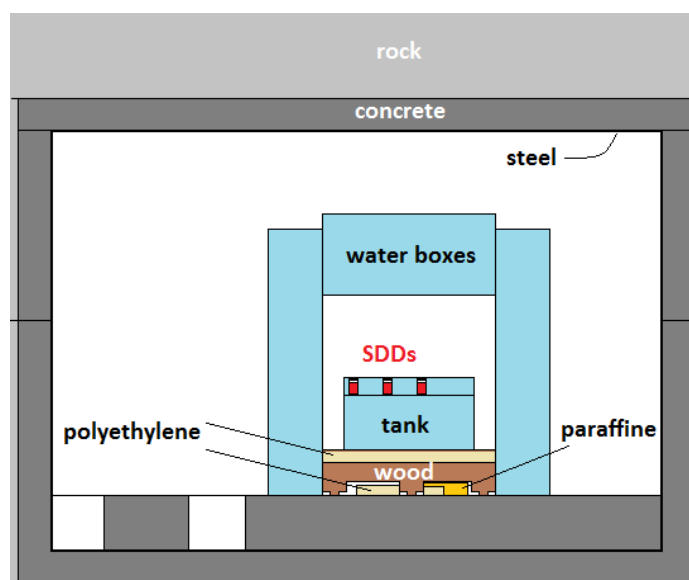


Fig. 2: Geometry of the MCNP model for Stage 2 of the SIMPLE experiment, displaying the additional polyethylene and paraffine shielding.

Within the SIMPLE project, improvements were made in the determination and reduction of the background using both simulation tools and analytical techniques available at CTN. Calculations of the neutron-induced background signal were done for the final stage of the experiment (Stage 2, 2010-2011), aiming at (i) a further reduction of the background relatively to the previous configuration (Stage 1, 2009-2010) via an improved neutron shielding (Fig. 2) and (ii) an increased accuracy of the background estimate using a complete set of experimental data regarding material radio-assays and the elemental composition of critical, non-standard materials (namely H in wood and B in glass). Monte Carlo simulations were performed using the MCNP code and a detailed model of the set-up. The neutron background signal is induced by neutron and alpha emitters (via alpha-neutron reactions) naturally present in the materials used in the experiment. Trace amounts of U-238 and Th-232 were quantified by alpha-spectroscopy at UPSR and neutron activation analysis at UCQR. Wood and glass compositions were determined using ion beams at UFA. The calculated neutron-induced background signal is $0.333 \pm 0.001(\text{stat.}) \pm 0.038(\text{syst.})$ cts/kg-d, which is 3 times lower than that for Stage 1, and 2 times larger than measured. It was found that the major contribution (98%) for the background in the current setup originates from the borosilicate glass used as detector container, due to the simultaneous occurrence of significant emitter levels and the high boron content in the material. A substantial background reduction for the subsequent SIMPLE Phase III (in preparation) is being planned based on low-activity containers and improved water radio-purity.

The expertise in simulation tools is not limited to neutron interactions. A long-standing strong collaboration with the UFA is based on the development by RPI personnel of advanced physical models for ion beam analysis and their implementation in data analysis codes. Several developments were presented in 2012. A new analytical calculation of the effect of multiple scattering on the width of Rutherford backscattering data was presented, finally solving a problem first posed in 1992. Also, a universal interchange data format was developed at the RPI as part of a European project led at CTN by the UFA, and is now an international standard. Finally, the RPI participated in a round robin with other European labs to demonstrate that an absolute uncertainty around 1% can be achieved in Rutherford backscattering.

RELEVANT PAPERS

- J.G. Marques, A. Kling, Radioactive Waste from Research Reactor Operation and Decommissioning, Chapter 2, Radioactive Waste: Sources, Types and Management, S. Yuan, W. Hidaka (Editors), Nova Science Publishers, New York, 2012, 41-76, ISBN 978-1-62100-188-1.
- M.I. Prudêncio, M.A.S. Pereira, J.G. Marques, M.I. Dias, L. Esteves, C.I. Burbidge, M.J. Trindade and M.B. Albuquerque, Neutron Tomography for the Assessment of Consolidant Impregnation Efficiency in Portuguese Glazed Tiles (XVII century), Journal of Archaeological Science, 39, 964-969 (2012), doi:10.1016/j.jas.2011.11.010.

- M. Felizardo, T.A. Girard, T. Morlat, A.C. Fernandes, A.R. Ramos, J.G. Marques, A. Kling, J. Puibasset, M. Auguste, D. Boyer, A. Cavaillou, J. Poupene, C. Sudre, H.S. Miley, R.F. Payne, F.P. Carvalho, M.I. Prudêncio, A. Gouveia, R. Marques, Final Analysis and Results of the Phase II SIMPLE Dark Matter Search, Physical Review Letters, 108, 201302, doi: 10.1103/PhysRevLett.108.201302.
- N.P. Barradas, The width of an RBS spectrum revisited: influence of multiple scattering, Nucl. Instrum. Methods Phys. Res. B, 270, 44-46 (2012), doi:10.1016/j.nimb.2011.10.002.
- C. Jeynes, N.P. Barradas, E. Szilagy, Accurate Determination of Quantity of Material in Thin Films by Rutherford Backscattering Spectrometry, Anal. Chem., 84, 6061-6069 (2012), doi: 10.1021/ac300904c.

FUNDS

Project/Service	Reference	Timeframe	2012
Accurate heavy ion ERDA of oxynitride films: Improved modelling of straggling and multiple scattering and extension of the stopping data bases	IAEA Research Contract No. 14365/R0 (N.P. Barradas: Coord.)	01/09/2007-30/04/2012	3.500,00 €
Tomografia com microsonda nuclear com discriminação em profundidade - Tomo3D	PTDC/FIS/115089/2009 (D.G. Beasley: Participant)		(UFA) 9.245,98 €
Real Time Wide Area Radiation Surveillance System (REWARD)	FP7-SEC-2011.1.5-1, Contract 284845 (J.G.Marques, co-coordinator)	12/2011-11/2014	See UPSR
Diagnosis, Decontamination and Conservation of Cultural Heritage: Neutrons and Ionizing Radiation in Artwork (RADIART)	PTDC/HIS-HEC/101756/2008 (J.G. Marques, M. Stanojev, Participants)	01/2010-06/2013	(UCQR) 23.509,44 €
Neutrino mass direct determination: Portuguese contribution to MARE	PTDC/FIS/116719/2010 (A. Kling, N.P.Barradas: Participants)	01/2012-12/2013	3.500,00 €
Total			39.755,42 €

INTERNATIONALIZATION

- Argonne National Laboratory, USA, Reduced Enrichment for Research and Test Reactors;
- Consejo Superior de Investigaciones Científicas, Barcelona, Spain, Radiation effects;
- Humboldt University Berlin, Germany, Argon-Argon dating;
- Institute for Particle and Nuclear Physics, Hungary, Accuracy of Rutherford backscattering;
- Instituto de Pesquisas Energéticas e Nucleares, Brasil, Neutron tomography;
- Instituto Valenciano de Investigaciones Agrarias, Spain, Radiation-induced mutations;
- ISOLDE Collaboration, CERN, Switzerland, Optimization of targets;
- Katholieke University Leuven, Bélgica, Artificial neural networks for data analysis;
- Mediterranean Research Reactor Network (IAEA), Research reactor network;
- South Africa's National Research Foundation, Evaluation of research programmes;
- Ruđer Bošković Institute, Croatia, Electronic stopping powers of materials;
- Universidade de Lisboa, Portugal, Dark matter search;
- Universidade de Lisboa, Portugal, Direct neutrino mass determination;
- Università degli Studi di Milano, Italy, Detectors for low-energy radioactive decays;
- Università di Genova, Italy, Detectors for low-energy radioactive decays;
- Universitat Politècnica de València, Spain, Hosting of ERASMUS MSc student;
- University of Heidelberg, Germany, Argon-Argon dating;
- University of Miami, USA, Development of advanced data analysis for cryogenic detectors;
- University of Santiago de Compostela, Spain, Radiation effects;
- University of Surrey, England, Development of software for ion beam analysis.

Applied Dynamics Group

TEAM

Name	Category	R&D
José Antunes	Principal Researcher	100%
Vincent Debut	Auxiliary Researcher (<i>Ciência 2007</i>)	100%
Miguel Carvalho	Researcher Grantee	100%
Miguel Marques	Researchers Grantee	100%

OBJECTIVES

Activities at Applied Dynamics Laboratory (ADL) are mainly devoted to research in nuclear engineering, with an emphasis on the vibratory and acoustic behaviour of mechanical components in nuclear facilities. On the other hand, research projects connected with dynamical problems of more fundamental nature are also pursued, in order to develop modelling and system identification methods and computational tools relevant for the problems addressed. The specific know-how which demarks ADL from other research laboratories in the country is our proven experience in: (a) Flow-induced vibrations, (b) Nonlinear dynamics due to localized impacts.

The objectives of the group for 2012 are connected with the research projects of ADL pursued under contract, namely: (1) Flow excited steam generator tubes and fuel rods (CEA contract, France), (2) Dynamical characterization and tuning of the Mafra carillons (FCT contract), (3) Dynamical modelling of the Portuguese guitar (FCT contract) and (4) Fault detection in machinery (FCT Transnational cooperation Portugal/Tunisia). Under this framework, the scientific objectives for 2012 were:

- (1-a) To develop a new method for accurate simulation of the flow turbulence excitation of tubular bundles;
- (1-b) To develop new techniques for attempting the experimental identification of flow excitation features from the system vibratory responses;
- (2-a) To perform the full experimental characterization of the current tuning state of the Mafra carillons;
- (2-b) To develop a technique for attempting the modal identification of bells which have been constrained by additional supporting fixtures;
- (3-a) To develop a detailed analytical model for worn guitar strings;
- (3-b) To develop a model for the vibrations of multiple strings coupled to a complex resonating structure;
- (4) To develop a new inverse technique for the remote identification of vibro-impact forces from the dynamical responses of beams with clearance supports.

MAIN ACHIEVEMENTS

Flow excited steam generator tubes and fuel rods

The main point of this project pursued for the French Commissariat à l'Energie Atomique et aux Energies Alternatives (CEA/Saclay) was to devise sophisticated identification methods in order to extract information on the spatial distribution and on the spectral content of flow turbulence excitations within the bundles of nuclear fuel rods. This topic is essential for the success of predictive analysis under flow induced vibration. During 2012, in collaboration with colleagues from CEA, we devised a general strategy to identify the turbulence excitation from measurements of the rod response vibrations, a very delicate inverse problem.

Concerning the flow excitation, we extended to convective flows the concept of "Equivalent Turbulence Spectrum", a useful approach which bypasses any uncertainty on the space-correlation of turbulence fluctuations. This is a significant step for unifying the use of experimental turbulence data in predictive vibration analysis. Also, we developed a new technique for the time-domain simulation of realistic turbulence excitations, which is more effective than previous approaches. From our collaborative efforts, two papers have been published in Journal of Fluids and Structures and two papers were published at a major international conference (FIV 2012, Dublin, Ireland). Three conference papers, as well as a journal publication, are scheduled for 2013.

Dynamical characterization and tuning of the Mafra carillons

This work is aimed at analysing the tuning of the Mafra carillons bells, which form the largest surviving 18th century carillons in Europe. It is part of a multidisciplinary FCT research project in partnership with the Music Department from the Universidade Nova de Lisboa. We developed suitable multi-reference identification

techniques to extract the bell vibration modes from experiments, and devised optimal strategies to infer their tuning status and tuning errors with respect to historical tempered scales. From this work, beyond a MSc thesis presented at UNL, two papers will be submitted for publication in 2013.

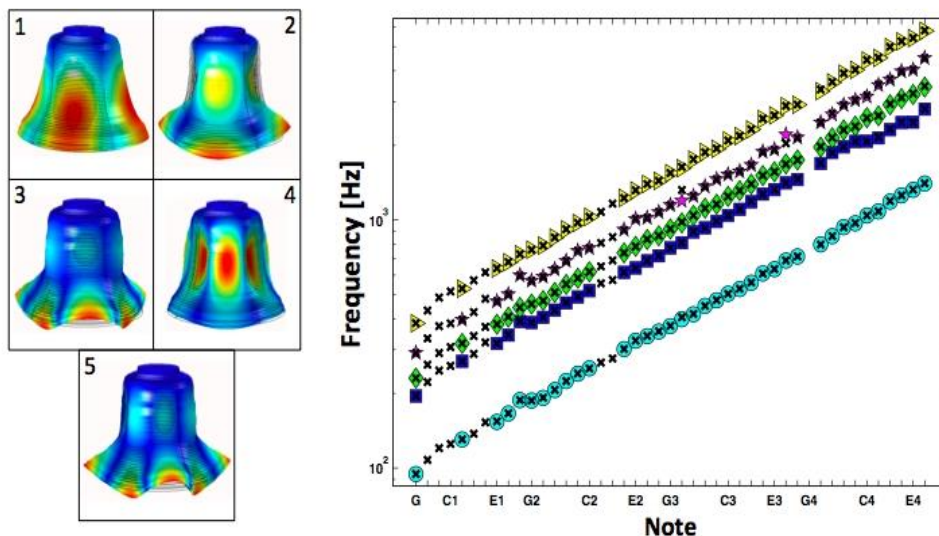


Fig. 1: Experimentally identified bell modal frequencies of the North tower Mafra carillon: First bell modal shapes (left); Identified tuning of the first bell modes (right).

Another aspect of the problem was to identify the original modes of several large bells, which for security reasons were lowered from their mounts, becoming provisionally supported by scaffolds securing the bell rim at several locations, leading to very different constrained modes. To infer the original bell resonances from the constrained bell modes is a very difficult inverse problem, which we attempted to solve using suitable structural modification formulations coupled with an optimization scheme. Our new method for this identification problem has been successfully tested using numerical simulations and we are now developing a laboratory experiment to validate our identification technique. From the results obtained so far, a paper was presented at an international conference (ICSV 2012, Vilnius, Lithuania) and two more papers are scheduled for presentation in 2013.

Dynamical modelling of the Portuguese guitar

In the framework of this project, we have modelled the perturbed dynamics of worn guitar strings, for which local defects of mass arise (due to progressive string wear or else to metal deposit from the instrument frets). It is well known to guitar players that, as string wears, the radiated sound changes. The theoretical model developed was successful in explaining important dynamical features connected with the string wear process. This model was exploited both by performing extensive statistical analysis of the string perturbed modes, but also through time-domain numerical simulations. We have thus shown that worn strings lose some of their original sound brightness due to localization phenomena in the higher order modes, preventing some high-frequency energy to be conveyed to the instrument body. From this work a paper was presented at an international conference (ICSV 2012, Vilnius, Lithuania). Another conference paper and a journal publication are scheduled for 2013.

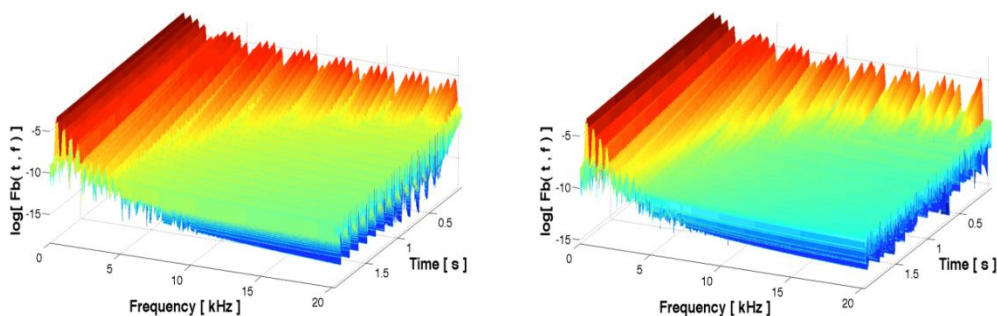


Fig. 2: Modelled spectrograms of string dynamical force at the instrument bridge: New string (left); Worn string (right).

We have also addressed the related problem of friction excited coupled systems, whose motion regimes are typically nonlinear and complex. Such systems are ubiquitous in nature and industry, the friction noise squeal and periodic sounds produced by bowed instruments being two representative examples. In order to discuss the gross topological features of bowed string dynamics, based on the scenarios stemming from the complex modes of a linearized model, we produced parametric stability plots with interesting conclusions in relation with the post-stable nonlinear limit cycles of the motion regimes. From this work an invited paper was presented at an international conference (Acoustics 2012, Nantes, France) and two journal papers are currently under review.

Fault detection in machinery

Many industrial components are prone to vibro-impact phenomena, due to support gaps or some other form of intermittent contacts. At LDA we have been working on this problem for many years and, in the framework of this bilateral international project, we have addressed the problem of impact force identification for multi-supported systems with gaps. This is a quite difficult problem and we have devised a constrained iterative scheme to isolate and progressively refine the force identifications, using the dynamical information provided by a small number of vibratory transducers. Results from our preliminary work, which was anchored so far on numerical simulations, are encouraging. A paper was produced for an international conference (CMMNO 2012, Hammamet, Tunisia) whose proceedings have been published as a book by Springer.

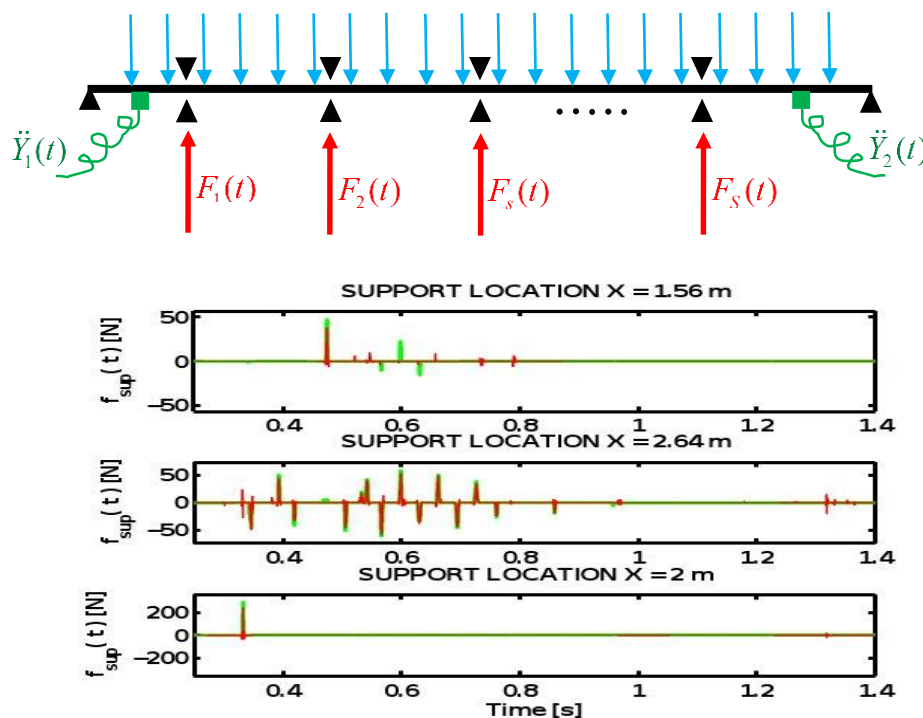


Fig. 3: Iterative impact force identification for multi-supported systems subjected to distributed random excitations: simulated system, as well as the actual (green) and identified (red) impact forces at three supports with clearances.

RELEVANT PAPERS

- P. Piteau, X. Delaune, J. Antunes, L. Borsoi, "Experiments and computations of a loosely supported tube in a rigid bundle subjected to single-phase flow", *Journal of Fluids and Structures*, Vol. 28, 56-71 (2012).
- P. Piteau, J. Antunes, "A theoretical model and experiments on the nonlinear dynamics of parallel plates subjected to laminar/turbulent squeeze-film forces", *Journal of Fluids and Structures*, Vol. 33, 1-18 (2012).
- V. Debut, J. Antunes, "Iterative method for the remote identification of impact forces at multiple clearance supports using few vibratory measurements". In *Condition Monitoring of Machinery in Non-Stationary Operations*, Springer, ISBN 978-3-642-28767-1 (2012).

- J. Antunes, L. Borsoi, P. Piteau, X. Delaune, "The equivalent spectrum concept for turbulence conveying excitations", *10th International Conference on Flow-Induced Vibration & Flow-Induced Noise (FIV 2012)*, 2-6 July 2012, Dublin, Ireland.
- V. Debut, M. Carvalho, J. Antunes, "Recovering the unconstrained modes of axisymmetric structures from measurements under constrained conditions", in *Proceeding of the 19th International Congress on Sound and Vibration (ICSV-19)*, 8-12 July 2012, Vilnius, Lithuania.

FUNDS

Project/Service	Reference	Timeframe	2012
IVECO: Modelling and identification of flow turbulence excitations in nuclear fuel rods	ADIST AD/2013/87 CEA 4000533537/P5B61	01/10/2012 30/09/2013	6.000,00 €
The Mafra carillons: Development of Advanced Methods in Music Acoustics for Tuning and Restoration	FCT PTDC/EAT- MMU/104255/2008	01/04/2010 31/03/2013	⁽¹⁾ 0,00 € ⁽¹⁾ 6.345,00€ expenses currently under analysis by FCT for reimbursement
Dynamical Analysis and Improvements on the Portuguese Guitar Strings and String/Body Interaction	FCT PTDC/FIS/103306/2008	01/03/2010 31/08/2012	2.271,40 €
Total			8.271,00 €

INTERNATIONALIZATION

- By far, the main international scientific partner of ADL is the *French Commissariat à l'Energie Atomique et aux Energies Alternatives* (CEA, Saclay, France), *Département de Modélisation des Systèmes et Structures, Laboratoire d'Études de Dynamique*. With this institution ADL developed 25 years of fruitful collaboration, attested by a significant number of published results and more than twenty research contracts since 1988. Important problems have been solved, such as nonlinear vibrations in steam-generators, flow-induced vibrations of nuclear fuel and stability problems in rotating machinery. Two ASME prizes were awarded in the past to LDA publications from our research with CEA. In recent years, we focused on new identification techniques, applied with success to nonlinear dynamical systems, through the research contracts VITAMINE, TGV-ICE and the currently pursued, IVECO (2012-2013), all funded by CEA.
- As a result of our long standing scientific collaboration with France, ADL has developed contacts with several French laboratories and universities in the field of nonlinear dynamics and acoustics, connected with problems of more fundamental nature. As a result, ADL researchers are often invited for lecturing at scientific meetings and short courses in France, during 2012 a course on Nonlinear Dynamics at *École Polytechnique de Paris*. The head of ADL was in 2013 reporter jury member for three PhD thesis, namely at *École Polytechnique*, *Université du Maine* and *Université de Provence Aix-Marseille*. He is member of the Scientific Council of *LAMSID – Laboratoire de Mécanique des Structures Industrielles Durables (UMR 2832)*, partenariat EDF/CNRS/CEA (Clamart, France) and committee member of the French *Agence d'Evaluation de la Recherche et de l'Enseignement Supérieur (AERES)* for the scientific evaluation of *IRCAM (UMR 9912)*, attached to Centre Pompidou for Contemporary Art, Paris, France. For his research record and sustained collaboration he was recently honoured with the prestigious "*Médaille Étrangère 2012*" of the French Society of Acoustics (SFA).

CONTRACTS

During 2012 the group was involved in three research contracts, one with CEA (France), the other two being FCT research projects. For these contracts three extensive reports were produced, containing results which have been presented at several meetings in 2012, and also to be presented during 2013. The third report mentioned hereafter is also the MSc thesis of Dr. Miguel Carvalho, a research student at ADL in the framework of FCT project PTDC/EAT-MMU/104255/2008. This thesis, supervised by Dr. Vincent Debut, was submitted and approved with distinction at Universidade Nova de Lisboa on December 2012.

- **Research contract IVECO with CEA, France:**
J. Antunes, "IVECO - Identification des sources d'excitation par la turbulence des écoulements: Méthodologie générale d'identification à partir d'un ensemble de mesures vibratoires", *Contract Report IST/CTN/URSN/LDA-Dec12/1*.

- **Research contract PTDC/FIS/103306/2008 with FCT:**
M. Marques, J. Antunes, V. Debut "Guitar strings loaded with localized masses", *Contract Report IST/CTN/URSN/LDA-Dec12/2*.
- **Research contract PTDC/EAT-MMU/104255/2008 with FCT:**
M. Carvalho, "The Mafra Carillons: Analysis and acoustical characterization of the bells", MSc Thesis, *Universidade Nova de Lisboa, Faculdade de Ciências Sociais e Humanas (UNL/FCSH)*, 20th December 2012. Also as *Contract Report IST/CTN/URSN/LDA-Dec12/3*.

Neutron Activation in Environment, Nutrition and Epidemiology Group

TEAM

Name	Category	R&D
Marta Almeida	Auxiliary Researcher (<i>Ciência 2008</i>)	100%
Isabel Dionísio	Technical Personnel	100%
Alexandra Silva	FCT Ph.D. student	100%
Carla Ramos	FCT Ph.D. student	100%
Joana Lage	FCT Ph.D. student	100%
Marina Almeida-Silva	FCT Ph.D. student	100%
Nuno Canha	FCT Ph.D. student	100%
Susana Sarmento	Ph.D. student	10%
Catarina Galinha	FCT fellowship	100%
Catarina Dias	B.Sc. student	30%
Ana Margarida Calado	B.Sc. student	30%
Sérgio Almeida	B.Sc. student	30%
Ana Cláudia Lopes	B.Sc. student	30%
Tiago Vidal	Technical student	30%
Maria do Carmo Freitas	Retired Principal Researcher - collaborator	30%
Ana Cruz	Ph.D student - collaborator	10%
Bruno Vieira	Ph.D student - collaborator	10%
Maria Manuel Farinha	Ph.D student - collaborator	10%
Carla Gomes	M.Sc. student- collaborator	10%
André Shataloff	M.Sc. student- collaborator	10%
Jaime Camacho	M.Sc. student- collaborator	10%
Cecilia Ganihlo	M.Sc. student- collaborator	10%
H.Th Wolterbeek	TU Delft Sen. Researcher	10%

OBJECTIVES

The research in NANE group is focused on the development of the INAA (Instrumental Neutron Activation Analysis) methodologies and on their application to environment, nutrition and epidemiology studies.

The objectives to 2012 included the following lines:

- Quality assurance and quality control (QA/QC) of the technique INAA by participating in proficiency tests. This work was developed within the IAEA projects “Support Air Quality Management” and “Enhancing the Sustainability of Research Reactors and their Safe Operation through Regional Cooperation, Networking and Coalition”;
- Research on air pollution assessment, aerosol characterization, identification of emission sources with receptor models and evaluation of air pollution impacts using dispersion models and biomonitoring techniques. These studies were performed within the EC project “Assessment of Emissions and Impact of Steel Processes”, the FCT projects “Mitigating the Environmental and Health Impacts of Particles from Fugitive Emissions” and “Atmospheric Aerosol in Cape Verde Region: Seasonal Evaluation of Composition, Sources and Transport” and 3 PhD studies;
- Research on the exposure of susceptible groups - children, elders and sportsmen – to pollutants and assessment of the associated health impacts. Work developed by 3 PhD students;
- Research on selenium supplementation of bread and durum wheat within the FCT project “Selenium distribution in cereals and Portuguese cultivation soils - Interactions between selenium and iodine uptake by cereals - a case study” and 1 PhD study;
- Collaboration with the industry within research projects and services;
- Graduation and Post-graduation training (B.Sc., M.Sc, Ph.D.);
- Services on Energy and Indoor Air Quality Certification of Buildings;
- Services on elemental characterization of samples by INAA;

- Application for research funding (13 proposals were submitted to FCT, QREN and Fundación Mapfre).
- Services on training.

MAIN ACHIEVEMENTS

PM_{fugitive} - Mitigating the Environmental and Health Impacts of Particles from Fugitive Emissions, FCT, PTDC/AAC-AMB/098825/2008

Significant amount of atmospheric dust arises from the mechanical disturbance of granular material exposed to the air. Dust generated from these open sources is termed "fugitive" because it is not discharged to the atmosphere in a confined flow stream. The objective of the project PM_{fugitive} is to improve the understanding of fugitive emissions by performing their chemical characterization, assessing their environmental and health impacts and identifying the likeliness and extend of the PM10 and PM2.5 limit value exceedences due to these emissions.

The assessment of the environmental impact of harbour operations (common source of fugitive dust) was performed by using modelling tools supported by high quality air measurements:

- Particles were sampling in a harbour during bulk material handling and their chemical characterization was performed by INAA and PIXE.
- Reverse dispersion models were used to estimate emission factors for the fugitive emissions. This work was performed in collaboration with Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas in Madrid;
- Dispersion models were used to predict the ground-level concentrations of particles and to evaluate the exposure of the population due to the harbour operations;

Results showed that, depending on the handled material, meteorological conditions and crane operators, the impact of harbour operations can have significant impacts on the environment.



Fig. 1: Fugitive emissions in harbours.

CV-Dust: Atmospheric Aerosol in Cape Verde Region: Seasonal Evaluation of Composition, Sources and Transport, FCT, PTDC/AAC-CLI/100331/2008

The main objectives of CV-Dust project are 1) to characterize the chemical and mineralogical composition of dust transported from Africa by setting up an orchestra of aerosol sampling devices in the strategic archipelago of Cape Verde; 2) to identify the sources of particles in Cape Verde by using receptor models; 3) to elucidate the role Saharan dust may play in the degradation of Cape Verde air quality and 4) to model processes governing dust production, transport, interaction with the radiation field and removal from the atmosphere.

PM10 sampled in Cape Verde was chemically characterized (elements, water soluble ions and carbonaceous aerosols) and the identification of the main sources and origins of the particles were carried out by integrating

complementary tools including Principal Component Analysis, Multilinear Regression Analysis, Positive Matrix Factorization and Cluster Analysis of Air Mass Back trajectories.

Results showed that Cape Verde aerosol is affected principally by natural sources: dust coming from Sahara desert contributes on average to 48% of the total PM10 mass and sea salt spray contributes on average to 20%. During trajectories from Sahara, dust contribution increases to more than 60% and PM10 concentrations reach very high concentrations (10 times higher than the EC limit values and WHO guidelines).

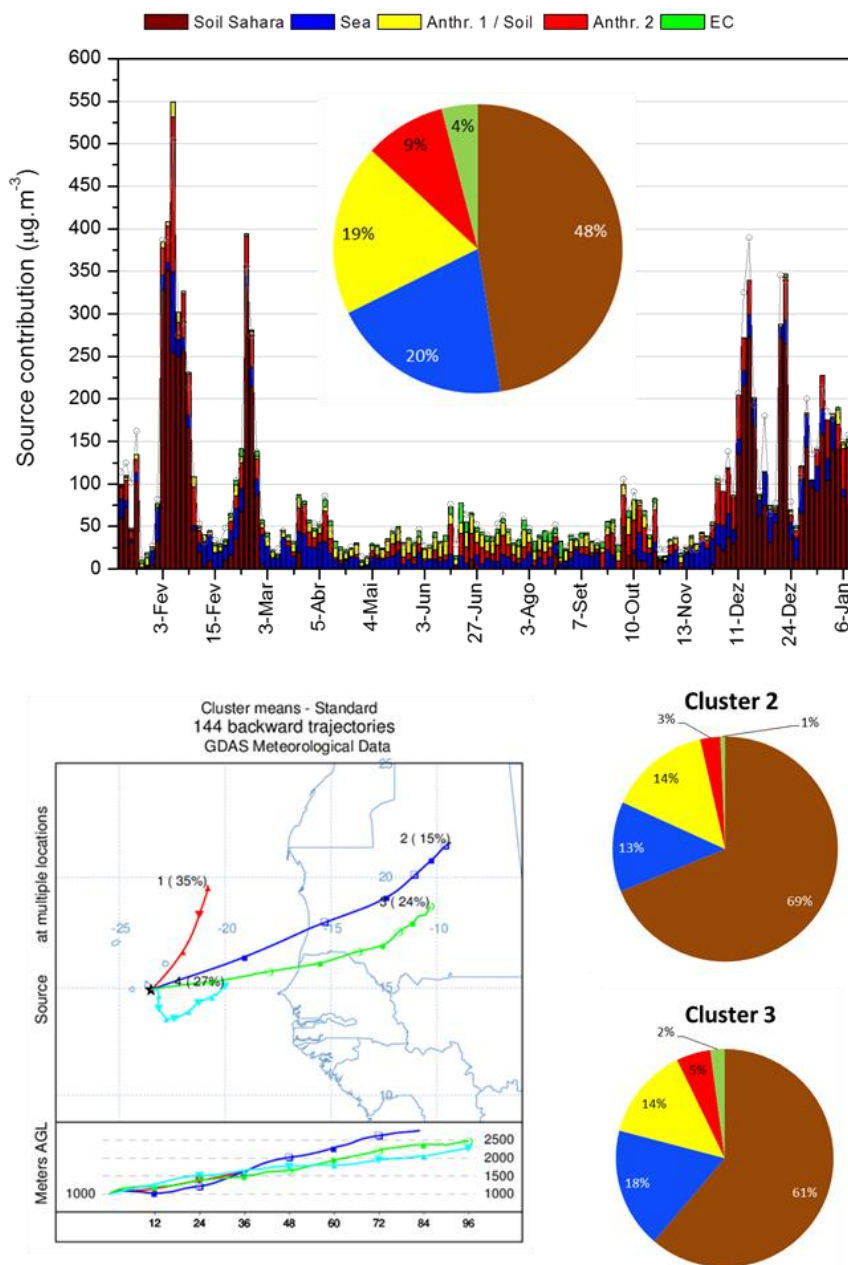


Fig. 2: Source contribution for PM10 concentrations measured in Cape Verde during 2011. Cluster analysis applied to the backward trajectories and relative source contribution for trajectories coming from Sahara desert.

ASEMIS - Assessment of Emissions and Impact of Steel Processes, EC, RFSR-CT-2009-00029

The objective of the project ASEMIS is to improve the understanding of steelworks’ emissions and their impacts on ambient air quality, thus enabling cost effective abatement measures to be properly targeted and implemented. This addresses the need to improve local air quality, helping to create a sustainable future for European steelmaking.

IST/ITN used complementary tools to assess the air quality and the contribution of emissions sources in the vicinities of the Gijon ArcelorMittal steelwork:

- 1) Metals concentrations were mapped in the surroundings of the steelwork using passive biomonitors;
- 2) Geographic Information System was used to evaluate the relations between the spatial distribution of the elements, contamination factors, land use and topography and to identify the sources and processes associated with the pollutants' formation.
- 3) Atmospheric particles were sampled in the steelwork and a temporal database of aerosol species was built to evaluate the seasonal variations of metal concentrations;
- 4) Receptor models were used to identify and quantify the contribution of the steelwork operations to metal concentration in the local ambient air.

This approach identified three principal sources of particles, related with the steelwork activities: fugitive emissions from the handling and storage of minerals and fuel; combustion processes and traffic of trucks.

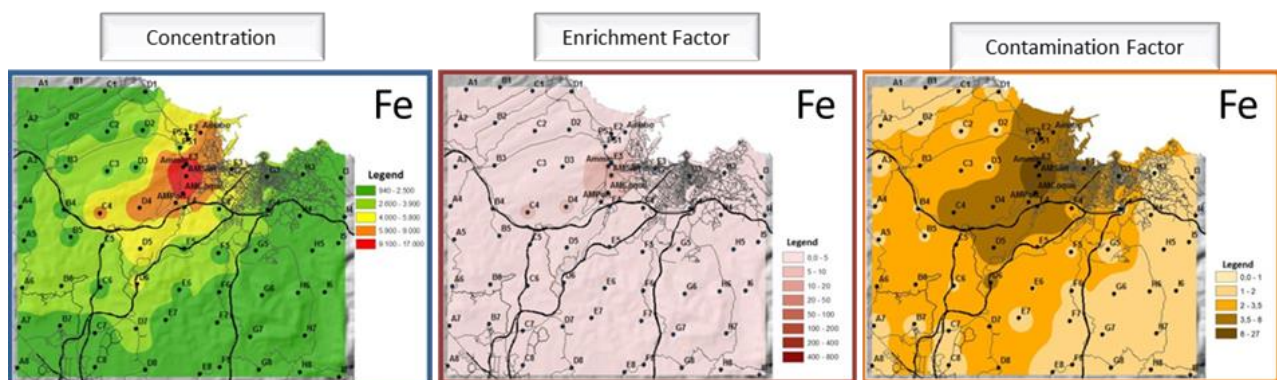


Fig. 3: Spatial distribution of the concentration, enrichment factor and contamination factor for the element Fe emitted by the steelwork.

Support Air Quality Management, IAEA, TC project RER/1/008

The objective of the IAEA TC Project “Support Air Quality Management” is to establish a network for air monitoring in order to increase the knowledge about the status of atmospheric pollution in the TC Europe Region by broadening access to nuclear analytical techniques.

In the scope of this project 1) an inter-laboratory comparison is being performed with aerosol filters prepared by the Institute for Medical Research and Occupational Health from Zagreb and 2) aerosol samples are being collected, in Lisbon. Half of each filter will be irradiated in the RPI in order to perform a chemical characterization of the particles by k_0 -INAA. In the other half of the filter, water soluble ions and carbonaceous aerosols will be analysed by the Environmental Research Laboratory, Institute of Nuclear Technology - Radiation Protection, NCSR "DEMOKRITOS" in Athens.

Enhancing the Sustainability of Research Reactors and their Safe Operation through Regional Cooperation, Networking and Coalition, IAEA, TC project RER/4/032

Under the IAEA Technical Cooperation project RER 4/032, European and one Middle East Neutron Activation Analysis laboratories participated in a proficiency testing round by inter-laboratory comparison organized by the Wageningen Evaluating Programs for Analytical Laboratories (WEPAL). Four soil samples of the International Soil Analytical Exchange and four botanical samples of the International Plant Analytical Exchange were provided for analysis. In IST/ITN, elemental determinations of these samples were carried out at the Portuguese Research Reactor by k_0 -INAA.

WEPAL reported the results of these exercises within three weeks after the closing date for submission of data and satisfactory performance was attained for consistently reporting z-scores < 2 . After the report of the results by WEPAL, a workshop was performed in Delft University of Technology as a feedback exercise for the laboratories in order to promote further improvement of their degree of trueness while conducting NAA.

RELEVANT PAPERS

- S.M. Almeida, J. Lage, M.C. Freitas, A.I. Pedro, T. Ribeiro, A.V. Silva, N. Canha, M. Almeida-Silva, T. Siteo, I. Dionísio, S. Garcia, G. Domingues, J. Perim de Faria, B. González Fernández, D. Ciaparra, H.Th. Wolterbeek, Integration of biomonitoring and instrumental techniques to assess the air quality in an industrial area located in the coastal of central Asturias, Spain, *Journal of Toxicology & Environmental Health, Part A* 75, 1392-1403 (2012), doi: 10.1080/15287394.2012.721173.
- S.M. Almeida, C.A. Ramos, A.M. Marques, A.V. Silva, M.C. Freitas, M.M. Farinha, M. Reis, A.P. Marques, Use of INAA and PIXE for multipollutant air quality assessment and management, *Journal of Radioanalytical and Nuclear Chemistry* 294, 343-347 (2012), doi: 10.1007/s10967-011-1473-4.
- S.M. Almeida, A. Silva, M.C. Freitas, A.M. Marques, C.A. Ramos, A.I. Silva, T. Pinheiro, Characterization of Dust Material Emitted during Harbour Activities by k_0 -INAA and PIXE, *Journal of Radioanalytical and Nuclear Chemistry* 291, 77-82 (2012), doi: 10.1007/s10967-011-1279-4.
- N. Canha, M. Almeida-Silva, M.C. Freitas, S.M. Almeida, H. Th Wolterbeek, Lichens as biomonitors at indoor environments of primary schools, *Journal of Radioanalytical and Nuclear Chemistry* 291, 123-128 (2012), doi: 10.1007/s10967-011-1259-8.
- N. Canha, M.C. Freitas, M. Almeida-Silva, S.M. Almeida, H.M. Dung, I. Dionísio, J. Cardoso, C.A. Pio, A. Caseiro, T.G. Verburg, H. Th. Wolterbeek, Burn Wood Influence on Outdoor Air Quality in a Small Village: Foros de Arrão, Portugal, *Journal of Radioanalytical and Nuclear Chemistry* 291, 83-88 (2012), doi: 10.1007/s10967-011-1261-1.

FUNDS

Project/Service	Reference	Timeframe	2012
Project: PMfugitive - Mitigating the Environmental and Health Impacts of Particles from Fugitive Emissions, Fundação para a Ciência e Tecnologia	PTDC/AAC-AMB/098825/2008	1 Jan 2012 – 31 Dec 2012	43.775,00 €
Project: CV-Dust: Atmospheric Aerosol in Cape Verde Region: Seasonal Evaluation of Composition, Sources and Transport, Fundação para a Ciência e Tecnologia,	PTDC/AAC-CLI/100331/2008	1 Jan 2012 – 31 Dec 2012	27.364,00 €
Project: ASEMIS - Assessment of Emissions and Impact of Steel Processes. European Commission, Research Fund for Coal and Steel	RFSR-CT-2009-00029	1 Jan 2012 – 31 Dec 2012	11.378,00 €
Project: Support Air Quality Management, International Atomic Energy Agency	TC project RER/1/008	1 Jan 2012 – 31 Dec 2012	(meetings, reference materials, filters)
Project: Enhancing the Sustainability of Research Reactors and their Safe Operation through Regional Cooperation, Networking and Coalition, International Atomic Energy Agency	TC project RER/4/032	1 Jan 2012 – 31 Dec 2012	(meetings, reference materials)
Service: Technical consultancy on aerosol analysis and receptor modelling, Instituto de Soldadura e Qualidade		1 Jan 2012 – 31 Dec 2012	6.567,00 €
Service: Teaching activities, Instituto de Soldadura e Qualidade		March – July 2012 Total: 41 hours	1.784,00 €
Service: Teaching activities, Agência para a Energia		March – Sept 2012 Total: 16 hours	800,00 €
Service: Analysis of heavy metals in fertilizers, ADP Fertilizante, S.A.		1-31 July 2012	450,00 €
Service: Indoor Air Quality Certification of Buildings, Instituto de Soldadura e Qualidade		1 Jan 2010 – Dec 2011	10.325,00 €
Total			102.443,00 €

INTERNATIONALIZATION

- Neutron Physics Laboratory, Nuclear Physics Institute of the ASCR (Řež, Czech Republic), supported by the European Commission under the 7th Framework Programme through the 'Research Infrastructures' action of the 'Capacities' Programme, Contract No: CP-CSA_INFRA-2008-1.1.1 Number 226507-NMI3, 10 September to 23 November 2012, Radiochemical neutron activation analysis for selenium determination in wheat samples.
- Dpto. Química Analítica, Facultad de Ciencias Químicas, Universidad Complutense de Madrid supported by the COST Action FA0905, 26 November to 14 December 2012, Agronomic biofortification of bread and durum wheat with selenium: Selenium species determination by HPLC-ICPMS.
- Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas (CIEMAT), Madrid, Spain, Application of Inverse Models to fugitive emissions from harbours.
- Participation in the COST ACTION FA 0905 “Mineral Improved Crop Production for Healthy Food and Feed”.
- Delft University of Technology, Netherlands, co-supervision of 8 Ph.D. students.
- Environmental Research Laboratory, Institute of Nuclear Technology - Radiation Protection, NCSR "DEMOKRITOS", Athens, Greece, collaboration in the analysis of aerosol filters.

OTHER PUBLICATIONS

- C. Galinha, M.C. Freitas, A.M.G. Pacheco, J. Kameník, J. Kučera, H.M. Anawar, J. Coutinho, B. Maças, A.S. Almeida (2012): Selenium determination in cereal plants and cultivation soils by radiochemical neutron activation analysis, *Journal of Radioanalytical and Nuclear Chemistry* 294: 349-354 [DOI: 10.1007/s10967-011-1510-3].
- C. Galinha, M.C. Freitas, A.M.G. Pacheco (2012): Elemental characterization of bread and durum wheat by instrumental neutron activation analysis, *Journal of Radioanalytical and Nuclear Chemistry* [in hard press; DOI: 10.1007/s10967-012-2368-8].
- C. Galinha, M.C. Freitas, A.M.G. Pacheco, J. Coutinho, B. Maças, A.S. Almeida (2012): Selenium supplementation of Portuguese wheat cultivars through foliar treatment in actual field conditions, *Journal of Radioanalytical and Nuclear Chemistry* [in hard press; DOI: 10.1007/s10967-012-2372-z].

COMMUNICATIONS

- C. Galinha, M.C. Freitas, A.M.G. Pacheco (2012): Elemental concentrations in Portuguese cereals by instrumental neutron activation analysis, *10th International Conference on Nuclear Analytical Methods in the Life Sciences (NAMLS-10)*, 15-20 January 2012, Bangkok, Thailand: Paper # AGO06, p. 2.
- C. Galinha, M.C. Freitas, A.M.G. Pacheco, J. Coutinho, B. Maças, A.S. Almeida (2012): Selenium supplementation of Portuguese wheat cultivars through foliar treatment in actual field conditions, *10th International Conference on Nuclear Analytical Methods in the Life Sciences (NAMLS-10)*, 15-20 January 2012, Bangkok, Thailand: Paper # AGP06, p. 3.
- C. Galinha, M.C. Freitas, A.M.G. Pacheco, J. Coutinho, B. Maças, A.S. Almeida (2012): Selenium biofortification of bread and durum wheat – Total selenium in wheat grains resulting from supplementation during the growth cycle, *1st Symposium of COST Action FA 0905 “Desenvolver culturas mais nutritivas – Biofortificação de trigo”*, 06 March 2012, Elvas, Portugal: p. 26/27.
- C. Galinha, M.C. Freitas, A.M.G. Pacheco, J. Coutinho, B. Maças, A.S. Almeida (2012): Selenium supplementation of wheat cultivars – A comparison of field procedures, *3rd Annual Workshop of COST Action FA 0905 “Mineral Improved Crop Production for Healthy Food and Feed”*, 23-26 October 2012, Monte de Caparica (FCT-UNL), Portugal: Paper #P07, p.52 [http://www.cost.eu/domains_actions/fa/Actions/FA0905].

Researchers – Scientific Activities

(ordered by category and name)

NAME: José Joaquim Gonçalves Marques

CATEGORY: Principal Researcher with habilitation

ID NUMBER: 5367

R&D ACTIVITIES

Nº	Activity Description	R&D
1	Management	50%
2	Participation in the SIMPLE project	15%
3	Participation in the RADIART project	10%
4	Design and implementation of dedicated irradiations	10%
5	Training	15%
Total		100%

Nº	Work Summary and Main Achievements
1	a) Vice-President of Installation Commission of IST/ITN. b) Manager of the Portuguese Research Reactor and coordinator of the research unit on nuclear reactors and safety (URSN). b) Vice-President of Portuguese Physics Society.
2	SIMPLE (Superheated Instrument for Massive ParticLe Experiments) is an experiment search for direct evidence of dark matter. It is located in a cavern 500 m deep in the Laboratoire Souterrain à Bas Bruit (LSBB) near Apt in southern France. The experiment is predominantly sensitive to spin-dependent interactions of weakly interacting massive particles (or WIMPs). Phase II of data acquisition ended in 2012, resulting in new and improved exclusion plots. A prototype detector for Phase III is being developed at IST/ITN and will be used in the LSBB during 2013. The work done was presented in two <i>Phys. Rev. Letters</i> papers and in two conference proceedings. These activities were supported by two FCT projects, PTDC/FIS/115733/2009 (Phase II) and PTDC/FIS/121130/2010 (Phase III).
3	The neutron tomography setup installed in the RPI was used to study conservation problems of ancient tiles within the framework of project PTDC/HIS-HEC/101756/2008 “Diagnosis, Decontamination and Conservation of Cultural Heritage: Neutrons and Ionizing Radiation in Artwork (RADIART)”. It was shown that neutron tomography is a useful tool for visualization of the inner structure of the tiles, and to assess the penetration depth of consolidant and its distribution inside the tile. Neutron tomography showed a greater and more uniform retention of resin inside the tile if the consolidant is applied by brushing rather than immersion. Two publications in international journals resulted from this work.
4	Tailor-made irradiations with fast and / or thermal neutrons were made in the RPI for basic materials, such as GaN, and for Si-based neutron detectors, respectively, within projects PTDC/CTM/100756/2008 “Ion Beam Modification and Neutron Irradiation Studies of Wide Bandgap Semiconductor Hetero- and Nanostructures” and FP7-SEC-2011.1.5-1, Contract 284845, “Real Time Wide Area Radiation Surveillance System” (REWARD). GaN samples show new emission bands whose structure and origin are not yet clear. Improvements were made to the Si-based neutron detectors developed by CSIC (Barcelona) and will be tested during 2013. Results were presented in two publications.
5	Lecturer of two courses at the Faculty for Sciences of the University of Lisbon. Supervisor of one M.Sc. thesis (completed, I. Lázaro) and of one Ph.D. thesis (on-going, R. Luis). Examiner in one M.Sc. thesis and one Ph.D. thesis. Approved in public exam of “Agregação” at the University of Lisbon.

PAPERS

- T.A. Girard, M. Felizardo, A.C. Fernandes, J.G. Marques, A.R. Ramos, Reply to Comment on First Results of the Phase II SIMPLE Dark Matter Search, *Physical Review Letters*, 108, 259002 (2012), doi:10.1103/PhysRevLett.108.259002.

- M.A.S. Pereira, J.G. Marques, R. Pugliesi, A Simple Setup for Neutron Tomography at the Portuguese Nuclear Reactor, *Brazilian Journal of Physics*, 42, 360-364 (2012), doi: 10.1007/s13538-012-0083-0.
- M. Felizardo, T.A. Girard, T. Morlat, A.C. Fernandes, A.R. Ramos, J.G. Marques, Recent Results from the SIMPLE Dark Matter Search, Proceedings 12th International Conference on Topics in Astroparticle and Underground Physics, Munich, September 2011, *Journal of Physics: Conference Series*, 375, 012011 (2012), doi:10.1088/1742-6596/375/1/012011.
- T.A. Girard, J. Puibasset, M. Felizardo, A.C. Fernandes, A.R. Ramos, J.G. Marques, Prospects for a Phase III SIMPLE Measurement Proceedings 12th International Conference on Topics in Astroparticle and Underground Physics, Munich, September 2011, *Journal of Physics: Conference Series*, 375, 012017 (2012), doi:10.1088/1742-6596/375/1/012017.

COMMUNICATIONS

- *Acidente de Fukushima Um Ano Depois*, J.G. Marques, 18^a Conferência Nacional de Física, Aveiro, Portugal, Sep 6-8 (2012), Invited talk.

EDUCATION / THESES SUPERVISION

- Lecturer, *Energia Nuclear: Aspectos Físicos, Ambientais e Económicos*, M.Sc. degree on Physical Engineering, Faculdade de Ciências, Universidade de Lisboa, 1st semester 2012.
- Lecturer, *Técnicas Nucleares*, M.Sc. degree on Physical Engineering, M.Sc. degree on Physical Engineering, Faculdade de Ciências, Universidade de Lisboa, 2nd semester 2012.
- Supervisor, M.Sc. Thesis, *Estudio de la Activación Neutrónica de un Acero Inoxidable en un Reactor Nuclear*, by Ignacio Lázaro Roche, Universitat Politècnica de València, Spain, 27 September 2012.
- Examiner, M.Sc. Thesis, *Study of Isotope Separation with Variable Frequency Lasers*, by Lígia Diana Pinto de Almeida Amorim, Instituto Superior Técnico, Universidade Técnica de Lisboa, 9 November 2012.
- Examiner, Ph.D. Thesis, *Nuclear Technology, Dosimetry and Radiological Protection Aspects of Accelerator Driven Systems and Radioactive Ion Beam Facilities*, by Yuriy Romanets, Instituto Superior Técnico, Universidade Técnica de Lisboa, 28 September 2012.

PROJECTS

- *Real Time Wide Area Radiation Surveillance System (REWARD)*, FP7-SEC-2011.1.5-1, Contract 284845. Leading Institution: CSIC, IST/ITN Coordinators: P. Vaz, J.G. Marques (10%).
- *ANALYtical and TOMographic techniques at the fission reactor of IST (ANATOMIST)*, PTDC/FIS-NUC/1770/2012. Leading Institution: IST/ITN, IST/ITN Coordinator: J.G. Marques (proposal submitted March 2012, not recommended for funding).

CONFERENCE ORGANIZATION / COMMITTEES

- Member, Programme Committee of the 15th International Topic Meeting on Research Reactor Fuel Management (RRFM), Prague, 18-22 March, 2012.
 - Liaison Officer, *International Nuclear Information System (INIS)*, IAEA.
 - Member, *Euratom Article 37 Group of Experts*, European Commission.
 - Member, *Consultative Committee Euratom-Fission (CCE-FISSION)*, European Commission.
 - Member, *Advisory Committee of the Euratom Supply Agency*, European Commission.
 - Member, *Working Group*, European Atomic Energy Society.
 - Member, *Research Reactor Operators Group*, European Atomic Energy Society.
-

NAME: Nuno Pessoa Barradas

CATEGORY: Principal Researcher with habilitation

ID NUMBER: 25378

R&D ACTIVITIES

Nº	Activity Description	R&D
1	RPI Supervision	15%
2	RPI Calculations	10%
3	Monitoring Visits	2%
4	Scientific Commission	5%
5	IBA Data Analysis – Collaboration in UFA/LFI's projects	11%
6	SPIRIT: Support of Public and Industrial Research Using Ion Beam Technology	15%
7	Material transport and erosion/deposition in the JET torus - JW12-FT-3.71	10%
8	Free-charge carrier properties and doping mechanisms of InN-based materials - PTDC/FIS/100448/2008	5%
9	Neutrino mass direct determination: Portuguese contribution to MARE - PTDC/FIS/116719/2010	20%
10	Accurate heavy ion ERDA of oxynitride films: Improved modelling of straggling and multiple scattering and extension of the stopping data bases - IAEA-14365/R0	7%
Total		100%

WORK SUMMARY

Nº	Work Summary and Main Achievements
1	I am Deputy Supervisor of the RPI, replacing the Supervisor in her absences, around 1 to 2 months per year, due e.g. to holidays or missions. The competences of the Supervisor and Deputy Supervisor are defined in national legislation.
2	I made calculations for the RPI, namely core neutronics and reactivity, fuel burnup, and calculation of safety limits. I used the software package REBUS-MCNP, based on the input files originally prepared for the core conversion from HEU to LEU. In the meantime, the software changed, and the new version is not back compatible. There is no documentation available for the old version. I implemented a new set of input files based on the old ones, in a procedure of trial, error, feeling, and programming aesthetics. Also, improved knowledge about the core, obtained after the conversion, was also included. The new calculations reproduce the experimental data significantly better than the original calculations, contributing to the improvement of the quality of the service supplied by the reactor. They are also important to the making of decisions relative to the reactor operation, including future implementation of a new core configuration.
3	I assisted 38 receptions and visits to IST/ITN and the reactor, from secondary schools, professional training, different professional bodies, and the general public. Each visit takes from 30 minutes to 1 hour. The main result is the promotion of the awareness of the science done at IST/ITN amongst the public, and in particular amongst secondary school students.
4	I am member of the Scientific Commission of IST/ITN, representing the URSN, designated the 13 March 2012. The SC has competences defined in the Regulation of IST/ITN, and has assisted the Installing Commission of IST/ITN in several matters.
5	I collaborate informally in numerous grants of the Ion Beam Laboratory of UFA, analysing IBA data collected there. This work is particularly relevant because I am author of the most advanced code for IBA data analysis that allows extracting in efficient manner information of superior quality. The variety of systems and samples analysed leads to the permanent development and improvement of the code. This work led to many joint publications with the IBL.
6	I am one of the members of the IST/ITN team involved in the European project SPIRIT (11 labs in 8 countries). In particular, I was the sole responsible in the entire Europe-wide project team for Milestone "19: Standards for IBA data format are established (KT14)", and the main contributor to Deliverable "39: New codes available to analyse data from new detectors and experimental set-ups (KT14)". This work led to several publications.
7	I worked in the analysis of IBA data from JET samples. In each experimental run of one week, many hundreds of spectra are collected with different IBA techniques. The data analysis is not

	trivial, both in the complexity of the data, and in the sheer amount of data, orders of magnitude larger than in usual applications. This work led to several publications.
8	I worked in the analysis of data from samples from this project. This work led to several publications.
9	I worked in the analysis of data from samples from this project.
10	This IAEA project was finished in 2012. I wrote the global final report of the project, which shall be published as an IAEA TECDOC. This work also led to several publications in international refereed journals.

PAPERS

- N.P. Barradas, The width of an RBS spectrum revisited: influence of multiple scattering, *Nucl. Instrum. Methods Phys. Res. B*, 270, 44–46 (2012).
- J.M. Chappé, A.C. Fernandes, C. Moura, E. Alves, N. P. Barradas, N. Martin, J.P. Espinósa, F. Vaz, Analysis of multifunctional titanium oxycarbide films as a function of oxygen addition, *Surf. Coatings Tech.*, 206, 2525–2534 (2012).
- E. Alves, N. Franco, N.P. Barradas, B. Nunes, J. Lopes, A. Cavaleiro, M. Torrell, L. Cunha, F. Vaz, Structural and optical studies of Au doped titanium oxide films, *Nucl. Instrum. Methods Phys. Res. B*, 272, 61–65 (2012).
- P. Pedrosa, E. Alves, N.P. Barradas, P. Fiedler, J. Haueisen, F. Vaz, C. Fonseca, TiN_x coated polycarbonate for bio-electrode applications, *Corrosion Science*, 56, (49–57)2012).
- R.C. Adochite, D. Munteanu, M. Torrell, L. Cunha, E. Alves, N.P. Barradas, A. Cavaleiro, J.P. Riviere, E. Le Bourhis, D. Eyidi, F. Vaz, The influence of annealing treatments on the properties of Ag:TiO₂ nanocomposite films prepared by magnetron sputtering, *Appl. Surf. Sci.*, 258, 4028–4034 (2012).
- Nuno P. Barradas, E. Alves, Z. Siketić, I. Bogdanović Radović, Stopping power of He, C and O in TiO₂, *Nucl. Instrum. Methods Phys. Res. B*, 273, 22–25 (2012).
- Nuno P. Barradas, E. Alves, Z. Siketić, I. Bogdanović Radović, Stopping power of He, C and O in GaN, *Nucl. Instrum. Methods Phys. Res. B*, 273, 26–29 (2012).
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- S. Magalhães, N.P. Barradas, E. Alves, I.M. Watson, K. Lorenz, High precision determination of the InN content of Al_{1-x}In_xN thin films by Rutherford backscattering spectrometry, *Nucl. Instrum. Methods Phys. Res. B*, 273, 105–108 (2012).
- S. Sérgio, M.E. Melo Jorge, Y. Nunes, N.P. Barradas, E. Alves, F. Munnik, Incorporation of N in TiO₂ films grown by DC-reactive magnetron sputtering, *Nucl. Instrum. Methods Phys. Res. B*, 273, 109–112 (2012).
- F.H.M. Cavalcante, M.R. Gomes, A.W. Carbonari, L.F.D. Pereira, D.A. Rossetto, M.S. Costa, E. Alves, N.P. Barradas, N. Franco, L.M. Redondo, A.M.L. Lopes, J.C. Soares, Characterization of nanostructured HfO₂ films using RBS and PAC, *Nucl. Instrum. Methods Phys. Res. B*, 273, 195–198 (2012).
- J. Demeulemeester, W. Knaepen, D. Smeets, A. Schrauwen, C. M. Comrie, N. P. Barradas, A. Vieira, C. Detavernier, K. Temst, and A. Vantomme, In situ study of the growth properties of Ni-rare earth silicides for interlayer and alloy systems on Si(100), *J. Appl. Phys.*, 111, 043511 (13. pp) (2012).
- F. Macedo, F. Vaz, M. Torrell, R. T. Faria Jr., A. Cavaleiro, N. P. Barradas, E. Alves, K. H. Junge and B. K. Bein, TiO₂ coatings with Au nanoparticles analysed by photothermal IR radiometry, *J. Phys. D: Appl. Phys.*, 45, 105301 (8pp) (2012).
- J.M. Chappé, A.C. Fernandes, C. Moura, E. Alves, N.P. Barradas, N. Martin, J.P. Espinós, F. Vaz, Analysis of multifunctional titanium oxycarbide films as a function of oxygen addition, *Surf. Coatings Tech.*, 206, 2525–2534 (2012).
- S. R. C. Pinto, M. Buljan, A. Chahboun, M. A. Roldan, S. Bernstorff, M. Varela, S. J. Pennycook, N. P. Barradas, E. Alves, S. I. Molina, M. M. D. Ramos, and M. J. M. Gomes, Tuning the properties of Ge-

quantum dots superlattices in amorphous silica matrix through deposition conditions, *J. Appl. Phys.*, 111, 074316 (6 pp) (2012).

- E. M. F. Vieira, J. Martín-Sánchez, A. G. Rolo, A. Parisini, M. Buljan, I. Capan, E. Alves, N. P. Barradas, O. Conde, S. Bernstorff, A. Chahboun, S. Levichev, and M. J. M. Gomes, Structural and electrical studies of ultrathin layers with Si_{0.7}Ge_{0.3} nanocrystals confined in a SiGe/SiO₂ superlattice, *J. Appl. Phys.*, 111, 104323 (9 pp) (2012).
- M. Torrell, R.C. Adochite, L. Cunha, N.P. Barradas, E. Alves, M.F. Beaufort, Jean Paul Rivière, Albano Cavaleiro, S. Dosta, F. Vaz, Surface Plasmon Resonance Effect on the Optical Properties of TiO₂ Doped by Noble Metals Nanoparticles, *Journal of Nano Research*, 18-19, 177-186 (2012).
- J. Borges, N. Martin, N.P. Barradas, E. Alves, D. Eyidi, M.F. Beaufort, J.P. Riviere, F. Vaz, L. Marques, Electrical Properties of AlN_xO_y Thin Films Prepared by Reactive Magnetron Sputtering, *Thin Solid Films*, 520, 6709–6717 (2012).
- C. Jeynes, N. P. Barradas, E. Szilagy, Accurate Determination of Quantity of Material in Thin Films by Rutherford Backscattering Spectrometry, *Anal. Chem.*, 84, 6061-6069 (2012).
- S.R.C. Pinto, M Buljan, L. Marques, J. Martín-Sánchez, O. Conde, A. Chahboun, A. R. Ramos, N.P. Barradas, E. Alves, S. Bernstorff, M.M.D. Ramos, and M.J.M. Gomes, Influence of annealing conditions on the formation of regular lattices of voids and Ge quantum dots in an amorphous alumina matrix, *Nanotechnology*, 23, 405605 (9 pp) (2012).

COMMUNICATIONS

- *The Portuguese Research Reactor transnational cooperation activities*, N. P. Barradas, *Research Reactor Coalitions: Concerted actions in the Mediterranean Region*, Istanbul, Turkey, July 10-13 (2012), nominated talk.
- *The Portuguese Research Reactor*, N. P. Barradas, *Workshop on Establishing Decommissioning Plans and Managing the Transition Period between Operation and Decommissioning of Research Reactors*, IAEA, Vienna, Austria, November 5-9 (2012), nominated talk.

EDUCATION / THESES SUPERVISION

- International Evaluator for the South Africa's National Research Foundation: Evaluation of the research in the period 2005-2012 of Prof. C.M. Comrie, Department of Physics, University of Cape Town, South Africa, 2012.

PROJECTS

- *Tomografia elemental com análise com feixes de iões: prova do conceito*, FCT EXPL/FIS-NAN/0398/2012. Leading Institution: IST/ITN. Coordinator: N.P. Barradas (50%). Submitted, rejected, under appeal.

NAME: António Manuel da Silva de Nazareth Falcão

CATEGORY: Principal Researcher

ID NUMBER: 5345

R&D ACTIVITIES

Nº	Activity Description	R&D
1	Teaching	5% (eq.)
2	Coordination of the Training Centre	25%
3	Equipment development	20%
4	Hybrid glass-polymer systems research	30%
5	Renovation of the diffractometer DIDE	8%
6	Out-reaching science activities	7%
7	Other research related activities	5%
Total		100%

WORK SUMMARY

Nº	Work Summary and Main Achievements
1	<p>Teaching (activity performed since August in the framework of a protocol between the Higher School for Health Technology and IST)</p> <p>Invited Coordinator Professor at the Higher School for Health Technology coordinating and lecturing three courses on Mechanics and Biomechanics.</p>
2	<p>Coordination of the Training Centre</p> <p><i>Organization and coordination of education and training courses</i></p> <p>Four courses on radiation protection for professionals coordinating activities and/or operation equipment that make use or detect ionizing radiation, involving 200 professionals. Total received in 2012 amounts to 24409 EURO.</p> <p><i>b-learning Course</i></p> <p>Development, in collaboration with the company UnyLeya, of a demonstration prototype, aiming at launching a radiation protection course including e-learning modules complemented by in-class practical sessions and examination. The course is directed to professionals, but will be available for all interested in refreshing or acquiring knowledge in the use of ionizing radiation, and would be made available in all Portuguese speaking countries.</p>
3	<p>Equipment development - Innovation in gamma-cell designing</p> <p>Conception of a compact gamma irradiation equipment of the gamma-cell type, and design of a prototype making use of interchangeable ^{60}Co and ^{137}Cs irradiation sources was carried-out. The equipment will provide a very uniform and reproducible gamma flux in the sample chamber, and be innovative in allowing for controlled irradiation environment, namely closed circuit circulation of gases, temperature control and in-line analysis of radiation produces gaseous components.</p> <p>The equipment can be useful to studies in multiple domains:</p> <ul style="list-style-type: none"> (i) development/characterization of polymeric materials; (ii) development/characterization of hybrid materials; (iii) development/characterization of composite materials; (iv) radiobiology; (v) radiotherapy; (vi) radio-pharmacy; (vii) microbiology; (viii) sterilization studies <p>Moreover simpler gamma-cell equipment (using a Cs source) are routinely operated at hospitals to irradiate blood.</p> <p>In view of this, many institutions have expressed their support to the project and endorse it:</p> <ul style="list-style-type: none"> • Chemistry Dept., U.N. Lisboa • Chemical Eng. Dept., FCT of the U. Coimbra • Ceramics and Glass Dept., U. Aveiro • Portuguese Institute of Oncology - Lisbon • Transfusional Medicine Service - HGO • Histocompatibility Centre (South) • Radiation Protection and Security Unit (IST/ITN) • Radio-chemistry and Radio-pharmacy Group, (IST/ITN) • Radiation Technologies Group (IST/ITN) • CM Group and Polymer Lab. (IST/ITN)
4	<p>Hybrid glass-polymer systems research</p> <p>Synthesis and characterization of hybrid (MH) glass-polymer systems produced by gamma irradiation of the precursors (PDMS, TEOS, PrZr)</p> <p>Study of:</p> <ul style="list-style-type: none"> (i) influence of the polymer molecular weight (range 4200 g/mol – 43500 g/mol) on the

	<p>microstructure of the MH, specifically the size and fractal dimension of the oxide regions in systems 20 wt% PDMS - 73 wt% TEOS - 7 wt% PrZr;</p> <p>(ii) Characterization of the effect of increasing catalyst content in size and porosity of the oxide microscopic domains. Using (M_w PDMS = 43500 g/mol), systems: 33 wt% PDMS - (67-x)TEOs - xPrZr (x = 1, 2, 3 e 5 wt%) (25-x)PDMS - 75TEOS - xPrZr (x= 1.4, 2.9, 4.3 wt%) (50-x)PDMS - 50TEOS - xPrZr (x= 1.4, 2.9, 4.3, 5.7 wt%)</p> <p>(iii) Microstructural changes in MH prepared from precursors in weight percent composition (20wt%PDMS - 79wt%TEOS - 1wt% PrZr) followed by the addition of Ca (both solid and in solution). x $Ca_3(PO_4)_2$ (x=1, 3, 5, 10 wt%) solid x $Ca_3(PO_4)_2$ (x=1, 3, 10 wt%) dissolved</p> <p>Overall results: two articles published, two articles submitted for publication and two communications.</p>
5	<p>Renovation of the diffractometer DIDE</p> <p>The present situation of the diffractometer components and systems was evaluated. A solution for the damaged detection system was reached. A solution was defined, a budget for the renovation prepared. They are included in a document proposing a research programme, submitted to the Presidency of the CTN.</p>
6	<p>Out-reaching science activities</p> <p>Coordination at IST/ITN of the programme <i>Ocupação Científica em Férias</i> that gave the opportunity of high-school level students to participate for one or two weeks in on-going research activities – programme carried out in collaboration with the <i>Agência Ciência Viva</i>.</p> <p>Coordination of the programme of regular visits to the institution: 46 visits involving 1522 visitors (1197 high school students, 266 university students and 59 other visitants), in the framework of which 16 talks were given.</p> <p>Talks on ionizing radiation and its applications were given under request.</p> <p>Work to recover and renovate an interactive replica of a nuclear reactor, including a control simulator was carried-out.</p>
7	<p>Other research related activities</p> <p>On-going project collaboration and project proposal preparation collaboration: PTDC/CTM/101115/2008 – <i>Hybrid Materials for Biomedical Applications</i> Univ. Aveiro/ ITN - (February/2010 to February/2013)</p> <p><i>Hybrid Materials for Heterogeneous Catalysis (CATHY)</i>, submitted to FCT call for Scientific Research and Technological Development Projects – 2012. The evaluation was rated Outstanding but the Project was not recommended for funding.</p> <p><i>Enhancement of biopolymers by ionizing radiation processing (BioP-Rad)</i>, submitted to FCT call for Scientific Research and Technological Development Projects – 2012. The evaluation was rated Outstanding but the Project was not recommended for funding.</p> <p><i>Application of Ionizing Radiation for a Sustainable Environment</i>, Consolidation of research skills and resources project, submitted to FCT call for Scientific Research and Technological Development Projects – 2012. The Project was recommended for funding.</p>

PAPERS

- Ferreira L.M., Leal J.P., Rodrigues P.A., Alves L.C., Falcão A.N., Gil M.H., Characterization of PE-g-HEMA films prepared by gamma irradiation through nuclear microprobe techniques, *Radiation Physics and Chemistry*, 81, 1319-1323 (2012), doi:10.1016/j.radphyschem.2012.01.045.
- Lancastre J.J.H., Fernandes N., Margaça F.M.A., Miranda Salvado I.M., Ferreira L.M., Falcão A.N., Casimiro M.H., Study of PDMS conformation in PDMS-based hybrid materials prepared by gamma irradiation, *Radiation Physics and Chemistry*, 81, 1336-1340 (2012), doi:10.1016/j.radphyschem.2012.02.016.

COMMUNICATIONS

- *Evidence of Structural Order Recovery in LDPE Based Copolymers Prepared by Gamma Radiation*, L.M. Ferreira, J.P. Leal, M.H. Casimiro, C. Cruz, J.J.H. Lancastre, A.N. Falcão, *IRaP'2012 - 10th Meeting of the Ionizing Radiation and Polymers Symposium, Cracow, Poland, Oct 14-19 (2012)*, Talk.
- *On the Insights of the Hybrid Materials Microstructure at Nanoscale: A SANS Study*, J.J.H. Lancastre, N. Fernandes, F.M.A. Margaça, I.M. Miranda Salvado, L.M. Ferreira, A.N. Falcão, M.H. Casimiro, *IRaP'2012 - 10th Meeting of the Ionizing Radiation and Polymers Symposium, Cracow, Poland, Oct 14-19 (2012)*, Talk.

EDUCATION / THESES SUPERVISION

a) Invited Coordinator Professor at the Higher School for Health Technology coordinating and lecturing:

- One course on Mechanics.
- Two courses on Biomechanics.

b) Courses coordinated and organized:

- *Radiation Protection* – University of Algarve (25 attendants'), March 2012.
- *Ionizing Radiation and Monitoring Radioactivity in Industrial Scrap Materials* - CIRVER-SISAV – Chamusca, 30 attendants (April 2012).
- *Radiation Protection for Exposed Workers in Medical Practices* (2 courses in consecutive weeks)– CHTAM – Vila Real, 150 attendants overall (October 2012).

c) Other lectures:

- *Ionizing Radiation and Applications* – SISAV, (April 2012).
- *Ionizing Radiation - biologic effects and their applications* – Proença a Nova, (November 2012).

NAME: José Manuel Vieira Antunes

CATEGORY: Principal Researcher

ID NUMBER: 1738

R&D ACTIVITIES

Nº	Activity Description	R&D
1	Modelling and identification of flow turbulence excitations in nuclear fuel rods Project IVECO-2/CEA-4000533537/P5B61	30%
2	Analysis of the tuning of the Mafra Carillons Bells Project PTDC/EAT-MMU/104255/2008	15%
3	Identification of the unconstrained modes of a structure from dynamical tests performed under constrained configuration Project PTDC/EAT-MMU/104255/2008	15%
4	Dynamics of coupled string-body interaction systems using linear theory Project PTDC/FIS/103306/2008	15%
5	Dynamical behaviour of worn guitar strings Project PTDC/FIS/103306/2008	10%
6	Identification of non-linear contact forces in vibratory systems from remote	15%

	vibratory measurements Project of Transnational Cooperation FCT/Tunisia "Fault detection in rotating machinery"	
Total		100%

WORK SUMMARY

N°	Work Summary and Main Achievements
1	<p>Modelling and identification of flow turbulence excitations in nuclear fuel rods: Project IVECO-2/CEA-4000533537/P5B61</p> <p>This work is being performed in the context of a research contract with the French Commissariat à l'Energie Atomique et aux Energies Alternatives, CEA/Saclay, with whom the Applied Dynamics Laboratory (ADL) has performed collaborative research, funded by CEA, for more than 25 years and through more than twenty research contracts. The main point of this project was to devise sophisticated identification methods in order to extract information on the spatial distribution and on the spectral content of flow turbulence excitations within the bundles of nuclear fuel rods. This topic is essential for the success of predictive analysis under flow induced vibration. During 2012, in collaboration with colleagues from CEA, we devised a general strategy to identify the turbulence excitation from measurements of the rod response vibrations, a very delicate inverse problem. Also, we developed a new technique for the time-domain simulation of realistic turbulence excitations, which is more effective than previous methods. From our collaborative efforts, two papers have been published in Journal of Fluids and Structures and two papers were published in the proceedings of a peer-reviewed international conference (FIV 2012, Dublin, Ireland). From the results produced so far, three conference papers, as well as another journal publication, are scheduled for 2013.</p>
2	<p>Analysis of the tuning of the Mafra Carillons Bells: Project PTDC/EAT-MMU/104255/2008</p> <p>This work is aimed at analysing the tuning of the Mafra carillons bells, which form the largest surviving 18th century carillons in Europe. It is part of a multidisciplinary FCT research project in partnership with the Music Department from the Universidade Nova de Lisboa. My participation in this project, beyond the coordination of the IST/CTN tasks, has been in supporting my colleague Dr Vincent Debut and his MSc student Miguel Carvalho on the physical and mathematical aspects connected with the vibrations of bells, on the development of suitable identification techniques to extract the bell vibration modes from experiments, as well as on devising optimal strategies to infer their tuning status and tuning errors, with respect to current historical knowledge on XVIIIth Century tempered scales. From this work, beyond the Miguel MSc thesis supervised by Dr Debut successfully presented at UNL/FCSH, a conference paper as well as a journal paper will be submitted for publication in 2013.</p>
3	<p>Identification of the unconstrained modes of a structure from dynamical tests performed under constrained configuration: Project PTDC/EAT-MMU/104255/2008</p> <p>As for the previous activity, this one is also connected with the FCT research project on the tuning of the Mafra carillons. The problem in hand was to identify the original modes of several large bells which, for security reasons were lowered from their mounts, becoming provisionally supported by scaffolds which constrain the bell rim at several locations, leading to very different constrained modes. To infer the original bell resonances from the constrained bell modes is a very difficult inverse problem, which we attempted to solve using suitable analytical formulations coupled with an optimization scheme. In collaboration with Dr Debut, we devised a new method to deal with the identification problem, which has been successfully tested using numerical simulations of the bell dynamics. We are now, with the help of Miguel Carvalho, developing a laboratory experiment to validate our identification technique. From the results obtained so far, a paper was presented at an international conference (ICSV 2012, Vilnius, Lithuania) and two more papers are scheduled for presentation in 2013.</p>

4	<p>Dynamics of coupled string-body interaction systems using linear theory: Project PTDC/FIS/103306/2008</p> <p>The self-excited motion regimes in systems subjected to moving friction forces are typically nonlinear and complex. Such systems are ubiquitous in nature and industry, the friction noise squeal and periodic sounds produced by bowed instruments being two representative examples in very different fields. Friction-excited systems are usually addressed through lengthy time-domain computations, which often provide more details than insight. In this activity, which I and Dr Vincent Debut have pursued in the context of a FCT project on the dynamics of string instruments, we intended to discuss the gross topological features of bowed string dynamics, based on the scenarios stemming from the complex modes of a linearized model. We have therefore developed such a model, and hence various parametric stability plots of the various string modes, with interesting conclusions in relation with the post-stable nonlinear limit cycles of the string motion regimes. From this work an invited paper was presented at an international conference (Acoustics 2012, Nantes, France) and two journal papers are currently under review.</p>
5	<p>Dynamical behaviour of worn guitar strings: Project PTDC/FIS/103306/2008</p> <p>In the framework of the same project, and also with Dr Debut, we have supervised the work at LDA of the research student Miguel Marques on modelling the perturbed dynamics of worn guitar strings, for which local defects of mass arise (due to progressive string wear or else to metal deposit from the instrument frets). It is well known to guitar players that, as string wears, the radiated sound changes in nature, and the theoretical model that we developed was successful in explaining important dynamical features connected with the string wear process. Our model was exploited both by performing an extensive statistical analysis of the string perturbed modes, but also through time-domain numerical simulations, as well as the sounds hence produced. We have shown, in particular, that worn strings loose some of their original sound brightness due to localization phenomena in the higher order modes, which prevents some high-frequency energy to be conveyed through the instrument bridge. From this work a paper was presented at an international conference (ICSV 2012, Vilnius, Lithuania). Another conference paper and a journal publication will be offered in 2013.</p>
6	<p>Identification of non-linear contact forces in vibratory systems from remote vibratory measurements</p> <p>Project of Transnational Cooperation FCT/Tunisia "Fault detection in rotating machinery"</p> <p>Many industrial components are prone to vibro-impact phenomena, due to support gaps or some other form of intermittent contacts. At LDA we have been working at length on this problem for many years and, in the framework of this bilateral international project, we have addressed the problem of impact force identification, for multi-supported systems with gaps. This is a quite difficult problem and, again with Dr Debut, we have devised a constrained iterative scheme to isolate and progressively refine the force identifications, using the dynamical information provided by a small number of vibrating transducers. Results from our preliminary work, which was anchored so far on numerical simulations, are encouraging. A paper was produced for an international conference (CMMNO 2012, Hammamet, Tunisia) whose proceedings have been published as a book by Springer.</p>

PUBLICATIONS

Journal

- P. Piteau, X. Delaune, J. Antunes, L. Borsoi, "Experiments and computations of a loosely supported tube in a rigid bundle subjected to single-phase flow", *Journal of Fluids and Structures*, Vol. 28, 56-71 (2012).
- P. Piteau, J. Antunes, "A theoretical model and experiments on the nonlinear dynamics of parallel plates subjected to laminar/turbulent squeeze-film forces", *Journal of Fluids and Structures*, Vol. 33, 1-18 (2012).

Papers in peer-reviewed conference proceedings

- V. Debut, J. Antunes, "Iterative method for the remote identification of impact forces at multiple clearance supports using few vibratory measurements". In *Condition Monitoring of Machinery in Non-Stationary Operations*, Springer, ISBN 978-3-642-28767-1 (2012).
- V. Debut, J. Antunes, O. Inácio, "What can we learn about the wolf phenomenon from a linearized analysis?". Invited paper, in *Proceedings of "Acoustic 2012" Conference*, 23-27 April 2012, Nantes, France.
- J. Antunes, L. Borsoi, P. Piteau, X. Delaune, "The equivalent spectrum concept for turbulence conveying excitations", *10th International Conference on Flow-Induced Vibration & Flow-Induced Noise (FIV 2012)*, 2-6 July 2012, Dublin, Ireland.
- L. Borsoi, P. Piteau, X. Delaune, J. Antunes, "Simple shock oscillator for modelling a loosely supported tube subjected to turbulence and fluid-elastic forces", *10th International Conference on Flow-Induced Vibration & Flow-Induced Noise (FIV 2012)*, 2-6 July 2012, Dublin, Ireland.
- V. Debut, M. Carvalho, J. Antunes, "Recovering the unconstrained modes of axisymmetric structures from measurements under constrained conditions", in *Proceeding of the 19th International Congress on Sound and Vibration (ICSV-19)*, 8-12 July 2012, Vilnius, Lithuania.
- M. Marques, O. Inácio, V. Debut, J. Antunes, "On the dynamical behaviour of worn guitar strings", in *Proceeding of the 19th International Congress on Sound and Vibration (ICSV-19)*, 8-12 July 2012, Vilnius, Lithuania.

Scientific reports

- J. Antunes, "IVECO - Identification des sources d'excitation par la turbulence des écoulements: Méthodologie générale d'identification à partir d'un ensemble de mesures vibratoires", *Report IST/CTN/URSN/LDA-Dec12/1*.
- M. Marques, J. Antunes, V. Debut "Guitar strings loaded with localized masses", *Report IST/CTN/URSN/LDA-Dec12/2*.

COMMUNICATIONS

- *Identification des excitations par la turbulence des écoulements à partir des mesures des réponses vibratoires par méthodes inverses*, J. Antunes. *Commissariat à l'Energie Atomique, Centre d'Études de Saclay*, France, 15 February 2012, Seminar.
- *Past, present and future of flow-induced vibrations*, J. Antunes. *10th International Conference on Flow-Induced Vibration & Flow-Induced Noise (FIV 2012)*, Dublin, Ireland, 2-6 July 2012, Keynote Closure Talk.
- *Research activities at the Applied Dynamics Laboratory*, J. Antunes. *Workshop at the IST Campus Tecnológico e Nuclear*, Sacavém, Portugal, 14 September 2012, Presentation.
- *Identification des forces non-linéaires de contact agissant sur les structures vibrantes à partir de réponses vibratoires mesurées*, J. Antunes and V. Debut. *Laboratoire d'Acoustique de l'Université du Maine*, Le Mans, France, 27 November 2012, Seminar.

EDUCATION / THESES SUPERVISION

Course lectures

- *Vibrations des structures non-linéaires*, R.J. Gibert, J. Antunes, D. Broc, C. Cremona, A. Millard, C. Stoisser, Collège de Polytechnique, Paris, France, 13-15 March (2012).

Student supervision

- Co-supervision of the research work of the research student Miguel Marques at LDA on the dynamics of worn strings and also on the coupled dynamics of a string/plate, in the framework of project PTDC/FIS/103306/2008.

- Co-supervision of part of the MSc research work performed by Elisa Costa at LDA on the modal identification of guitar strings, in the framework of project PTDC/FIS/103306/2008.

PhD juries

- Reporter jury member for the PhD thesis of Benjamin Elie, *Caractérisation vibratoire et acoustique des instruments à cordes: application à l'aide à la facture instrumentale*, Université du Maine, Le Mans, France, 26 November 2012.
- Reporter jury member for the PhD thesis of Benoit Theckes, *Amortissement par le branchement des structures flexibles: Une approche bio-inspirée des arbres*, École Polytechnique, Paris, France, 22 October 2012.
- Jury member for the PhD thesis of Sami Karkar, *Bifurcation des régimes périodiques dans les instruments auto-oscillants*, Université de Provence Aix-Marseille, Marseille, France, 10 January 2012.

PROJECTS

- *The Mafra carillons: Development of Advanced Methods in Music Acoustics for Tuning and Restoration*. FCT project PTDC/EAT-MMU/104255/2008. Leading Institution: Universidade Nova de Lisboa/Faculdade de Ciências Sociais e Humanas. IST/CTN Coordinator: J. Antunes (30%).
- *Dynamical Analysis and Improvements on the Portuguese Guitar Strings and String/Body Interaction*. FCT project PTDC/FIS/103306/2008. Leading Institution: Instituto Superior Técnico/Departamento de Engenharia Mecânica. IST/CTN Coordinator: J. Antunes (25%).
- *Inovative Shape Optimized Multi-Modal Resonators for Acoustical Control*. FCT project submission PTDC/EMS-SIS/2595/2012. Leading Institution: Instituto Superior Técnico/Campus Tecnológico e Nuclear. Principal Coordinator: J. Antunes. Project submission not recommended for funding.

CONTRACTS

- Research Contract Ref. CEA-4000533537/P5B61 with IST/ADIST, "IVECO 2 - Modelling and identification of flow turbulence excitations in nuclear fuel rods", Commissariat à l'Énergie Atomique et aux Énergies Alternatives, Saclay, France. Duration 1 year. 18000 euros.

CONFERENCE ORGANIZATION / COMMITTEES

- Committee member of the French *Agence d'Évaluation de la Recherche et de l'Enseignement Supérieur (AERES)* for the scientific evaluation of *IRCAM (Institut de Recherche et Coordination Acoustique/Musique)*, attached to Centre Pompidou for Contemporary Art, Paris, France), *Unité Mixte de Recherche (UMR 9912)*, which associates the French CNRS, Université Pierre et Marie Curie and the Ministry of Culture. Evaluation meetings on 19-20 November 2012 at the IRCAM laboratories. The committee evaluation report was sent to AERES on 3rd January 2013.
- Member of the Scientific Council of *LAMSID – Laboratoire de Mécanique des Structures Industrielles Durables, Unité Mixte de Recherche (UMR 2832)*, partenariat EDF/CNRS/CEA, Clamart, France.
- Member of the Scientific Committee of the 2nd *International Conference on Condition Monitoring of Machinery in Non-Stationary Operations*, Hammamet, Tunisia, 26-28 March 2012.
- Member of the Scientific Committee of the 10th *International Conference on Flow-Induced Vibration & Flow-Induced Noise*, Dublin, Ireland, 2-6 July 2012.

COLLABORATIONS

- C. Besnainou, LAM, Université Pierre et Marie Curie, Paris, France, 20-23 January 2012. Development of a realistic dynamical string model.
-

NAME: Andreas Kling

CATEGORY: Auxiliary Researcher with habilitation

ID NUMBER: 5353

R&D ACTIVITIES

Nº	Activity Description	R&D
1	Radioprotection at the Portuguese Research Reactor	90%
2	Production of ^{163}Ho for the direct determination of the neutrino mass	5%
3	Characterization of materials used in the dark matter search experiment SIMPLE	4%
4	Formation of reactor operators and radiation protection technicians	1%
Total		100%

WORK SUMMARY

Nº	Work Summary and Main Achievements
1	<p>The function of a Responsible for the Radiological Protection of the URSN obliges to dedicate the vast majority of the time available to activities related to the assurance and improvement of the protection against ionizing radiation at the RPI complementing the activities and services supplied by UPSR.</p> <p>The main part of the work is dedicated to routine tasks as: 1) supervision of the work of the technicians in the Radioprotection Group of the reactor; 2) preparation of annual and semi-annual reports on the radiological protection of the RPI with detailed analysis of all data collected manually and by automatic systems; 3) preparation, supervision and participation in the annual maintenance and calibration of the radiation protection systems; 4) substitution of the radiological protection technicians during absence, 5) Preparation of the shipment of material irradiated at RPI etc.</p> <p>With regard to the improvement of the radiological control the focus in 2012 was on the revision and elaboration of the future Safety Analysis Report, specifically the revisions of the Chapters 11 (Reactor Utilization), 12 (Operational Radiological Safety) and 20 (Internal Emergency Plan of RPI). The elaboration of a written calibration procedure for the aerosol monitor ABPM201L completed the series of such manuals.</p>
2	<p>The project PTDC/FIS/116719/2010 intends – as part of the MARE experiment – to determine the neutrino mass directly from the decay spectrum of the isotope ^{163}Ho. This isotope has one of the lowest Q-values (2.15 keV) for electron capture known and is therefore an excellent candidate.</p> <p>Due to its long half-life (4570 y) the production of this isotope is a challenging task. After a positive evaluation of the conditions of the production at the RPI using the reaction $^{162}\text{Er}(n,\gamma)^{163}\text{Er} \rightarrow ^{163}\text{Ho}$ a first lot of erbium oxide (12.5 mg) enriched to 39.5% in ^{152}Er has been irradiated for 120 hours at RPI. The activity obtained (≈ 20 kBq ^{163}Ho) has been incorporated into cryogenic micro-calorimeters which serve for testing the method. For spectra with sufficient statistics for the detection of deviations in the spectrum endpoint – and with this the neutrino mass or an upper limit - more ^{163}Ho has to be produced at RPI during 2013.</p>
3	<p>In the dark matter search Project SIMPLE (Superheated Instrument for Massive Particle Experiments) suppression of neutron background has high priority. The characterization of materials and their impurities is therefore crucial.</p> <p>Specifically the hydrogen content of the wooden support that influences the moderation of fast neutrons has been determined using Elastic Recoil Detection. The measurements have been performed with small charge intervals (30 nC) to characterize H loss during measurement and using mylar and kapton as reference standards. The result (45.6 at.% H) matched the value indicates – as expected – a well dried wood.</p> <p>Another important issue has been the determination of the exact boron content of borosilicate glass used in the detectors since the reactions $^{10}\text{B}(\alpha,n)^{13}\text{N}$ and $^{11}\text{B}(\alpha,n)^{14}\text{N}$ induced by alphas stemming from U, Th and their decay products is an important neutron source. Measurements combining Non-Rutherford Elastic Backscattering of protons and Nuclear Reaction Analysis with the $^{11}\text{B}(p,\alpha)2\alpha$ reaction allowed to determine the boron content to 6.81 at.%.</p>

	The experimental results enabled to refine the calculations on the expected neutron background leading to an excellent agreement between observation and calculus.
4	Besides steady training during normal work hours an annual refreshing course for the operators and radiological technicians is held. As usual one of the modules of the course was dedicated specifically to a radiological protection topic (Radiation monitoring equipment at RPI). Due to the general interest of this topic the module was also attended by students and other URSN staff and complemented by practical exercises.

PAPERS

- A. Kling, The refurbished CASSIS code for channelling simulations, *Nuclear Instruments and Methods in Physics Research B*, 273 88-90 (2012), doi:10.1016/j.nimb.2011.07.046.
- J.G. Marques, A. Kling, Radioactive Waste from Research Reactor Operation and Decommissioning, Chapter 2 in '*Radioactive Waste: Sources, Types and Management*', S. Yuan, W. Hidaka (eds.), Nova Science Publishers, Hauppauge, N.Y., 2012, ISBN: 978-1-62100-188-1, pp. 41-76.
- M. Felizardo, T.A. Girard, T. Morlat, A.C. Fernandes, A.R. Ramos, J.G. Marques, A. Kling, J. Puibasset, M. Auguste, D. Boyer, A. Cavaillou, J. Poupenny, C. Sudre, H.S. Miley, R.F. Payne, F.P. Carvalho, M.I. Prudêncio, A. Gouveia, R. Marques, Final Analysis and Results of the Phase II SIMPLE Dark Matter Search, *Physical Review Letters*, 108 (2012) Art. No. 201302, doi:10.1103/PhysRevLett.108.201302.

NAME: Ana Rita Lopes Ramos Wahl

CATEGORY: Auxiliary Researcher

ID NUMBER: 5352

R&D ACTIVITIES

Nº	Activity Description	R&D
1	Management	80%
2	Collaboration in the SIMPLE Experiment	20%
Total		100%

WORK SUMMARY

Nº	Work Summary and Main Achievements
1	<p>My main role in the Operation and Exploitation Group of URSN is to act as Reactor Supervisor of the Portuguese Research Reactor (RPI). The duties and responsibilities of the Supervisor are described in the <i>Despacho</i> 10-A/MCT/96, published in <i>Diário da República, II série</i>, nº 62 of March 13, 1996. The Supervisor ensures that the Reactor operates in accordance with the Operation Limits and Conditions (OLC) imposed by the licensing authority and with national legislation relating to radiation protection and nuclear safety. My work in 2012 included:</p> <p>a) Receiving, analysing and processing all irradiation requests for the Reactor. Irradiation requests are analysed in order to check compliance with the limits established in the OLC and with applicable Rules of Operation;</p> <p>b) Daily management and supervision of the Reactor Operators' work, including: a) quality control of verifications and measurements related to maintenance procedures (daily, weekly and monthly) and Reactor start-up/shut-down procedures (daily); b) in case of lack of personnel, acting as Operator or Radiation Protection Technician, in order to ensure proper functioning of the service and compliance with safety regulations;</p> <p>c) Development of procedures for routine and non-routine actions in the Reactor, including manipulation of experiments, instrument calibration, core interventions and emergency procedures (relating to the latter, in 2012 I attended the course: "<i>Training Course on Preparedness and Response for Nuclear and Radiological Emergencies</i>", 1-5 October 2012, SCK.CEN, Mol, Belgium);</p> <p>d) Maintenance and verification of the records (paper and electronic) required by the OLC;</p>

	<p>e) Supervision of all preventive and curative maintenance in the Reactor, including programming of activities, acquisition of necessary equipment or materials, personal supervision of the work (when I am not doing it myself), final assessment of equipment performance after maintenance and writing of maintenance records and reports;</p> <p>f) Ensuring the continuous training of the Reactor Operators (specific annual retraining and on the job training).</p>
2	<p>The SIMPLE (<i>Superheated Instrument for Massive ParticLe Experiments</i>) experiment is dedicated to the direct search for dark matter, in particular WIMPS (<i>Weekly Interacting Massive Particles</i>). In 2012 the activities were supported by two FCT funded projects: PTDC/FIS/115733/2009 (Phase II) and PTDC/FIS/121130/2010 (Phase III). Phase II ended in 2012, resulting in a contour minimum of $\sigma_p=5.7\times 10^{-3}$ pb at 35 GeV/c² in the spin-dependent sector of WIMP proton interactions, the most restrictive to date for $M_w\leq 60$ GeV/c² from a direct search experiment and overlapping, for the first time, with results previously obtained only indirectly. Phase III started in 2012 and aims at building a new prototype detector, currently being developed at IST/ITN, which will be deployed at the experiment's underground laboratory at LSBB (Laboratoire Souterrain à Bas Bruit, Rustrel-Pays d'Apt. France) during 2013. In 2012 SIMPLE published two <i>Phys. Rev. Letters</i>' papers and two conference proceedings.</p>

PAPERS

- M. Felizardo, T.A. Girard, T. Morlat, A.C. Fernandes, A.R. Ramos, J.G. Marques, A. Kling, J. Puibasset, M. Auguste, D. Boyer, A. Cavaillou, J. Poupény, C. Sudre, H.S. Miley, R.F. Payne, F.P. Carvalho, M.I. Prudêncio, A. Gouveia, R. Marques, Final Analysis and Results of the Phase II SIMPLE Dark Matter Search, *Physical Review Letters*, 108, 201302, doi:10.1103/PhysRevLett.108.201302.
- T.A. Girard, M. Felizardo, A.C. Fernandes, J.G. Marques, A.R. Ramos, Reply to Comment on First Results of the Phase II SIMPLE Dark Matter Search, *Physical Review Letters*, 108, 259002 (2012), doi:10.1103/PhysRevLett.108.259002.
- S.R.C. Pinto, M. Buljan, L. Marques, J. Martín-Sánchez, O Conde, A. Chahboun, A. R. Ramos, N. P. Barradas, E. Alves, S. Bernstorff, J. Grenzer, A. Mücklich, M. M. D. Ramos and M. J. M. Gomes, Influence of annealing conditions on the formation of regular lattices of voids and Ge quantum dots in amorphous alumina matrix, *Nanotechnology* 23 (2012) 405605, doi:10.1088/0957-4484/23/40/405605.
- M. Felizardo, T.A. Girard, T. Morlat, A.C. Fernandes, A.R. Ramos, J.G. Marques, Recent Results from the SIMPLE Dark Matter Search, Proceedings 12th International Conference on Topics in Astroparticle and Underground Physics, Munich, September 2011, *Journal of Physics: Conference Series*, 375, 012011 (2012), doi:10.1088/1742-6596/375/1/012011.
- T.A. Girard, J. Puibasset, M. Felizardo, A.C. Fernandes, A.R. Ramos, J.G. Marques, Prospects for a Phase III SIMPLE Measurement Proceedings 12th International Conference on Topics in Astroparticle and Underground Physics, Munich, September 2011, *Journal of Physics: Conference Series*, 375, 012017 (2012), doi:10.1088/1742-6596/375/1/012017.

COMMUNICATIONS

- M. Chiari, D. Abriola, N. P. Barradas, I. Bogdanovic-Radovic, A. F. Gurbich, C. Jeynes, M. Kokkoris, M. Mayer, A. R. Ramos, L. Shi and I. Vickridge, Nuclear Cross-Sections Data for Ion Beam Analysis, IonBeams12 – Multidisciplinary Applications of Nuclear Physics with Ion Beams, 6-8 June 2012, Laboratori Nazionali de Legnaro (Padova), Italy. Communication by M. Chiari.

NAME: Ana Cristina Fidalgo Palma Fernandes

CATEGORY: Auxiliary Researcher (*Ciência 2008*)

ID NUMBER: 251

R&D ACTIVITIES

Nº	Activity Description	R&D
1	Participation in the SIMPLE collaboration for direct dark matter search. (Exploitation of the current SIMPLE measurement, FCT, PTDC/FIS/115733/2009 (2011-2012) and Initiation of a Phase III SIMPLE dark matter search, FCT, PTDC/FIS/121130/2010 (2012). Coordinator: T.A: Girard, Centro de Física Nuclear da Universidade de Lisboa)	85%
2	Reactor dosimetry	15%
Total		100%

WORK SUMMARY

Nº	Work Summary and Main Achievements
1	<p>The participation in the “background sector” of SIMPLE Phase II involved Monte Carlo simulations (MCNP code) of the neutron-induced background signal for Stage 2 of the experiment (2010-2011), aiming at (i) a further reduction of the background relatively to previous Stage 1 (2009-2010) via an improved shielding and (ii) an increased accuracy of the background estimate using a complete set of experimental data regarding material radio-assays and the elemental composition of critical materials (namely H in wood and B in glass).</p> <p>Data requirements were identified; the initial contact within IST/ITN towards U and Th quantification by neutron activation analysis, as well as wood and glass characterization using ion beams was established; corresponding sample acquisition and distribution was coordinated (the experiment site is located in France).</p> <p>The calculated neutron-induced background signal is $0.333 \pm 0.001(\text{stat.}) \pm 0.038(\text{syst.})$ cts/kg-d, which is 3 times lower than the revised background for Stage 1. A major (98%) contribution for the background originates from the borosilicate glass used in the detector container. A substantial background reduction for the subsequent SIMPLE Phase III (in preparation) is being planned based on low-activity containers and improved water radio-purity.</p>
2	<p>The neutron dosimetry activities in the Portuguese Research Reactor were:</p> <p>(i) Participation in a round-robin intercomparison for dosimetry measurements promoted by the European Workgroup in Reactor Dosimetry. A set of activation detectors was measured with respect to activity and mass. Results have been reported and submitted to the EWGRD from which there is indication that the round-robin has been successful.</p> <p>(ii) Coordination of the epithermal neutron beam dosimetry for Monte Carlo simulations (by D. Beasley, URSN). Inconsistencies in previous data motivated revised measurements for the 5 cm beam diameter. The localization of the radiation beam by radiography demonstrated a shift from the shutter axis to be considered in the conduction of the measurements (collaboration with J. Santos and A. Ramos, URSN). At 110 cm from the beam shutter, neutron fluence rates (in $\text{cm}^{-2}\text{s}^{-1}$) at 1 MW reactor power are: $\phi_0=4.9\text{E}6$ (conventional thermal); $\theta=2.2\text{E}5$ (epithermal per unit lethargy); $\phi_f=8\text{E}5$ (fast >1 MeV).</p> <p>(iii) Microdosimetry for boron neutron capture (collaboration with F. Marques, UCQR). With a preliminary observation that novel boron compounds can target cell nuclei, Monte Carlo simulations of the energy deposited in a cell model were initiated.</p>

PAPERS

- M. Felizardo, T.A. Girard, T. Morlat, A.C. Fernandes, A. Kling, A.R. Ramos, J.G. Marques, M. Auguste, D. Boyer, A. Cavaillou, J. Poupenny, C. Sudre, J. Puibasset, H.S. Miley, R.F. Payne, F.P. Carvalho, M.I.

Prudêncio, R. Marques, Final Analysis and Results of the Phase II SIMPLE Dark Matter Search, *Physical Review Letters*, 108, 201302/1-5 (2012), doi: 10.1103/PhysRevLett.108.201302.

- T.A. Girard, M. Felizardo, A.C. Fernandes, J. G. Marques, A. R. Ramos, Reply to comment of C.E. Dahl et al, *Physical Review Letters*, 108, 259002/1-2 (2012), doi: 10.1103/PhysRevLett.108.259002.
- A.C. Fernandes, M. Felizardo, T.A. Girard, A. Kling, A.R. Ramos, J.G. Marques, M.I. Prudêncio, R. Marques, F.P. Carvalho, Neutron background estimates in GESA, *Proc. 4th Inter-Disciplinary Underground Science and Technology Conference (i-DUST2012)*, Apt, France, May 9-11 (2012) (accepted).
- M. Felizardo, T.A. Girard, A.C. Fernandes, T. Morlat, J. Puibasset, A.R. Ramos, J.G. Marques, A. Kling, F.P. Carvalho, M.I. Prudêncio, A. Gouveia, R. Marques, M. Auguste, D. Boyer, A. Cavaillou, J. Poupenny, C.Sudre, The SIMPLE dark matter search: present and future, *Proc. 4th Inter-Disciplinary Underground Science and Technology Conference (i-DUST2012)*, Apt, France, May 9-11 (2012) (accepted).
- T.A. Girard, J. Puibasset, M. Felizardo, A.C. Fernandes, A.R. Ramos, J.G. Marques, Prospects for a Phase III SIMPLE Measurement, *Journal of Physics Conference Series*, 375, 012017 (2012), doi: 10.1088/1742-6596/375/1/012017.

COMUNICATIONS

- *Neutron background estimates in GESA*, A.C. Fernandes, M. Felizardo, T.A. Girard, A. Kling, A.R. Ramos, J.G. Marques, M.I. Prudêncio, R. Marques, and F.P. Carvalho, *4th Inter-Disciplinary Underground Science and Technology Conference (i-DUST2012)*, Apt, France, May 9-11 (2012), Oral Presentation.
- *The SIMPLE dark matter search: present and future*, M. Felizardo, T.A. Girard, A.C. Fernandes, T. Morlat, J. Puibasset, A.R. Ramos, J.G. Marques, A. Kling, F.P. Carvalho, M.I. Prudêncio, A. Gouveia, R. Marques, M. Auguste, D. Boyer, A. Cavaillou, J. Poupenny, and C.Sudre, *4th Inter-Disciplinary Underground Science and Technology Conference (i-DUST2012)*, Apt, France, May 9-11 (2012), Oral Presentation (by M. Felizardo).

PROJECTS

- *Inovative measurement of alpha particle contamination in integrated circuits - a contribution to the assessment of intrinsic soft error rates*, FCT, EXPL/EEI-ELC/0654/2012 (not funded).

COLLABORATIONS

- EWGRD, European Workgroup on Reactor Dosimetry, Jun-Dec. 2012, Round-robin Intercomparison of Dosimetry Measurements.

NAME: Daniel Beasley

CATEGORY: Auxiliary Researcher (*Ciência 2008*)

ID NUMBER: 25488

R&D ACTIVITIES

Nº	Activity Description	R&D
1	Project: PTDC/FIS/115089/2009 – tomo3d	20%
Total		20%

WORK SUMMARY

Nº	Work Summary and Main Achievements
1	A combination of simultaneous Proton Induced X-Ray Emission Tomography (PIXE-T), Scanning Transmission Ion Microscopy Tomography (STIM-T) and Rutherford Backscattering Spectrometry (RBS) can produce 3D quantitative elemental maps with a resolution on the micron scale. To reconstruct complex datasets, iterative procedures are usually applied, which is very computer-intensive. A GPU-accelerated PIXE-T/STIM-T simulation and

	reconstruction software has been developed enabling rapid simulation and reconstruction of data, simulating X-ray attenuation in 3D, and analysing and displaying the results. The data can be reconstructed using either filtered back projection, MLEM or a modified version of DISRA, an iterative algorithm used for PIXE-T. A phantom and was simulated and the results reconstructed.
2	A new neutron irradiation chamber has been designed for the purpose of multi-elemental Prompt Gamma Neutron Activation Analysis (PGNAA). Based upon simulations using MCNP, the new design which will result in significantly lower background radiation at the proposed detector position. It is proposed to fill the current chamber with shielding material and to form a collimator which extends through the back of the current chamber. A new sample chamber, detector port and beam stop are constructed behind the existing beam stop. This lowers the beam flux however the detector can be placed much closer to the sample and there is significantly less background radiation. A further benefit is that access to the proposed sample chamber is much easier: currently a crane is required to remove the lid of the chamber and access the sample holder. Two papers have prepared with the results of measurements, simulations and dose calculations.

PAPERS

- D.G. Beasley, A.C. Marques, L.C. Alves, R.C. da Silva, GPU-Accelerated Reconstruction of Proton Induced X-Ray Emission Tomography Data, *Radiation Physics and Chemistry* (2012). *Submitted*.
- D.G. Beasley, A.C. Marques, L.C. Alves, R.C. da Silva, Fast Simulation of Proton Induced X-Ray Emission Tomography Using CUDA, *Nuc. Inst. and Meth A.* (2012). *Accepted for publication*.
- A.C. Marques, M.M.F.R. Fraga, P. Fontec, R. Ferreira Marques, D. Beasley, L.C. Alves, R.C. da Silva, New gas detector setup for on-axis STIM tomography experiments, *Nuc. Inst. and Meth A.* (2012). *Accepted for publication*.
- A.C. Marques, D.G. Beasley, L.C. Alves, R.C. da Silva, Selected pre-processing methods to STIM-T projections, *Computational Modelling of Objects Represented in Images III: Fundamentals, Methods and Applications* (2012) 377.

COMMUNICATIONS

- D.G. Beasley, A.C. Marques, L.C. Alves, R.C. da Silva, GPU-Accelerated Reconstruction of Proton Induced X-Ray Emission Tomography Data, *12th International Symposium on Radiation Physics*, Rio de Janeiro, Brazil, 7-12 October (2012), Poster.
- D.G. Beasley, THE DEVELOPMENT OF A NEW IRRADIATION CHAMBER AT THE PORTUGUESE RESEARCH REACTOR , *12th International Symposium on Radiation Physics, Rio de Janeiro, Brazil, 7-12 October* (2012), Poster.
- D.G. Beasley, A.C. Marques, L.C. Alves, R.C. da Silva, Fast Simulation of Proton Induced X-Ray Emission Tomography Using CUDA *13th International Conference on Nuclear Microprobe Technological Applications (ICNMTA), Lisbon, Portugal, 22-27 July* (2012), Poster.

PROJECTS

- *Micro-tomografia em amostras e células biológicas por raios-X característicos excitados por prótons em combinação com AAN e mapeamento elementar 2D e 3D por PIXE*, PTDC/FIS-OPT/3035/2012. IST/ITN Coordinator: Daniel Beasley (50%).

NAME: Marco Antonio Stanojev Pereira

CATEGORY: Auxiliary Researcher (*Ciência 2008*)

ID NUMBER: 25495

R&D ACTIVITY

Nº	Activity Description	R&D
1	Diagnosis, decontamination and conservation of cultural heritage: neutrons and ionizing radiation in artwork (RADIART).	40%

2	Analysis of a gold solidus of roman emperor Valentinian I	30%
3	Neutron Tomography applied to a wax cast figurine	30%
Total		100%

WORK SUMMARY

Nº	Work Summary and Main Achievements
1	<p>Neutron tomography (NT) has been applied to visualize the inner structure of ancient Portuguese glazed tiles undergoing conservation treatments. Neutrons have the advantage of interacting strongly with hydrogen, so NT is able to map hydrogenous compounds with high sensitivity. The present study explores its potential for assessing the distribution of the consolidant Paraloid B-72 inside tiles, to evaluate the efficiency of two different methods of treatment: brushing and immersion in solution.</p> <p>Using a prototype NT setup at the Reactor Português de Investigação (Sacavém, Portugal), each two-dimensional image is obtained from a 90 s exposure, at a thermal neutron flux of $2 \times 10^5 \text{ n.cm}^{-2}.\text{s}^{-1}$ at the irradiation site. The neutron beam has a diameter of 5 cm, so fragments with outer dimensions up to 4.8 cm can be inspected. Samples are automatically rotated by an angle of 0.9° between successive images. Images were obtained before and after the application of the consolidant. The results obtained show that Neutron Tomography is a useful tool for visualization of the inner structure of ancient glazed tiles, and to assess penetration depth of consolidant and its distribution inside the tile. Neutron tomography showed a greater and more uniform retention of resin inside the tile if the brush is used to apply the consolidant, to increase the cohesion of the object.</p>
2	<p>A gold solidus of Valentinian I, Emperor of Rome (A.D. 364-375), belonging to a private collection, was subjected to material and stylistic analysis, in order to ascertain about its authenticity. Due to the rarity of such a coin, only non-destructive analytical techniques were used, namely Scanning Electron Microscopy (SEM), Particle Induced X-ray Emission (PIXE), electrical resistivity, Neutron Tomography and optical microscopy. The results obtained show that Neutron Tomography is an important tool for the studies of the ancient metallic coins, specifically gold, it shows in great detail the homogeneities and inhomogeneities in the internal structure of the coin.</p>
3	<p>As neutron tomography is particularly suitable for organic artefacts, it has been used to investigate the physical characteristics of a figurine (E657), 30 cm high, belonging to the Museu Nacional Machado de Castro (Coimbra, Portugal), produced by casting with a wax-based mixture [4]. This finished artwork was examined by means of thermal neutron beam (25meV; 5 cm diameter) and positioned as close as possible to the scintillator screen. The software used for image analysis consists in Octopus V.8.1, for 3D image reconstruction and VGStudio Max 2.0 for visualization and metric measurements.</p> <p>The main goal of these analysis consisted in evaluating different densities which characterizes each constitutive part of the statuette and understanding the way they were cast. Special attention was given to the material thickness and the joint techniques used to bind the parts together.</p> <p>This technique has proved suitable for the object under study and broadened our knowledge on this kind of cultural heritage.</p>

PUBLICATIONS

PAPERS (ISI Journals)

- M. A. Stanojev Pereira, J. G. Marques, R. Pugliesi, A simple setup for neutron tomography at the Portuguese Nuclear Research Reactor, *Braz. J. Phy.* 42, 5-6 (2012) 360-364, doi 10.1007/s13538-012-0083-0.
- M. I. Prudêncio, M.A. Stanojev Pereira, J.G.Marques, M.I. Dias, L. Esteves, C. I. Burbidge, M.J. Trindade, M.B.Albuquerque, Neutron tomography for the assessment of consolidant impregnation efficiency in Portuguese glazed tiles (16th and 18th centuries), *J. Arch. Science.* 39, (2012), 964-969.

Books and Book Chapters

- Marco A. Stanojev Pereira, *Algumas histórias da química dos elementos* (2012), 1a. Edição, ISBN: 978-85-913809-1-6, 354p

Proceedings

- Le Gac, M. Manso, S. Longelin, J. Bleton, L. Piorro, M.J. Oliveira, M.A. Stanojev Pereira, T.I. Madeira, A. Candeias and M.L. Carvalho. (2012). A step-by-step scientific procedure for the accurate

characterization of colored wax figurines, *2nd International Workshop Physical and Chemical Analytical Techniques in Cultural Heritage*, Lisbon University, June 4-5

COMMUNICATIONS

Oral

- M.A. Stanojev Pereira, T.I. Madeira, A. Le Gac, J. P. Santos, A. Candeias, M.L. Carvalho, J.G. Marques. Neutron Tomography applied to a wax cast figurine, *2nd International Workshop Physical and Chemical Analytical Techniques in Cultural Heritage*, Lisbon, Portugal, June 4-5 June (2012).

Poster

- Scintillators Applied in Neutron Imaging Techniques, M.A.Stanojev Pereira, J.G.Marques, M.I. Prudêncio, J.P.Santos, C. Burbidge, *2nd Luminescence in Archaeology International Symposium*, Lisbon, Portugal Sep. 5 -7 (2012).

Others

- E. Figueiredo, M.F. Araujo, M.A. Stanojev Pereira, J.G. Marques, J.P. Santos, Characterization of Archaeological Metal Artefacts, *Regional Workshop on Use of Nuclear Technology for Cultural Heritage Characterization, Dating and Preservation*, Belgrade, Serbia Sep. 4-6 (2012).

INTERNATIONAL COLLABORATIONS

- R. Pugliesi, IPEN/CNEN-SP, Nuclear and Energy Research Institute, Brazil, 2012, *Improvement of a neutron tomography system at the IPEN/CNEN-SP*, April 2010 to April 2013.

NAME: Susana Marta Lopes Almeida

CATEGORY: Auxiliary Researcher (*Ciência 2008*)

ID NUMBER: 5472

R&D ACTIVITIES

Nº	Activity Description	R&D
1	Project: PMfugitive - Mitigating the Environmental and Health Impacts of Particles from Fugitive Emissions, Fundação para a Ciência e Tecnologia, PTDC/AAC-AMB/098825/2008	30%
2	Project: CV-Dust: Atmospheric Aerosol in Cape Verde Region: Seasonal Evaluation of Composition, Sources and Transport, Fundação para a Ciência e Tecnologia, PTDC/AAC-CLI/100331/2008	10%
3	Project: ASEMIS - Assessment of Emissions and Impact of Steel Processes. European Commission, Research Fund for Coal and Steel, RFSR-CT-2009-00029	10%
4	Project: Support Air Quality Management, International Atomic Energy Agency, TC project RER/1/008	4%
5	Project: Enhancing the Sustainability of Research Reactors and their Safe Operation through Regional Cooperation, Networking and Coalition, International Atomic Energy Agency, TC project RER/4/032	4%
6	Services: Analysis of heavy metals in fertilizers	2%
7	Services: Teaching activities within the scope of the Portuguese Certification System of buildings for Energy and Indoor Air Quality	5%
8	Students supervision	12%
9	Teaching: Course "Air Quality Management" in the degree of Environmental Health in ESTeSL	10%
10	Management of the group NANE	13%
Total		100%

WORK SUMMARY

Nº	Work Summary and Main Achievements
1	Significant amount of atmospheric dust arises from the mechanical disturbance of granular

	<p>material exposed to the air. Dust generated from these open sources is termed "fugitive" because it is not discharged to the atmosphere in a confined flow stream. The objective of the project PMfugitive is to improve the understanding of fugitive emissions by performing their chemical characterization, assessing their environmental and health impacts and identifying the likeliness and extend of the PM10 and PM2.5 limit value exceedences due to these emissions.</p> <p>The assessment of the environmental impact of harbour operations (common source of fugitive dust) was performed by using modelling tools supported by high quality air measurements:</p> <ol style="list-style-type: none"> 1) Particles were sampling in harbour during bulk material handling and their chemical characterization was performed by INAA and PIXE. 2) Reverse dispersion models were used to estimate emission factors for the fugitive emissions. This work was performed in collaboration with Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas in Madrid; 3) Dispersion models were used to predict the ground-level concentrations of particles and to evaluate the exposure of the population due to the harbour operations; <p>Results showed that, depending on the handled material, meteorological conditions and crane operators, the impact of harbour operations can have significant impacts on the environment.</p>
2	<p>The main objectives of CV-Dust project are 1) to characterize the chemical and mineralogical composition of dust transported from Africa by setting up an orchestra of aerosol sampling devices in the strategic archipelago of Cape Verde; 2) to identify the sources of particles in Cape Verde by using receptor models; 3) to elucidate the role Saharan dust may play in the degradation of Cape Verde air quality and 4) to model processes governing dust production, transport, interaction with the radiation field and removal from the atmosphere.</p> <p>PM10 sampled in Cape Verde was chemically characterized (elements, water soluble ions and carbonaceous aerosols) and the identification of the main sources and origins of the particles were carried out by integrating complementary tools including Principal Component Analysis, Multilinear Regression Analysis, Positive Matrix Factorization and Cluster Analysis of Air Mass Back trajectories.</p> <p>Results showed that Cape Verde aerosol is affected principally by natural sources: dust coming from Sahara desert contributes on average to 48% of the total PM10 mass and sea salt spray contributes on average to 20%. During trajectories from Sahara, dust contribution increases to more than 60% and PM10 concentrations reach very high concentrations (10 times higher than the EC limit values and WHO guidelines).</p>
3	<p>The objective of the project ASEMIS is to improve the understanding of steelworks' emissions and their impacts on ambient air quality, thus enabling cost effective abatement measures to be properly targeted and implemented. This addresses the need to improve local air quality, helping to create a sustainable future for European steelmaking.</p> <p>IST/ITN used complementary tools to assess the air quality and the contribution of emissions sources in the vicinities of the Gijon ArcelorMittal steelwork:</p> <ol style="list-style-type: none"> 1) Metals concentrations were mapped in the surroundings of the steelwork using passive biomonitors; 2) Geographic Information System was used to evaluate the relations between the spatial distribution of the elements, contamination factors, land use and topography and to identify the sources and processes associated with the pollutants' formation. 3) Atmospheric particles were sampled in the steelwork and a temporal database of aerosol species was built to evaluate the seasonal variations of metal concentrations; 4) Receptor models were used to identify and quantify the contribution of the steelwork operations to metal concentration in the local ambient air. <p>This approach identified three principal sources of particles, related with the steelwork activities: fugitive emissions from the handling and storage of minerals and fuel; combustion processes and</p>

	traffic of trucks.
4	<p>The objective of the IAEA TC Project “Support Air Quality Management” is to establish a network for air monitoring in order to increase the knowledge about the status of atmospheric pollution in the TC Europe Region by broadening access to nuclear analytical techniques.</p> <p>In the scope of this project 1) an inter-laboratory comparison is being performed with aerosol filters prepared by the Institute for Medical Research and Occupational Health from Zagreb and 2) aerosol samples are being collected, in Lisbon through periods of 12 hours. Half of each filter will be irradiated in the RPI in order to perform a chemical characterization of the particles by INAA. In the other half of the filter, water soluble ions and carbonaceous aerosols will be analysed by the Environmental Research Laboratory, Institute of Nuclear Technology - Radiation Protection, NCSR "DEMOKRITOS" in Athens, Greece.</p>
5	<p>Under the IAEA Technical Cooperation project RER 4/032, European and one Middle East Neutron Activation Analysis (NAA) laboratories participated in a proficiency testing round by inter-laboratory comparison organized by the Wageningen Evaluating Programs for Analytical Laboratories (WEPAL). Four soil samples of the International Soil Analytical Exchange (ISE) and four botanical samples of the International Plant Analytical Exchange (IPE) were provided for analysis. In IST/ITN, elemental determinations of these samples were carried out at the Portuguese Research Reactor by k_0-INAA.</p> <p>WEPAL reported the results of these exercises within three weeks after the closing date for submission of data and satisfactory performance was attained for consistently reporting z-scores < 2. After the report of the results by WEPAL, a workshop was performed in Delft University of Technology as a feedback exercise for the laboratories in order to promote further improvement of their degree of trueness while conducting NAA.</p>
6	<p>Service: Analysis of fertilizers by the technique INAA</p> <p>Client: ADP Fertilizantes S.A.</p>
7	<p>Services: Teaching activities within the scope of the Portuguese Certification System of buildings for Energy and Indoor Air Quality</p> <p>Clients: ADENE and ISQ</p>
8	Supervision of 6 PhD, 6 MSc, 4 BSc.
9	Responsible and teacher of the Course Air Quality Management in the degree of Environmental Health in Escola Superior de Tecnologia da Saúde de Lisboa (ESTeSL)
10	<p>Scientific, technical and financial management of the group NANE:</p> <ol style="list-style-type: none"> 1) Preparation and submission of projects; 2) Management of the URSN Neutron Activation Laboratory; 3) Management of the group team.

PUBLICATIONS

Papers

- M.A. Barreiros, T. Pinheiro, P.M. Félix, C. Franco, M. Santos, F. Araújo, M.C. Freitas, S.M. Almeida, Exhaled Breath Condensate as a Biomonitor for Metal Exposure: A new analytical challenge, *The Journal of Radioanalytical and Nuclear Chemistry* (2012), doi: 10.1007/s10967-012-2354-1.
- S.M. Almeida, J. Lage, M.C. Freitas, A.I. Pedro, T. Ribeiro, A.V. Silva, N. Canha, M. Almeida-Silva, T. Siteo, I. Dionisio, S. Garcia, G. Domingues, J. Perim de Faria, B. González Fernández, D. Ciaparra, H.Th. Wolterbeek, Integration of Biomonitoring and Instrumental Techniques to Assess the Air Quality in an Industrial Area Located in the Coastal of Central Asturias, Spain, *Journal of Toxicology & Environmental Health*, Part A 75, 1392-1403 (2012), doi: 10.1080/15287394.2012.721173.
- Cruz, M.C. Freitas, N. Canha, TG. Verburg, S.M. Almeida, H.Th. Wolterbeek, Spatial Mapping of the City of Lisbon Using Biomonitoring, *Int. J. Environment and Health* 6 (1) (2012), doi: 10.1504/12.46852.

- M. Trancoso, A. Sousa, F. Mouro, M.C. Freitas, S.M. Almeida, N. Canha, Indoor Air Quality: Validation and Setting up for Determination of Anions and Cations in Particulate Matter, *Accred Qual Assur.* 17 (2) 199-206 (2012). doi:10.1007/s00769-011-0864-0.
- S.M. Almeida, C.A. Ramos, A.M. Marques, A.V. Silva, M.C. Freitas, M.M. Farinha, M. Reis, A.P. Marques, Use of INAA and PIXE for Multipollutant Air Quality Assessment and Management, *Journal of Radioanalytical and Nuclear Chemistry* 294, 343-347 (2012), doi: 10.1007/s10967-011-1473-4.
- A.V. Silva, S.M. Almeida, M.C. Freitas, A.M. Marques, A.I. Silva, C.A. Ramos, T. Pinheiro, INAA and PIXE Characterization of Heavy Metals and Rare Earth Elements Emissions from Phosphorite Handling in Harbours, *Journal of Radioanalytical and Nuclear Chemistry* 294, 277-281 (2012), doi: 10.1007/s10967-011-1524-x.
- S.M. Almeida, A. Silva, M.C. Freitas, A.M. Marques, C.A. Ramos, A.I. Silva, T. Pinheiro, Characterization of Dust Material Emitted during Harbour Activities by k0-INAA and PIXE. *Journal of Radioanalytical and Nuclear Chemistry* 291, 77-82 (2012), doi: 10.1007/s10967-011-1279-4.
- N. Canha, M. Almeida-Silva, M.C. Freitas, S.M. Almeida, H. Th Wolterbeek, Lichens as Biomonitors at Indoor Environments of Primary Schools, *Journal of Radioanalytical and Nuclear Chemistry* 291, 123-128 (2012), doi: 10.1007/s10967-011-1259-8.
- N. Canha, M.C. Freitas, M. Almeida-Silva, S.M. Almeida, H.M. Dung, I. Dionísio, J. Cardoso, C.A. Pio, A. Caseiro, T.G. Verburg, H. Th. Wolterbeek, Burn Wood Influence on Outdoor Air Quality in a Small Village: Foros de Arrão, Portugal, *Journal of Radioanalytical and Nuclear Chemistry* 291, 83-88 (2012), doi: 10.1007/s10967-011-1261-1.

Book of Proceedings

- S.M. Almeida, M. Almeida-Silva, M. Pinto, D. Rodrigues, Indoor Air Quality Certification in Portuguese Buildings, *Plenary Presentation at the International Conference on Environment and Health 2012*, Lisbon, Portugal, 29 May-1 June (2012), ISBN 978-989-8077-22-6.
- S.M. Almeida, J. Lage, M.C. Freitas, A.I. Pedro, T. Ribeiro, A.V. Silva, N. Canha, M. Almeida-Silva, T. Siteo, I. Dionisio, S. Garcia, G. Domingues, J. Perim de Faria, B. González Fernández, D. Ciaparra, Integrated Approach for Air Quality Assessment in an Industrial Area Located in the Coastal of Central Asturias, Spain. *International Congress on Environmental Health 2012*, Lisbon, Portugal, 29 May-1 June (2012), ISBN 978-989-8077-22-6.
- M. Almeida-Silva, S.M. Almeida, C.A. Pio, T. Nunes, J. Cardoso, Impact of Sahara Dust Transport in Cape Verde Atmospheric Element Particles. *International Congress on Environmental Health 2012*, Lisbon, Portugal, 29 May-1 June (2012), ISBN 978-989-8077-22-6.
- C.A. Pio, M. Almeida-Silva, J. Cardoso, T. Nunes, S.M. Almeida, M.C. Freitas, O. Tchepel, F. Rocha, M. Cerqueira, J. Ferreira, D. Terroso, D. Jorge, Seasonal Variability of Atmospheric Dust over Cape Verde Islands. *International Congress on Environmental Health 2012*, Lisbon, Portugal, 29 May-1 June (2012), ISBN 978-989-8077-22-6.
- S.M. Garcia, G. Domingues, S. Clara, C. Gomes, A.V. Silva, S.M. Almeida, Impacts of Road Traffic Emissions on Ambient Air Quality from an Industrialized Area. *International Congress on Environmental Health 2012*, Lisbon, Portugal, 29 May-1 June (2012), ISBN 978-989-8077-22-6.
- J. Lage, S.M. Almeida, M. Pacheco, M.C. Freitas, T. Ribeiro, S. Garcia, B.G. Fernández, H. Th. Wolterbeek, Geospatial Distribution of Trace Element Air Pollution in the North of Spain Using Biomonitors. *International Congress on Environmental Health 2012*, Lisbon, Portugal, 29 May-1 June (2012), ISBN 978-989-8077-22-6.
- N. Canha, S.M. Almeida, M.C. Freitas, M. Taübel, O.O. Hänninen, Winter Ventilation Rates at Primary Schools: Comparison Between Portugal and Finland. *International Congress on Environmental Health 2012*, Lisbon, Portugal, 29 May-1 June (2012), ISBN 978-989-8077-22-6.
- S.M. Almeida, A.I. Silva, M.C. Freitas, H.M. Dzung, A. Caseiro, C.A. Pio, Impact of Maritime Air Mass Trajectories on the Western European Coast Urban Aerosol. *International Congress on Environmental Health 2012*, Lisbon, Portugal, 29 May-1 June (2012), ISBN 978-989-8077-22-6.

- S.M. Almeida, P.M. Félix, C. Franco, J. Sousa, A. Barreiros, A.B. Almeida, S. Garcia, T. Pinheiro, Exhaled Breath Condensate as a Suitable Matrix to Assess Workers Exposure to Lead. *International Congress on Environmental Health 2012*, Lisbon, Portugal, 29 May-1 June (2012), ISBN 978-989-8077-22-6.
- A.V. Silva, S.M. Almeida, S.M. Sarmiento, A. Cruz, T. Verburg, A. Miranda, Impact of Air Pollution on Cardiorespiratory Diseases in Setúbal, Portugal. *International Congress on Environmental Health 2012*, Lisbon, Portugal, 29 May-1 June (2012), ISBN 978-989-8077-22-6.
- A.V. Silva, S.M. Almeida, M.C. Freitas, A.M. Marques, A.I. Silva, C.A Ramos, T. Pinheiro, S.L. Almeida, A. Lopes, S.M. Garcia, G. Domingues, A.I. Miranda, Determination of Fugitive Emissions During Harbour Operations. *International Congress on Environmental Health 2012*, Lisbon, Portugal, 29 May-1 June (2012), ISBN 978-989-8077-22-6.
- A.M.J. Cruz, S.M. Sarmiento, A.V. Silva, T. Verburg, S.M. Almeida, C. Alves, M.C. Freitas, H. Th. Wolterbeek, Air Pollution Impact on Respiratory and Circulatory Diseases in Lisbon, Portugal. *International Congress on Environmental Health 2012*, Lisbon, Portugal, 29 May – 1 June (2012), ISBN 978-989-8077-22-6.

COMMUNICATIONS

Invited

- Composição e Origem das Partículas Respiráveis na Zona Urbana de Lisbon, S.M. Almeida, A.I. Silva, M.C. Freitas, H.M. Dung, C.A. Pio, A. Caseiro, *2º Encontro Riscos Ambiente e Qualidade do Ar, Fundação Calouste Gulbenkian*, Lisbon, 8 November (2012), Invited Talk.
- Indoor Air Quality Certification in Portuguese Buildings, S.M. Almeida, M. Almeida-Silva, M. Pinto, D. Rodrigues, *Plenary Presentation at International Conference on Environment and Health*, Lisbon, 29 May -1 June (2012), Invited Talk.

Oral

- Integrated Approach for Air Quality Assessment in an Industrial Area Located in the Coastal of Central Asturias, S.M. Almeida, J. Lage, M.C. Freitas, A.I. Pedro, T. Ribeiro, A.V. Silva, N. Canha, M. Almeida-Silva, T. Siteo, I. Dionisio, S. Garcia, G. Domingues, J. Perim de Faria, B. González Fernández, D. Ciaparra, Spain. *International Congress on Environmental Health 2012*, Lisbon, Portugal, 29 May-1 June (2012).
- Combining Biomonitoring Techniques and Geographic Information Systems to Assess Air Pollution, J. Lage, S.M. Almeida, M. Pacheco, M.C. Freitas, T. Ribeiro, S. Garcia, J.P. Faria, B.G. Fernández, H.Th. Wolterbeek, *6th International Workshop on Biomonitoring of Atmospheric Pollution (BIOMAP'12)*, Çesme, Turkey, 15-19 October (2012).
- Source Apportionment of Trace Elemental Air Pollution by Employing Biomonitoring Techniques, J. Lage, S.M. Almeida, M. Pacheco, M.C. Freitas, T. Ribeiro, S. Garcia, J.P. Faria, B.G. Fernández, H.Th. Wolterbeek, *6th International Workshop on Biomonitoring of Atmospheric Pollution (BIOMAP'12)*, Çesme, Turkey, 15-19 October (2012).
- Elemental Composition of Air Particulate Matter in Cape Verde, M. Almeida-Silva, S.M. Almeida, C.A. Pio, T. Nunes, J. Cardoso, *European Aerosol Conference 2012*, Granada, Spain, 3-7 September (2012).
- Impact of Sahara Dust Transport in Cape Verde Atmospheric Element Particles, M. Almeida-Silva, S.M. Almeida, C.A. Pio, T. Nunes, J. Cardoso, *International Congress on Environmental Health 2012*, Lisbon, Portugal, 29 May-1 June (2012).
- Seasonal Variability of Atmospheric Dust Over Cape Verde Islands, C.A. Pio, M. Almeida-Silva, J. Cardoso, T. Nunes, S.M. Almeida, M.C. Freitas, O. Tchepel, F. Rocha, M. Cerqueira, J. Ferreira, D. Terroso, D. Jorge, *International Congress on Environmental Health 2012*, Lisbon, Portugal, 29 May-1 June (2012).
- Impacts of Road Traffic Emissions on Ambient Air Quality from an Industrialized Area, S.M. Garcia, G. Domingues, C. Sousa, C. Gomes, A.V. Silva, S.M. Almeida, *International Congress on Environmental Health 2012*, Lisbon, Portugal, 29 May-1 June (2012).

- Geospatial Distribution of Trace Element Air Pollution in the North of Spain Using Biomonitors, J. Lage, S.M. Almeida, M. Pacheco, M.C. Freitas, T. Ribeiro, S. Garcia, B.G. Fernández, H. Th. Wolterbeek *International Congress on Environmental Health 2012*, Lisbon, Portugal, 29 May-1 June (2012).
- Winter Ventilation Rates at Primary Schools: Comparison Between Portugal and Finland, N. Canha, S.M. Almeida, M.C. Freitas, M. Taübel, O.O. Hänninen, *International Congress on Environmental Health 2012*, Lisbon, Portugal, 29 May-1 June (2012).

Poster

- Impact of the Traffic on the Air Particulate Matter from the Urban Area of Setúbal, Portugal, S.M. Almeida, Alexandra V. Silva, A.I. Pedro, A. Ferreira, *European Aerosol Conference 2012*, Granada, Spain, 2-7 September (2012).
- Impact of Maritime Air Mass Trajectories on the Western European Coast Urban Aerosol, S.M. Almeida, A.I. Silva, M.C. Freitas, H.M. Dzung, A. Caseiro, C.A. Pio, *International Congress on Environmental Health 2012*, Lisbon, Portugal, 29 May-1 June (2012).
- Exhaled Breath Condensate as a Suitable Matrix to Assess Workers Exposure to Lead. S.M. Almeida, P.M. Félix, C. Franco, J. Sousa, A. Barreiros, A.B. Almeida, S. Garcia, T. Pinheiro, *International Congress on Environmental Health 2012*, Lisbon, Portugal, 29 May-1 June (2012).
- P. Scotti, I. Pais, J. Semedo, A.E. Leitão, A.L. Fernando, F. Reboredo, A.R. Costa, A.S. Almeida, B. Maçãs, J. Coutinho, J. Ramalho, A. Ribeiro, L. Goulão, M.M. Silva, M.P. Duarte, F. Simões, J. Matos, A.L. Leitão, C. Galinha, S.M. Almeida, V. Ribeiro, F. Lidon (2012) Fatty acids profile in Zn and Fe biofortified wheat grown under field conditions, *COST ACTION FA 0905 Third Annual Workshop, Enhanced Nutritional Value of Plant-Derived Food or Feed*, Lisbon, Portugal, 23-26 October (2012).
- Zn and Fe Biofortification in Triticum Aestivum l. - Impact on Leaf Photosynthesis and Grain Molecular features, J.C. Ramalho, F. Simões, J. Matos, A.I. Ribeiro, A.E. Leitão, L.F. Goulão, B. Maçãs, A.S. Almeida, P. Scotti-Campos, I.P. Pais, J. Semedo, J.P. Coutinho, A.R. Costa, A.L. Fernando, F.H. Reboredo, M.P. Duarte, A.L. Leitão, M.M.A. Silva, S.M. Almeida, C. Galinha, V. Ribeiro, F.C. Lidon, *COST ACTION FA 0905 Third Annual Workshop, Enhanced Nutritional Value of Plant-Derived Food or Feed*, Lisbon, Portugal, 23-26 October (2012).
- Wheat Crop in Portugal – Biofortification Prospective, B. Maçãs, J.P. Coutinho, A.S. Almeida, A.R. Costa, A.E. Leitão, A.L. Leitão, M.P. Duarte, M.M. Abreu da Silva, A.L. Fernando, P. Scotti-Campos, J. Semedo, I.P. Pais, J.C. Ramalho, A.I. Ribeiro, L.F. Goulão, F. Simões, J. Matos, F.H. Reboredo, S.M. Almeida, C. Galinha, V. Ribeiro, F.C. Lidon, *COST ACTION FA 0905 Third Annual Workshop, Enhanced Nutritional Value of Plant-Derived Food or Feed*, Lisbon, Portugal, 23-26 October (2012).
- Simultaneous Biofortification of Zn and Fe in Triticum Aestivum l. cv Nabão Under Field Conditions, A.R. Costa, A.S. Almeida, N. Pinheiro, B. Maçãs, J.P. Coutinho, A.E. Leitão, M.P. Duarte, M.M. Abreu da Silva, A.L. Fernando, P. Scotti-Campos, I.P. Pais, J. Semedo, J.C. Ramalho, A.I. Ribeiro, L.F. Goulão, F. Simões, J. Matos, F.H. Reboredo, S.M. Almeida, C. Galinha, V. Ribeiro, F.C. Lidon, *COST ACTION FA 0905 Third Annual Workshop, Enhanced Nutritional Value of Plant-Derived Food or Feed*, Lisbon, Portugal, 23-26 October (2012).
- Can Biofortification of Triticum Aestivum l. Seeds Prevent Fungal Contamination? A.L. Leitão, A.L. Fernando, P. Scotti-Campos, I.P. Pais, A.E. Leitão, C. Galinha, S.M. Almeida, F.H. Reboredo, A.S. Almeida, F. Pessoa, B. Maçãs, J.P. Coutinho, J. C. Ramalho, A.I. Ribeiro, L.F. Goulão, M.M. Silva, M.P. Duarte, V. Ribeiro, F. Simões, A.R. Costa, J. Semedo, J. Matos, F.C. Lidon, *COST ACTION FA 0905 Third Annual Workshop, Enhanced Nutritional Value of Plant-Derived Food or Feed*, Lisbon, Portugal, 23-26 October (2012).
- Molecular Genetic Analysis of Biological Aerosol Particles from African Dust Storms, C.R. Nespoli, J. Fröhlich-Nowoisky, T. Nunes, J. Cardoso, S.M. Almeida, U. Pöschl, *European Aerosol Conference 2012*, Granada, Spain, 3-7 September (2012).
- Carbonaceous and Inorganic Water Soluble Species in PM in Cape Verde Atmosphere, T. Nunes, J. Cardoso, D. Custódio, M. Cerqueira, S.M. Almeida, M. Almeida-Silva, C. Pio, *European Aerosol Conference 2012*, Granada, Spain, 3-7 September (2012).

- Mineralogy of Atmospheric Dust in Santiago island, Republic of Cape Verde: preliminary results, F. Rocha, A. Quintela, D. Terroso, C. Costa, J. Cardoso; T. Nunes; C.A. Pio, S. M. Almeida and M.C. Freitas, *European Aerosol Conference 2012*, Granada, Spain, 3-7 September (2012).
- Modelling of Long-range Transport of Mineral Dust in Cape Verde, O. Tchepel, J. Ferreira, A.P. Fernandes, C. Gama, C. Borrego, C. Pio, J. Cardoso, S.M. Almeida, C. Pío, *European Aerosol Conference 2012*, Granada, Spain, 3-7 September (2012).
- Aerosol Optical Properties at Santiago Island, Cape Verde, M. Cerqueira, C. Pio, P. Fialho, J. Cardoso, T. Nunes, S.M. Almeida, *European Aerosol Conference 2012*, Granada, Spain, 3-7 September (2012).
- Spatial Distribution of the Air Quality in Portugal (rural, urban, and archipelagos), A.M.J. Cruz, S.M. Sarmento, A.V. Silva, T. Verburg, S. Almeida, C. Alves, M.C. Freitas, H. Th. Wolterbeek, *European Aerosol Conference 2012*, Granada, Spain, 3-7 September (2012).
- Indoor Air Quality in Gymnasiums, C.A. Ramos, S.M. Almeida, S. Cabo Verde, S. Viegas, C. Viegas, *European Aerosol Conference 2012*, Granada, Spain, 3-7 September (2012).
- Indoor PM_{2.5} Source Apportionment from Primary School in Rural Area, Portugal, N. Canha, S.M. Almeida, M.C. Freitas, H.Th. Wolterbeek, J. Cardoso, C.A. Pio, A. Caseiro, *European Aerosol Conference 2012*, Granada, Spain, 3-7 September (2012).
- Particulate Fugitive Emissions in Harbours: Characterization and Emission Factors Estimation, A.V.Silva, S.M. Almeida, A.I. Miranda, F. Martín, *European Aerosol Conference 2012*, Granada, Spain, 3-7 September (2012).
- Contributions of Traffic Emissions to the Ambient Aerosol in an Industrial Area, S. Garcia, G. Domingues, C. Santos, C. Gomes, A. Silva, S.M. Almeida, *European Aerosol Conference*, Granada, Spain, 3-7 September (2012).
- Chemical Composition of Total Particulate Matter from Indoor School Environments, N. Canha, M. Almeida-Silva, S.M. Almeida, M.C. Freitas, H. Th. Wolterbeek, *Urban Environmental Pollution*, Amsterdam, The Netherlands, 17-20 June (2012).
- Impact of Air Pollution on Cardiorespiratory Diseases in Setúbal, Portugal. A.V. Silva, S.M. Almeida, S.M. Sarmento, A. Cruz, T. Verburg, A. Miranda, *International Congress on Environmental Health 2012*, Lisbon, Portugal, 29 May – 1 June (2012).
- Determination of Fugitive Emissions During Harbour Operations, A.V. Silva, S.M. Almeida, M.C. Freitas, A.M. Marques, A.I. Silva, C.A Ramos, T. Pinheiro, S.L. Almeida, A. Lopes, S.M. Garcia, G. Domingues, A.I. Miranda, *International Congress on Environmental Health 2012*, Lisbon, Portugal, 29 May – 1 June (2012).
- Air Pollution Impact on Respiratory and Circulatory Diseases in Lisbon, Portugal. A.M.J. Cruz, S.M. Sarmento, A.V. Silva, T. Verburg, S.M. Almeida, C. Alves, M.C. Freitas, H. Th. Wolterbeek, *International Congress on Environmental Health 2012*, Lisbon, Portugal, 29 May – 1 June (2012).
- CV-Dust: Atmospheric Aerosol in the Cape Verde Region: Carbon and Soluble Fractions of PM₁₀, C. Pio, T. Nunes, J. Cardoso, A. Caseiro, D. Custódio, M. Cerqueira, D. Patoilo, S.M. Almeida, M.C. Freitas, *European Geosciences Union General Assembly 2012*, Vienna, Austria, 22-27 April (2012).
- Size Distribution of PM at Cape Verde-Santiago Island, C. Pio, T. Nunes, J. Cardoso, A. Caseiro, M. Cerqueira, D. Custodio, M.C. Freitas, S.M. Almeida, *European Geosciences Union General Assembly 2012*, Vienna, Austria, 22-27 April (2012).
- Exhaled Breath Condensate as a Biomonitor for Metal Exposure: A New Analytical Challenge, M.A. Barreiros, T. Pinheiro, P.M. Félix, C. Franco, M. Santos, F. Araújo, M.C. Freitas, S.M. Almeida, *10th International Conference on Nuclear Analytical Methods in the Life Sciences*, Bangkok, Thailand, 15-20 January (2012).

SEMINARS

- Qualidade do Ar Exterior, S.M. Almeida, Course “Seminários em Saúde Ambiental”, Degree in Environmental Health, Escola Superior de Tecnologia da Saúde de Lisboa, 16 November (2012).

EDUCATION / THESES SUPERVISION

Theses Supervision

- Supervisor, PhD Thesis, New Biomarkers of Exposure to Metals Using Exhaled Breath Condensate (EBC), by Pedro Félix, Delft University, 31 October 2012.
- Supervisor, MSc Thesis, Modelação da Contribuição do Tráfego Automóvel para a Qualidade do Ar em Zona Industrial, by Carla Gomes, Instituto Superior de Engenharia de Lisboa, 6 January 2012.
- Supervisor, BSc Thesis, Qualidade do Ar em Ginásios: Exposição a Poluentes e Contaminantes do Ar Interior Durante a Realização de Exercício Físico, Course “Estágio I” from the degree Environmental Health, Escola Superior de Saúde Ambiental, by Ana Margarida Calado, December 2012.
- Supervisor, BSc Thesis, Qualidade do Ar em Lares de Idosos, Course “Estágio I” from the degree Environmental Health, Escola Superior de Saúde Ambiental, by Catarina Dias, December 2012.
- Supervisor, BSc Thesis, Medição de Emissões Fugitivas Durante uma Operação de Descarga Portuária de Açúcar, Course “Estágio I” from the degree Environmental Health, Escola Superior de Saúde Ambiental, by Sérgio Almeida and Ana Cláudia Lopes, January 2012.

Teaching

- “Auditorias à QAI”, Curso de Gestão de Energia em Edifícios de Serviços, Formação Complementar para Reforço de Competências, S.M. Almeida, Agência para a Energia, Oporto, 6 November (2012).
- “Auditorias à QAI”, Curso de Gestão de Energia em Edifícios de Serviços, Formação Complementar para Reforço de Competências, S.M. Almeida, Agência para a Energia, Lisbon, 18 October (2012).
- “Sistema Nacional de Certificação Energética e da Qualidade do Ar Interior nos Edifícios, Módulo RSECE-QAI”, S.M. Almeida, ISQ-Oeiras, June 2012.
- “Indoor Air Quality: pollutants, sources and legislation”, S.M. Almeida, Pre-congress course at the International Conference on Environment and Health 2012, Lisbon, Portugal, 29 May (2012).
- “Qualidade do Ar Interior”, Pós-Graduação em Eficiência Energética nos Edifícios, S.M. Almeida, ISQ, Lisbon, May (2012).
- “Auditorias à QAI”, Curso de Gestão de Energia em Edifícios de Serviços, Formação Complementar para Reforço de Competências, S.M. Almeida, Agência para a Energia, Lisbon, 10 May (2012).
- “Sistema Nacional de Certificação Energética e da Qualidade do Ar Interior nos Edifícios, Módulo RSECE-QAI”, S.M. Almeida, CELBI, Figueira da Foz, March (2012).
- “Auditorias à QAI”, Curso de Gestão de Energia em Edifícios de Serviços, Formação Complementar para Reforço de Competências, S.M. Almeida, Agência para a Energia, Faro, 16 March (2012).
- “Auditorias à QAI”, Curso de Gestão de Energia em Edifícios de Serviços, Formação Complementar para Reforço de Competências, S.M. Almeida, Agência para a Energia, Oporto, February (2012).

Jury Membership

- Pedro M. Félix (2012), New biomarkers of exposure to metals using exhaled breath condensate (EBC), PhD thesis, Delft University of Technology, 31 October.
- Carla Duarte Poceiro (2012), Caracterização dos níveis BTEX no ar em Estarreja – avaliação de campo, MSc em Engenharia do Ambiente, Universidade de Aveiro, 18 December.
- Daniel Santiago Brandão de Almeida (2012), Variação temporal das propriedades ópticas do aerossol em Cabo Verde, MSc em Engenharia do Ambiente, Universidade de Aveiro, 18 December.
- Marta Sofia Guerreiro Sanguessuga (2012), Síndrome dos Edifícios Doentes: Estudo da qualidade do ar interior e despiste da eventual existência de SED entre a população do edifício “E” de um estabelecimento de ensino superior, MSc Segurança e Higiene do Trabalho, Escola Superior de Tecnologia da Saúde de Lisboa, Instituto Politécnico de Lisboa, 23 April.

- Carla Gomes (2012), Modelação da contribuição do tráfego automóvel para a qualidade do ar em zona industrial, MSc Engenharia Química, Instituto Superior de Engenharia de Lisboa, 6 January.

PROJECTS

Running

- *Mitigating the Environmental and Health Impacts of Particles from Fugitive Emissions (PM_{fugitive})*, Fundação para a Ciência e Tecnologia, PTDC/AAC-AMB/098825/2008, Leading Institution: IST/ITN, IST/ITN Coordinator: S.M. Almeida (30%)
- *Atmospheric Aerosol in Cape Verde Region: Seasonal Evaluation of Composition, Sources and Transport (CV-Dust)*, Fundação para a Ciência e Tecnologia, PTDC/AAC-CLI/100331/2008, Leading Institution: Universidade de Aveiro, IST/ITN Coordinator: S.M. Almeida (10%)
- *Assessment of Emissions and Impact of Steel Processes (ASEMIS)*. European Commission, Research Fund for Coal and Steel, RFSR-CT-2009-00029 Leading Institution: TataSteel, IST/ITN Coordinator: S.M. Almeida (10%)
- *Support Air Quality Management*, International Atomic Energy Agency, TC project RER/1/008 Leading Institution: IAEA, IST/ITN Coordinator: S.M. Almeida (4%)

Submitted

- *Modelo de Monitorização da Eficiência Funcional de Infraestruturas de Unidades de Saúde (EFICARE)*, Quadro de Referência Estratégica Nacional. Leading Institution: A Integridade – Serviços de Manutenção e Integridade Estrutural, Lda. IST/ITN Coordinator: S.M. Almeida.
- *Assessment of Susceptible Population Exposure to Chemical and Microbiological Particle Components (XPaC)*, Fundação para a Ciência e Tecnologia, PTDC/AAG-GLO/2369/2012. Leading Institution: Associação do Instituto Superior Técnico para a Investigação e o Desenvolvimento (IST-ID). IST/ITN Coordinator: S.M. Almeida (35%).
- *Reducing Exposure to Air Pollutants During Physical Exercise (MOVE)*, Fundação para a Ciência e Tecnologia, PTDC/AAG-GLO/2372/2012. Leading Institution: Associação do Instituto Superior Técnico para a Investigação e o Desenvolvimento (IST-ID). IST/ITN Coordinator: S.M. Almeida (35%).
- *Avaliação da Exposição da População Idosa Residente em Lares a Poluentes Atmosféricos*, Fundación Mapfre, MA/12/AYU/774. Leading Institution: Instituto Superior Técnico, Universidade Técnica de Lisboa (IST-ITN). IST/ITN Coordinator: S.M. Almeida.
- *Diminuição da Exposição a Poluentes Atmosféricos na Potenciação dos Benefícios do Exercício Físico (DEPort)*, Fundación Mapfre, MA/12/AYU/667. Leading Institution: Instituto Superior Técnico, Universidade Técnica de Lisboa (IST-ITN). IST/ITN Coordinator: S.M. Almeida.

CONTRACTS

- “Consultoria Técnica de Análise de Aerossóis”, Instituto de Soldadura e Qualidade, 1 year, 9382€
- “Formação”, Instituto de Soldadura e Qualidade, 41 hours, 1784€
- “Formação”, Agência para a Energia, 16 hours, 800€
- “Análise completa de metais pesados a adubos”, ADP Fertilizante, S.A., 1 month, 450€
- “Certificação da Qualidade do Ar Interior de Edifício”, Instituto de soldadura e Qualidade, 2 years, 10.325,00 €

CONFERENCE ORGANIZATION / COMMITTEES

- Member of the organization, *Third Annual Workshop COST ACTION FA 0905 - Mineral improved crop production for healthy food and feed*, Monte da Caparica, Portugal, 23-26 October, 2012.
 - Member of the Scientific Committee, *International Congress on Environmental Health (ICEH2012)*, Lisbon, Portugal, 29 May – 1 June 2012.
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NAME: Vincent Debut**CATEGORY:** Auxiliary Researcher (*Ciência 2007*)**ID NUMBER:** 5484**R&D ACTIVITIES**

Nº	Activity Description	R&D
1	Analysis of the tuning of the Mafra Carillons Bells Project PTDC/EAT-MMU/104255/2008	30%
2	Recovering the unconstrained modes of a structure from the dynamical information performed under constrained configuration Project PTDC/EAT-MMU/104255/2008	20%
3	Dynamics of coupled string-body interaction system using linear theory Project PTDC/FIS/103306/2008	20%
4	Dynamical behaviour of worn guitar strings Project PTDC/FIS/103306/2008	10%
5	Identification of non-linear contact forces in vibratory systems from remote vibratory measurements Project Transnational cooperation FCT/Tunisia "Fault detection in rotating machinery"	10%
6	Lecturership-Universidade Nova de Lisboa, FCSH-UNL	10%
Total		100%

WORK SUMMARY

Nº	Work Summary and Main Achievements
1	<p><i>Analysis of the tuning of the Mafra Carillons Bells</i></p> <p>This work aimed to analyse the tuning of the Mafra carillons bells, which form the largest surviving 18th century carillons in Europe. This work is part of a multidisciplinary FCT research project in partnership with the Music Department from the Universidade Nova de Lisboa.</p> <p>In collaboration with José Antunes, my efforts were first devoted to develop the experimental and identification techniques for extracting the bell vibrational modal properties. Once the feasibility of the technique established, in-field experiments were performed in Mafra with the help of my MSc student, Miguel Carvalho. It consisted in measuring the vibratory responses of more than one hundred bells, which represents an amount of 4 months of work, sometimes under difficult conditions (accessibility to the bells, climate conditions).</p> <p>I then analysed the collected data in view of musicological aspects, namely the musical temperament and reference tuning, by using optimization techniques in order to minimize the differences between measured and theoretical modal frequencies.</p> <p>If large tuning differences are evidenced by our identifications, results also revealed that no correct tuning of the carillons with respect to a target temperament had been achieved. A conference paper as well as a journal paper will be submitted for publication in 2013.</p>
2	<p><i>Recovering the unconstrained modes of a structure from the dynamical information performed under constrained configuration</i></p> <p>The study stems from an interest in knowing the tuning of large historical bells, which had to be provisionally supported using scaffolds, constraining the bell rim at several locations. Therefore, the difficulties created by the additional anchoring of the bells appeared as an opportunity to formulate the dynamical problem in terms of structural modification techniques in order to estimate the original bell tuning in their suspended state.</p> <p>In collaboration with José Antunes, we proposed a method for recovering the free modes of axisymmetric systems from frequency response data stemming from a constrained configuration. The method was first applied for a conceptual system of discrete mass-stiffness elements arranged in a ring shape, and recently, we extended to 3D structures the technique.</p> <p>Instead of solving an eigenvalue problem, the technique involves a set of linear equations. A central feature of the method is to impose some specific properties of all axisymmetric bodies</p>

	<p>during the inversion, which also allows identifying simultaneously both mass and stiffness modifications.</p> <p>Based on simulated data, results show the feasibility of the technique, and we are now developing a laboratory setup for experimental validation. Two papers have been recently submitted to international conferences to be held in 2013.</p>
3	<p><i>Dynamics of coupled string-body interaction system using linear theory</i></p> <p>Objective is to give a basic and interesting picture on the strongly non-linear dynamical responses of friction-excited musical instruments, by providing an interpretation of their linear behaviour. In collaboration with José Antunes, we addressed the problem of the bowed sting/body coupled interaction system using a modal approach, and gave light on specific issues related to string-body interaction.</p> <p>Our approach is directly inspired by studies of disk brake systems for which the linearization of the nonlinear dynamical equations is performed in the vicinity of steady sliding states. From the computation of the complex eigenvalues and eigenvectors, we examined the linear stability of the coupled modes of the system as its dynamical characteristics change. Interestingly, these calculations provided an instability region for a pair of coupled modes as the playing frequency approaches that of the instrument body, which gives a plausible interpretation of the so-called wolf note phenomenon, in terms of a frequency lock-in as observed in vortex-induced vibrations. Calculations were further performed to interpret the dependence of the wolf beating frequencies with the control parameters, and linear predictions were always compared with nonlinear time-domain simulations to assess the similarities between linear and nonlinear approaches. Two journal papers are currently under review.</p>
4	<p><i>Dynamical behaviour of worn guitar strings</i></p> <p>This work is part of an FCT research project toward the dynamical analysis of the Portuguese guitar, for which José Antunes and I have supervised the research student Miguel Marques. Here, objective was to evidence the effects of the string wear on its sound quality.</p> <p>To that end, a physical model of a string displaying unevenness was developed by coupling an ideal string with a given set of (added or extracted) local point masses, and then, extensive numerical simulations were proposed. Computations were first performed in the frequency domain in order to study the string perturbed modes, and numerical time-domain simulations were also performed.</p> <p>The overall results showed that defects could affect the higher modes of the string, which may explain why players feel a loss of brightness of their instrument compared to its sound obtained with new strings. As expected, we found that the string modal frequencies changes depend not only on the amount of mass modification but also on the locations of the perturbations. As an interesting academic result, defects may cause localization phenomenon in the perturbed mode shapes. One journal paper is in preparation as well as one paper for international conference.</p>
5	<p><i>Identification of non-linear contact forces in vibratory systems from remote vibratory measurements</i></p> <p>Multi-supported tubes with clearances are critical mechanical components found in many industrial facilities such as nuclear reactors or gas-heat exchangers. Under flow excitation, they are particularly prone to vibro-impacts, which may induce some detrimental effects on the operating conditions. Following our previous studies on the identification of non-linear forces from remote motion transducers, José Antunes and I proposed an iterative constrained-inversion procedure to deal with simultaneous multiple identifications of impact forces, from a limited number of vibratory measurements.</p> <p>Based on a modal representation of a multi-supported beam with clearance supports subjected to impulse or turbulent excitation, the identification technique operates in an alternate fashion between the time and frequency domains, and enforces some additional physical knowledge for the solution. To be more specific, the identification procedure is applied in the frequency domain while physical constraints are imposed to the force estimates in the time domain at each iteration.</p> <p>The technique was tested numerically by comparing the identified dynamical impact forces with the actual values stemming from actual nonlinear computations. Preliminary identification results</p>

	assert the satisfactory behaviour of the method to isolate the impact forces in multi-supported systems for realistic noise levels.
6	Lectureship at Universidade Nova FCSH-UNL I have both lectured and been in charge of courses on Acoustics and Music Acoustics, for graduate and MSc students at Universidade Nova de Lisboa (128 hours).

PUBLICATIONS

- V. Debut and J. Antunes, "Iterative method for the remote identification of impact forces at multiple clearance supports using few vibratory measurements", In *Condition Monitoring of Machinery in Non-Stationary Operations*, Springer, ISBN 978-3-642-28767-1, 2012.
- V. Debut, J. Antunes and O. Inácio, "What can we learn about the wolf phenomenon from a linearized analysis?", Invited paper, in *Proceedings of Acoustic 2012*, April 2012, Nantes, France.
- V. Debut, M. Carvalho and J. Antunes, "Recovering the unconstrained modes of axisymmetric structures from measurements under constrained conditions", in *Proceeding of the International Congress on Sound and Vibration (ICSV)*, July 2012, Vilnius, Lithuania.
- M. Marques, O. Inácio, V. Debut and J. Antunes, "On the dynamical behaviour of worn guitar strings", in *Proceeding of the International Congress on Sound and Vibration (ICSV)*, July 2012, Vilnius, Lithuania.

COMMUNICATIONS

- V. Debut, "Caracterização vibratória dos carrilhões de Mafra: primeiros resultados", Presentation, 12 April 2012, Palácio Nacional de Mafra.
- J. Antunes and V. Debut, "Identification de force non-linéaires de contact agissant sur les structures vibrantes à partir de réponses vibratoires mesurées", Seminar, 27 November 2012, Laboratoire d'Acoustique de l'Université du Maine, Le Mans.

EDUCATION / THESES SUPERVISION

Student supervision

- Supervisor, MSc. Thesis, "Os Carrilhões de Mafra: Estudo e Caracterização Acústica dos Sinos", by Miguel Carvalho, Faculdade de Ciências Social e Humanas, Universidade de Lisboa, 20 December 2012.
- Co-supervision of the research student Miguel Marques at ADL on the dynamics of worn strings and also on the coupled dynamics of a string-plate, in the framework of the FCT research project PTDC/FIS/103306/2008.
- Co-supervision of part of the work performed by the MSc student Elisa Costa at ADL on the modal identification of guitar strings, in the framework of the FCT research project PTDC/FIS/103306/2008.

Lectureship

- Lecturer and in charge of a course on Acoustics for Master students, Universidade Nova de Lisboa, FCSH-UNL.
- Lecturer and in charge of a course on Musical Acoustics for undergraduate students Universidade Nova de Lisboa, FCSH-UNL.

Jury

- Jury member for the MSc. Thesis of Miguel Carvalho, "Os Carrilhões de Mafra: Estudo e Caracterização Acústica dos Sinos", Faculdade de Ciências Social e Humanas, Universidade Nova de Lisboa, 20 December 2012.
- Jury member for the MSc. Thesis of Carlos Damas, "Violino e Tecnologia: origem e evolução tecnológica entre os séculos XV e XXI", Faculdade de Ciências Social e Humanas, Universidade Nova de Lisboa, 10 October 2012.

PROJECTS

- *Dynamical optimization of large-spectrum granular impact dampers*. FCT research project. Principal coordinator: Vincent Debut. The project was not recommended for funding.
- *Dynamic characterization and optimized balancing of rotating machinery in non-stationary operating conditions*. Transnational cooperation, Agreement Tunisia/Portugal. Partner: Ecole Nationale d'Ingénieurs de Sfax – Université de Sfax. Principal coordinator: Vincent Debut. Submitted.