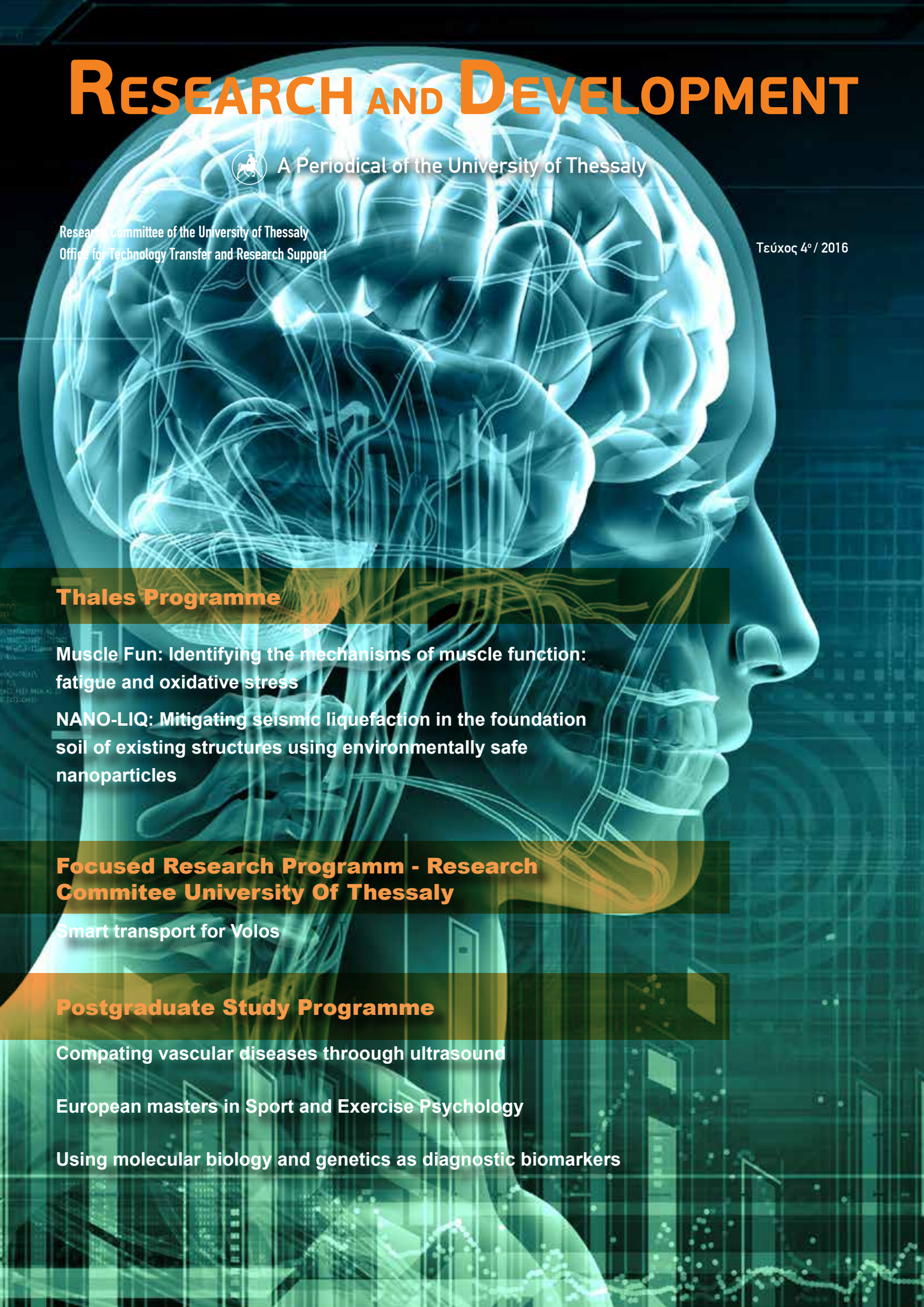
RESEARCH AND DEVELOPMENT

A Periodical of the University of Thessaly

Research Committee of the University of Thessaly
Office for Technology Transfer and Research Support

Τεύχος 4ο / 2016



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NANO-LIQ

Mitigating seismic liquefaction in the foundation soil of existing structures using environmentally safe nanoparticles

BOX

Principal researchers: Achilleas Papadimitriou, Assistant Professor, National Technical University of Athens (formerly University of Thessaly) and Panos Dakoulas, Professor, Department of Civil Engineering, University of Thessaly

TEXT

Funded by the Thales programme, the Nano-Liq project aims to make passive stabilisation a theoretically sound, fail-safe and practical technique for liquefaction mitigation.

A natural phenomenon, soil liquefaction occurs when soil layers of specific types below the groundwater table lose their (shear) strength during strong earthquake motions. This is due to the increase in pore water pressure. This loss of strength (seismic liquefaction) is observed only during the quake, but it may suffice to cause large settlements (see fig. 1) or the overturning of buildings and bridge piers, flow failures in soil media, but also the flotation of buried pipelines. Luckily, liquefaction may only be observed in loose granular soils (e.g. sandy gravel, sands), and only if they are fully saturated (e.g. next to seas, lakes or rivers). Nevertheless, from a statistical point of view, liquefaction has proven to be one of the most important causes of failure in civil engineering works during strong earthquake excitations.

Figure 1: Large differential settlements due to liquefaction under a building (without obvious structural damage) during the Caracas Venezuela 1967 earthquake (M = 6.5)

Technical problem

Nowadays, the design of ordinary buildings in a seismic liquefaction regime is not scientifically acceptable. Hence, seismic codes enforce ground improvement (for liquefaction mitigation) before construction, which does not present technical challenges. However, very often, liquefaction risk is detected after the construction of the building. At such locations, the vast majority of these ground improvement techniques proves difficult or impossible to apply. The few appropriate techniques cannot readily mitigate liquefaction effects beneath the entire structure and may create structural problems (e.g. footing heave due to grouting).

Technical solution

A new technique for improving the foundation

soil of existing structures is passive stabilisation. It concerns the enrichment of the pore water of a liquefiable soil with an environmentally safe nano-stabiliser (colloidal silica), which changes the mechanical response of the soil, rendering it less vulnerable to strain accumulation related to the (almost complete) loss of shear strength of the soil, during and immediately after the seismic excitation. The enrichment is performed via injection of the stabiliser, whose viscosity is initially comparable to that of water and increases rapidly (after a controllable gel time) when the stabiliser reaches the desired location (e.g. under the building). The injection may be performed after drilling a series of boreholes and thereby applying low gradient stabiliser flow under the structure (see fig. 2).

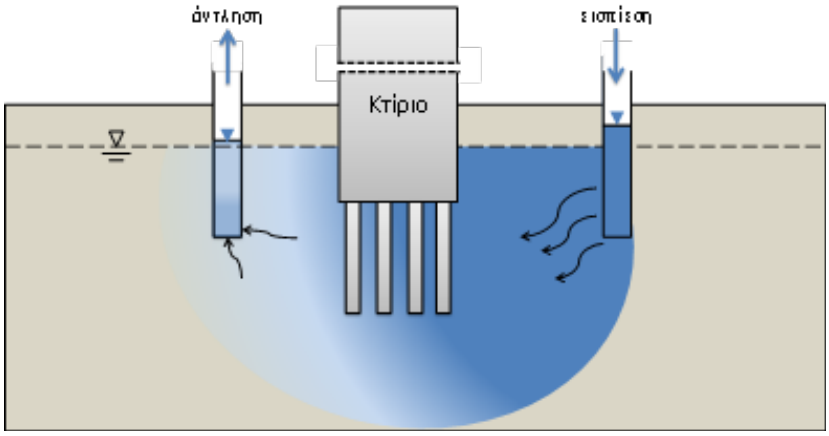


Figure 2: Concept of passive stabilisation of the foundation soil of an existing structure

Research project

Given that passive stabilisation remains at an experimental phase worldwide, the goal of the current research is to devise an integrated design methodology for passive stabilisation of liquefiable soils, and to make it useable for practical applications via specifications for quality control.

As presented in detail in the dedicated website www.nanoliq.org, the goal has been accomplished via a combined experimental and computational effort to fill the gaps in the relevant international literature. It was materialised via specific work packages, namely via:

- An extensive experimental study of the rheology of colloidal silica, which depicted the control parameters of gel time, and of the injection potential of silica in soil samples and how this is affected by its increased unit weight and its continuously increasing viscosity in comparison to the displaced water
- The experimental measurement of the mechanical behaviour of stabilised soils under monotonic and cyclic loading (see fig 3), which showed that even small percentages per weight of silica suffice for liquefaction mitigation
- Developing an elastoplastic constitutive law for the mechanical response of stabilised soils, which was implemented

Figure 3: Antigoni Vranna, PhD candidate, prepares a cylindrical sample of stabilised sand in the cyclic triaxial device

into a finite element code

- A study of the soil improvement mechanism via discrete element analyses, as well as finite difference analyses where the pore fluid had properties different from those of water

- Dynamic analyses of seismic response of stabilised soils (see intense reduction of settlements in fig. 4), which led to defining design acceleration spectra and allowed for the estimation of springs and dashpots (Winkler) for the analysis of structures on stabilised soils

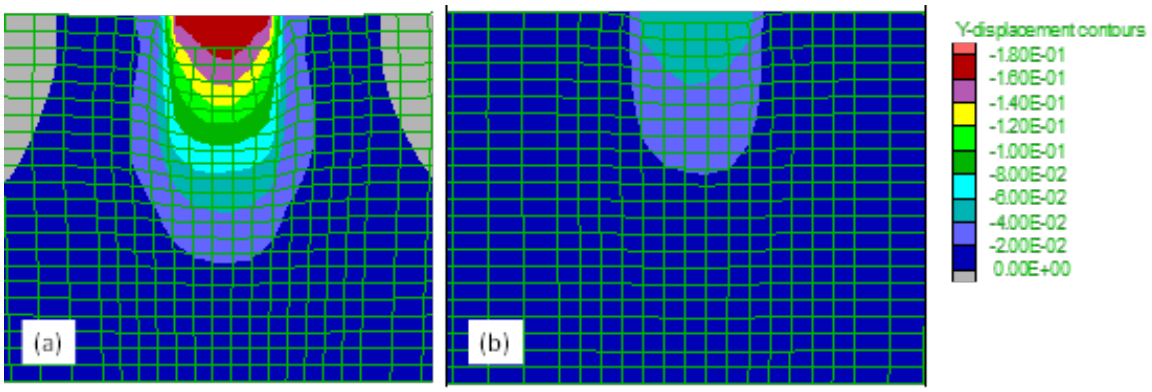


Figure 4: Example of reduction of seismic settlements under a strip footing due to passive stabilisation (right), in comparison to much higher values for untreated sand (left)

- Design charts for passive stabilisation (e.g. estimating percentage per weight of silica, gel time, injection and pumping rates), and specifications for quality control (e.g. measurement of unconfined compression strength as an indirect estimate of colloidal silica percentage)

Research team

The interdisciplinary main research team consisted of 11 faculty members from four Greek universities (University of Thessaly: P. Dakoulas; National Technical University of Athens: A. Papadimitriou, V. Georgiannou, M. Kavvadas, P. Tsopelas, G. Bouckovalas, M. Pantazidou; University of Patras: G. Mylonakis, G. Athanasopoulos; Aristotle University of Thessaloniki: T. Tika-Vassilikou, D. Achilias) and Professor D. Asimaki, a California Institute of Technology academic who agreed to participate in the project. Respectively, the team of external collaborators consists of 15 members, four of whom are postdoctoral researchers and nine PhD candidates.

Acknowledgments

This research was co-financed by the European Union (European Social Fund, ESF) and Greek national funds through the Operational Programme “Education and Lifelong Learning” of the National Strategic Reference Framework (NSRF) – Research Funding Program: Thales. Investing in knowledge society through the European Social Fund.

For more information: www.nanoliq.org

Muscle Fun

Identifying the mechanisms of muscle function: fatigue and oxidative stress

Yiannis Koutedakis
Professor of the School of PE and Sports Science, University of Thessaly

The purpose of the Muscle Fun project is to reveal the critical factors and mechanisms that regulate muscle function under systemic uremia, and which are directly or indirectly responsible for the extreme fatigue and muscle dysfunction (collectively described as uremic myopathy) observed in patients with chronic kidney disease (CKD).

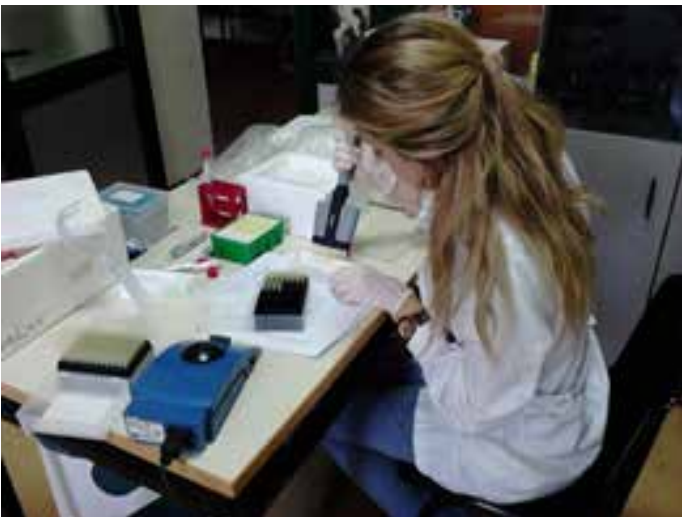
Across the EU and in Greece as well, CKD has become an epidemic. It is however a silent epidemic as sufferers realise they have a health problem when CKD has progressed (having lost >50% of their kidney function). It is estimated that in Greece alone, about 10,000 citizens need hemodialysis (that is, they are at the end-stage of CKD). However, a million Greeks (or 10% of the entire population) suffer from some kind of kidney disease, with approximately 100,000 presenting with symptoms of CKD (at the pre-dialysis stage).

Christina Karatzaferi,
Associate Professor of the School of PE and Sports Science, University of Thessaly

Research that supports the elucidation of pathophysiological mechanisms underpinning uremic myopathy and improvement of muscle function before patients reach the end-stage is of critical importance for society at large, given the long waiting times for kidney transplantation (>10 years), the comorbidities and the mortality of end-stage CKD patients, which are linked to a host of metabolic problems and which are directly or indirectly dependent on compromised muscle status.

The researchers

The Muscle Fun project is led Professor Yiannis Koutedakis and the principal researcher is



Associate Professor Christina Karatzaferi, of the School of PE and Sports Science, University of Thessaly.

The faculty researchers are organized in four thematic groups: Skeletal Muscle Physiology and Mechanics (Team 1: C. Karatzaferi, A. Tsiokanos and V. Gerodimos of the University of Thessaly and M.A. Geeves, of the University of Kent); Systemic Effects of Renal Disease and Uremia (Team 2: I. Stefanidis and K. Tepetes, University of Thessaly); Biochemistry of Oxidative Stress (Team 3: A. Jamurtas and Y. Koutedakis of the University of Thessaly), and Effects of Chronic Disease on Skeletal Muscle Morphology and Metabolism (Team 4: G. Sakkas of the University of Thessaly and M. Maridaki of the University of Athens).

The above researchers are supported by a collaborating team consisting of other faculty, technical staff and specialists (G. Giakas and V. Bouglas of the University of Thessaly, G. Bogdanis and A. Filippou of the University of Athens) as well as young researchers, at the doctoral or postdoctoral career stage, from the University of Thessaly, University of Athens and the Centre for Research and Technology-Hellas (CERTH) (G. Mitrou, K. Poulianiti, A. Theos, S. Grigoriou, A. Kaltsatou and A. Karioti) and other experts who support this project (we thank D. Leonidas, S. Sotiropoulos, F. Diamantis for their expertise).

Progress

The Muscle Fun project is being realised according to its original plan and has maximised the use of the available funds, thanks to the hard work of the University of Thessaly Research Committee Staff (special thanks to A. Zisis, D. Messalouris, E. Gkagka, T. Kontos and the rest of the Research Committee staff) and the smooth collaboration of all team members.

Experienced and new investigators have presented findings from Muscle Fun to congresses, conferences and symposia across Europe and in the USA, while the submission and publication of research articles related to the project has started.

Thanks to the Muscle Fun project, our school has obtained new equipment, two doctoral and two postdoctoral projects were supported, and existing or new collaborations were forged with national and international laboratories.

For more information: http://www.pe-uth.gr/musclefun/index.php?lang=en

The present research was supported by the European Union and Greek national funds through the Operational Programme "Education and Lifelong Learning" of the National Strategic Reference Framework (NSRF) – Research Funding Program: Thales. Investing in knowledge society through the European Social Fund (MuscleFun Project: MIS 377260).

Smart transport for Volos

Commuting in and around Volos is all that more convenient thanks to the i-Mobi Volos smart transport project

The main objective of the Intelligent Urban Mobility Information and Management System Towards Urban Sustainability in the City of Volos project was the development of smart transport information and management system for Volos. An electronic route planner, i-Mobi Volos, was developed, aiming to improve urban mobility, upgrade the traffic landscape of Volos and promote sustainable travel options, meeting citizens' needs.

Hosted on the http://imobivolos.uth.gr/ website, i-Mobi Volos is available in two languages, Greek and English.

Through i-Mobi Volos, the commuter has the opportunity to seek transport information and optimise the selected trip according to three criteria: time (shortest route), cost (most economical route) and pollutant emissions (most environmental friendly route).

The basic services of i-Mobi Volos involve:

- providing the commuter with the appropriate information regarding available public transport modes (timetables, fares), places of interest (sports facilities, local services, campuses, bus stops, terminals etc) and ways of communication with stakeholders
- enabling data input for the selected trip, which more specifically are comprised of the chosen departure and destination point, the selected transport mode and the related optimisation criterion in addition to the preferable time of departure
- the assessment of the best route and its characteristics, i.e. time, distance, bus line etc.
- the evaluation of the application, taking also into account the users' suggestions for improvement

The project consists of seven work packages (WP). At this stage the deliverables associated with WPs 1, 2, 3, 4 and 7 have been completed and submitted to the University of Thessaly Research Committee, whereas the project team is still working on WPs 5 and 6, which will bring the project to an end.

WP 1: Literature review

WP 1 encompasses the literature review and selection of good practices of other implemented route planners, not only on a national scale such as OASA in Athens and Mobithess in Thessaloniki, but also on an international scale such as Trenitalia in Italy and OpenMBTA in Boston. A literature review set the foundations for the development of i-Mobi Volos.

WP 2: Investigation of existing traffic conditions, infrastructures and travel demand

In WP 2, a detailed study was conducted regarding urban and suburban services, rail transportation, taxi transfers and parking lots. Also, the analysis of the travel demand was completed. Finally, a brief summary of i-Mobi Volos functional specifications was provided.

WP 3: Investigation of travel and information needs in the city of Volos

WP 3 was mainly focused on the development and implementation of an appropriate methodology for the investigation of citizens' and stakeholders' information and travel needs. According to the survey's results, most of the respondents (approximately 95%) were positive about the development of the route planner, whereas 18% stated that they needed information about the estimated travel time, 15% about the available means of transport and 14% about the proposed routing that the route planner indicates, based on the criteria selected by the user (e.g., time, cost, number of interchanges etc.) As regards the perspective of stakeholders,

they generally agreed that the proposed route planner should embed information on bus services, the availability of parking lots, the estimated time and cost to reach the destination as well as the available transportation modes. The results of this WP led to the development of the information framework, incorporated by i-Mobi Volos and meeting the travel needs of users.

WP 4: Development of an information portal for commuters

WP 4 was focused merely on the development of the application. The operating system requirements (information services, trip characteristics, optimised route selection and research on commuters' travel needs and evaluation of i-Mobi Volos) were presented and three models (shortest distance, travel cost and environmental impact assessment) were implemented. In order to clarify the function of i-Mobi Volos, a comprehensive application scenario was demonstrated.

WP 5: Education

WP 5 concerns the organisation and implementation of the training project which comprises of students' workshops aiming to assist the use of i-Mobi Volos and a roundtable discussion among the stakeholders of the city in order to acquire useful feedback for the improvement of the platform.

WP 6: Evaluation

WP 6 presents the functional evaluation of i-Mobi Volos as well as the evaluation of the training activities through a questionnaire.

WP 7: Dissemination

WP 7 concerns the dissemination activities through press releases on radio, TV and social networks, distribution of leaflets at central points in the city of Volos, involving the website http://imobivolos.uth.gr/website/, social media (Facebook, Twitter), mailing lists, publications and presentations in conferences and monitoring of the dissemination process.

The benefits from the operation of i-Mobi Volos are expected to be multiple, with a significant positive impact on the travel patterns of citizens and tourists, the local community and the urban landscape.

Combating vascular diseases through ultrasound

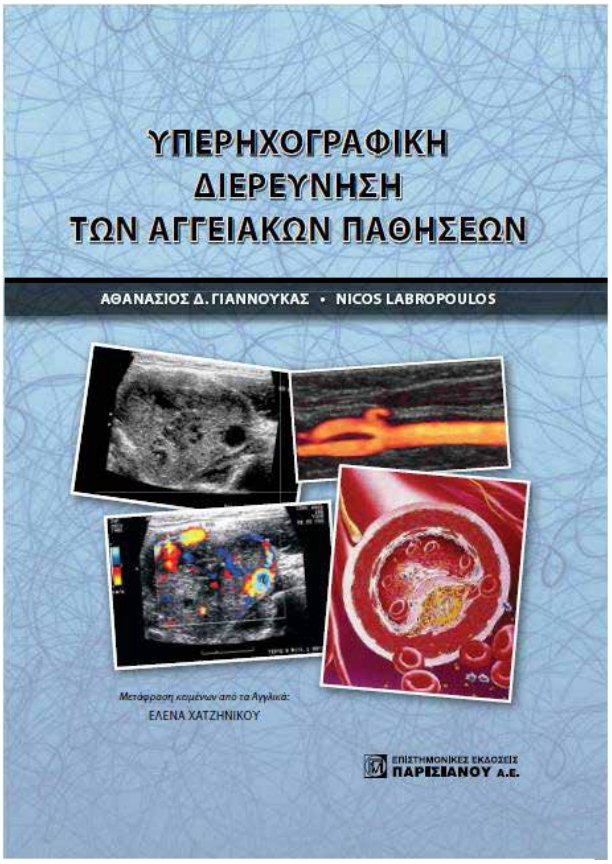
SUBTITLE

Joint Greek-Italian MSc focuses on advanced ultrasonic functional imaging and research for the prevention and diagnosis of vascular diseases

By
Athanasios Giannoukas
Professor
Scientific director of the MSc programme

The subject of this joint international MSc, which is offered by the Faculty of Medicine of the University of Thessaly and the School of Medicine and Pharmacy of the University of Genoa, Italy, is the use of ultrasound study in the prevention and diagnosis of vascular diseases. The use of ultrasound in angiology and vascular surgery has changed the current field since diagnosis can be made non-invasively and vascular diseases can be detected in the early stages, thus enabling the prevention of their development through the proper modification of risk factors. The MSc focuses both on the clinical application of ultrasound in diagnosis and the techniques that can be used as tools for research study. Theoretical training in hemodynamics and an understanding of ultrasound techniques are combined with clinical and research applications, ensuring that MSc graduates are perfectly adequate to cope with current and future challenges in the clinical and research field in the European Union.

The duration of studies for the acquisition of the MSc degree is two semesters and includes compulsory attendance and successful assessment in course modules. During the course of studies, a thesis has to be prepared. Lectures of two-day duration (Friday and Saturday) are carried out in eight thematic sessions (one lecture a month). The assessment of students includes assign-



ments and written examinations. Students are obliged to attend the lectures, workshops and other activities for each module.

The MSc includes compulsory and optional modules as well as practice; it also requires the accumulation of 60 ECTS in total.

The course accepts up to 20 students per academic year. They may be:

- Medical graduates from Greece, Italy and abroad, as well as Technological Educational Institute graduates of related specialties such as radio therapy technologists and nurses
- Physicians with any of the following specialties: vascular surgery, general practice, cardiology, radiology, internal medicine, general surgery, neurology and cardiac surgery

Selection criteria

The selection process takes into consideration the qualifications of the candidates, based on the documents they submit in their application.

Assessment of students

The grading scale is from 0 to 100 and each candidate receives a specific number of points based on the following criteria:

- Degree grade x 2 (up to 25 points)
- Work experience; years of work x 1 (up to 25 points)
- Knowledge of a foreign language (up to 10 points when certified).
- Relevance to the subject of the programme (up to 20 points)
- Additional qualifications (up to 20 points for those who have publications in international scientific journals)

Fees

Tuition fees for the MSc have been established by the decision of the Assessment Committee and the Senate of the University of Thessaly. They are paid at the beginning of the semester and amount to €1,500 per semester (total annual fees €3,000).

Correspondence

For further information, please visit the website: www.med.uth.gr/pms.vasc.ultrasound or contact the course secretary:

Tel: +30 2413 501 739 (Monday & Wednesday, 10:00–14:00 EET)

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European masters in Sport and Exercise Psychology

A course providing high-level research and career training in the field of sports psychology

The European masters in Sport and Exercise Psychology (EMSEP) is co-organised by the University of Thessaly in association with another leading European university in sport psychology, the University of Jyväskylä in Finland.

The two-year course consists of four semesters, one of which is spent at the University of Jyväskylä, which means that graduates earn their degree from both universities.
Recognised and supported by the European Union, the course offers scholarships to EU and non-EU students. In addition, distinguished professors from around the world are invited to present guest lectures to participants.

The curriculum draws on the wide choice of courses available at both universities and there is a focus on independent research and obtaining extensive internship experience.
Responding to the increased demands for experts in the field, programme aims to provide high-level research and career training in the field of sports psychology. It also provides

support for athletes, and seeks to develop children's sports, promote healthy living and quality of life through exercise and maximise the benefits of physical eEducation. Multicultural in outlook, it welcomes international graduates seeking a high quality of education. Overall, 35 international students from 22 countries (among them the US, Australia, Canada, UK, Holland, Germany, Denmark, Brazil, Ethiopia, India, Iran and China) from five continents have enrolled in the course. International students have enjoyed interacting with the residents of the city of Volos as well as Greek athletes, coaches and practitioners.

In terms of future opportunities, EMSEP graduates are ideally suited to working in the private or public sector in the field of exercise and sports, to become instructors (especially in the field of increasing human performance), mental health counsellors and academic researchers.

For more information: postgrad.pe.uth.gr/emsep

Using molecular biology and genetics as diagnostic biomarkers

MSc programme in Applications of Molecular Biology - Genetics. Diagnostic Biomarkers prepares professionals for the constantly changing field of molecular diagnostics

The MSc programme in **Applications of Molecular Biology - Genetics. Diagnostic Biomarkers** provides professional education and training at postgraduate level for laboratory scientists in the area of molecular diagnosis of acquired, inherited and infectious diseases.

Molecular diagnosis using nucleic acids (DNA or RNA) is not only limited to medicine, but can be applied in many diverse fields such as population genetics, toxicology, pharmacogenomics, forensics, archaeology, palaeontology, genetically modified organisms. Indeed, the list of disciplines where it can be applied is endless.

The course discusses the major methodologies and presents their use in various areas. Although the areas of use are different, the methodology is often similar. For that reason, the many methods that are commonly used will first be described in detail, followed by lectures on how they can be applied across different scientific disciplines.

Programme graduates will be competent in performing and interpreting molecular-based laboratory tests, in explaining the appropriate use and meaning of molecular-based tests to other professionals as well as to patients, and in establishing and validating new molecular methods in a molecular diagnosis laboratory. The required commitment in time and resources will enable students to strengthen their preparation for future roles as practitioners, educators, researchers and leaders in the exciting and constantly changing field of molecular diagnostics.

The course, which lasts three academic semesters, consists of theoretical classes (60 ECTS) and a master's thesis (30 ECTS), based on research on a scientific topic selected by the candidate and which is one of the scientific interests of the academic staff in the MSc course.

The theoretical classes are conducted during the first and second semesters, in courses of six months duration. **The courses consist of teaching as theoretical lectures and seminars to enforce the basic courses of the organization of studies.**

The MSc programme accepts applications from health science, biological science, agricultural science, **technical university** and veterinary graduates from universities or technological educational institutions (TEIs) in Greece or abroad.

Contact

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