8th Research Day

School of Engineering – University of Thessaly

Book of abstracts

Tuesday

June 4, 2024

09:30-17:30

Dept. of Planning and
Regional Development Building,
Room A1

Πολυτεχνική Σχολή

8th Research Day

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PROGRAM

9:30-9:45	Registration - Welcome Reception
9:45-10:00	Welcome Speech
10:00-12:00	1st Session: Technology
12:00-12:30	Coffee Break
12:30-14:30	2nd Session: Algorithms and Analysis
14:30-15:30	Break – Light lunch
15:30-17:30	3rd Session: Planning

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1st Session: Technology

1.1. The effect of pulmonary surfactant on alveolar dynamics

Konstantinos Bouchoris

Department of Mechanical Engineering

Abstract

This PhD thesis deals with the dynamics of pulmonary surfactant. Initially, a mathematical model describing the temporal response of a liquid surface uniformly coated with surfactant and subjected to successive compression/expansion cycles with the kinetics incorporating the intrinsic compressibility of the adsorbed molecules was developed. The model is in agreement with experimental results from literature under physiological conditions. Subsequently, this model is used to describe the spatial and temporal dynamics/response of an oscillating model alveolus. The dynamics of the liquid membrane is studied through the lubrication theory. A new boundary condition, which is supported by experimental evidence and strengthened by comparison of characteristic scales, is applied at the entrance of the alveolus. Linear and weakly non-linear analysis of the problem around the equilibrium position (stationary cell) shows that the intensity of the shear flow in the membrane, induced by Marangoni stresses, is related to the thickness of the membrane over the alveolar opening, and the shear velocity just at the interface is an order of magnitude smaller than the radial velocity of the oscillating wall. The kinetics of the surfactant due to non-zero adsorption sets a 2nd order time constant surfactant outflow at the exit of the alveolus. Based on the above, an attempt is made to correlate the model predictions with physiological data on airflow and particle deposition inside the alveoli, as well as stress-induced trauma in diseased lungs. Finally, a parametric analysis on the geometric and surfactant parameters of the model is presented to draw possible physiological and pathophysiological implications.

Key-words

τάσεις Marangoni, ασθενώς μη γραμμική ανάλυση, πνευμονικό επιφανειοδραστικό

1.2. Theoretical-numerical analysis of the acoustic response of a coated microbubble adhered to a solid substrate.

Sotiris Rosios

Department of Mechanical Engineering

Abstract

Studies have shown that bubbles oscillating in the vicinity of a wall exhibit lower resonance frequencies compared to free ones. This phenomenon is expected to be more pronounced when bubbles are adhered to a solid substrate, as experimental data have also indicated, and is attributed to the impact of short-range molecular interactions between the protective shell and the substrate. Numerical simulations were performed using the Galerkin finite element method to solve for the bubble interface and flow.

To this end, initially, the static configuration was studied. An asymptotic analysis was carried out, which allows for the study of the external part of the bubble, where the effect of adhesion forces is negligible. Their integration is accomplished in the form of boundary conditions at the contact point. In this fashion, the contact surface and the thin liquid film that develops between the bubble and the solid substrate are ignored.

Following the same asymptotic modeling, a linear global stability analysis is performed at the limit of weak disturbances, to obtain the eigenfrequencies of the bubble. Their extraction is achieved by means of the Arnoldi iterative method for generalized non-symmetric eigenproblems.

Finally, the nonlinear time-dependent problem is studied, where the bubble is placed in a viscous incompressible fluid subject to pressure variations in the far field. Dynamic simulations were carried out including both weak disturbances to validate the linear stability results, as well as strong disturbances to study phenomena of intense surface deformation. Transient and steady states are obtained for various shell parameter values and adhesion forces.

Some preliminary result regarding the nonlinear problem show the transient phenomena occurring until a new static configuration is achieved with a step change in pressure. In the meantime global stability analysis is performed to obtain the eigenfrequencies that are observed in the p0 mode and contact length diagrams.

Key-words

coated microbubble adhesion, asymptotic analysis, global stability, nonlinear dynamics, finite element analysis

1st Session: Technology

1.3. Numerical study of the dynamic behavior of a liquid metal inside a pore and of the spreading process out of the pore in the presence of Lorentz and intermolecular forces

Maria Vlachomitrou and Alkmini Lytra

Department of Mechanical Engineering

Abstract

Liquid metals are considered as alternative plasma-facing components (PFCs) to protect the walls of fusion reactors. They are usually fed to the wall surface through a capillary porous system, however, operational issues like drop ejection may arise. In this work, we investigate the dynamic behavior of liquid lithium in the presence of a magnetic field when the interface accepts a heat load and an electric current from the surrounding plasma. The role of intermolecular forces in the spreading process is also investigated. The Navier-Stokes equations coupled with the Lorentz forces are solved using the finite element method. When the interface is pinned on the pore mouth, above a critical magnetic number (Bom=5.85), we capture the onset of a Rayleigh-Taylor instability that leads to drop ejection. However, in the presence of high thermal loads the interface is stabilized due to evaporation and is led to steady pulsations or even a steady state. When the interface forms a thin film along the wall, the interplay of Lorentz and intermolecular forces is investigated. Simulations with an imposed overpressure above static conditions capture a film formation with a dynamic contact angle that conforms with the law, O(Ca1/3), of spreading. When a magnetic pressure above the threshold value is applied, Rayleigh-Taylor instabilities are captured leading to drop formation. The spreading velocity increases/decreases as the strength of the repulsive/attractive-repulsive potential increases. The critical magnetic pressure for drop ejection is inversely proportional to the pore radius while it increases with surface tension and strength of attractive-repulsive potential.

Key-words

CPS, FEM, Drops, Instability, Heat load

1.4. Design and Development of a Smart Grid Testbed

Donatos Stavropoulos

Department of Electrical and Computer Engineering

Abstract

In this presentation, we will examine the design and implementation of an experimental infrastructure for smart electrical grids. This project integrates commercially available sensors and devices in a setting of 50 households in Volos. We utilize open-source software and cloud services for real-time data monitoring and analysis. The system enables efficient data exchange through ontologies, supporting various pilot use cases such as machine learning for data analysis, user engagement, and demand response scenarios.

Key-words

IoT, Smart Home, Smart Grid, Testbed, Data Interoperability

1.5. Artificial Intelligence in Modern Power Systems

Vasileios Laitsos

Department of Electrical and Computer Engineering

Abstract

Modern electricity power systems face numerous and significant challenges. Firstly, the increasing demand for electricity requires efficient resource management and continuous investment in infrastructure. Simultaneously, the integration of renewable energy sources, such as solar and wind energy, necessitates managing production and balancing it with electricity demand. Maintaining network stability and security is also a critical factor, as any failures can lead to network malfunctions. Within these challenges, the penetration of Artificial Intelligence can offer significant solutions. Initially, through the analysis of big data in real-time, accurate demand and electricity production forecasting can be achieved. Additionally, through advanced machine and deep learning algorithms, systems can optimize energy distribution, reducing losses and improving efficiency and the overall functioning of the energy market. All of the above constitute a sufficient condition to transform the conventional nature of networks into Smart Grids. Smart Electric Grids offer improved reliability and efficiency, reducing losses and interruptions. They allow for better demand management, integration of renewable energy sources, and promote decentralized production. They also improve transparency and dynamic pricing, increasing competitiveness in the electricity market and enabling the operation of advanced programs, such as Demand Response programs. With the increased use of Artificial Intelligence, we can lead to more efficient and flexible energy systems capable of meeting future challenges.

Key-words

Electricity Demand Forecasting, Electricity Price Forecasting, Demand Side Management

1.6. Reducing the Mission Time of Drone-Based Sensing Applications

Georgios Polychronis

Department of Electrical and Computer Engineering

Abstract

: Lately there is a trend using drones for aerial sensing application in different fields, due to their flexibility of deployment, agility and minimal human interaction required to execute such missions. The focus of my work is on such applications, where one or more drones must fly autonomously to the various points of interest, perform a sensing task, and process the sensed data during the mission. Additionally, the result of the processing may lead to the detection/generation of some event, in which case the drone must perform on the spot an additional action or a more precise sensing before continuing the mission. The goal is to minimize the completion time of such missions, while considering possible energy constraints and the need to refuel/change batteries of the drones.

Key-words

drones, edge computing, offloading decisions, scheduling, path planning

1.7. A novel homogenization-based elastic-plastic model for porous metals accounting for void shape effects

Sokratis Xenos

Department of Mechanical Engineering

Abstract

This work is concerned with the development, calibration, and numerical implementation of a novel fully explicit isotropic, rate-independent, elasto-plastic model for porous metallic materials. The microstructure is assumed to consist of a random, with uniform probability, distribution of randomly oriented spheroidal voids of the same shape. The resulting expressions exhibit the simplicity of the well-known Gurson model and, thus, its numerical implementation in a finite element code is straightforward. To assess the accuracy of the analytical model, we carry out detailed finite-strain, three-dimensional finite element (FE) simulations of representative volume elements (RVEs) with the corresponding microstructures. Proper parameter calibration of the model leads to fairly accurate agreement of the analytical predictions with the corresponding FE average stresses and porosity evolution. We show, both analytically and numerically, that the initial shape of the voids has a significant effect on the homogenized effective response of the porous material leading to extremely soft responses for penny-shaped microvoids, especially at high stress triaxialities. To deal with the computational issues related to the numerical implementation of rate-independent models that lead to softening material behavior, a regularized version of the newly proposed model is also developed. The model is implemented in the commercial FE software ABAQUS and is used for the numerical simulation of various industrially relevant structural problems. The model's capability to reproduce experimental results with sufficient accuracy suggests that it can be utilized to provide predictions with only a small amount of parameters that may be calibrated from either micromechanics calculations or experimental data.

Key-words

Porous metals, Homogenization, Forming simulations, Ductile fracture simulations

1.8. Finite element analysis of JCO-E fabrication process and its influence on the material properties and collapse capacity of offshore pipelines

Aris G. Stamou

Department of Mechanical Engineering

Abstract

A commonly used process in pipe production industry is the so-called JCO-E process, which involves the deformation of plate through the following consecutive steps: (a) plate edge crimping (b) J, C and O steps where the plate is deformed using a vertical forming tool (punch) (c) welding of plate edges and (d) expansion. Those cold forming steps mainly induce local bending/unloading and stretching loading conditions along the plate cross-section and thus they significantly control the geometry and the material properties of the final product which is the JCO-E pipe. Previous studies on the subject [1], [2] showed that the fabrication process of the JCO-E pipe significantly deteriorate its cross-sectional imperfection and compression properties which affect the resistance to collapse ("collapse pressure") under external pressurization. In the present study, the JCO-E manufacturing process, and the stability of the JCO-E pipe under external pressure are simulated in ABAQUS/STANDARD for a real case study of a thick-walled pipe. Also, the material properties of the actual plate are considered and modelled using a user defined plasticity model. The numerical results quantify the effects of the manufacturing process on the properties and the collapse pressure of the final pipe and recommendations are given for optimizing the process to achieve the ultimate performance of offshore pipelines

Key-words

JCO-E pipe, pipe manufacturing, mechanical properties, collapse pressure

2nd Session: Algorithms and Analysis

2.1. Longterm Reliabilty of Integrated Circuits: The issue of Electromigration, its analysis and mitigation

Olympia Axelou

Department of Electrical and Computer Engineering

Abstract

The technology downscaling of the integrated circuits (ICs), combined with the need for more powerful systems, is leading to circuits of extreme complexity. In particular, the performance and reliable operation of ICs is largely determined by critical subsystems such as the power distribution network, multi-segment interconnects, etc. Long-term reliability has been identified as the biggest problem for the current and future generation of ICs, with paramount importance in critical applications such as automotive and aerospace. Aging and long-term wear problems lead to a decrease in the performance of ICs over time, and in the worst case to incorrect operation or destruction (open circuit). A long-term wear problem that needs special attention is electromigration (EM) in power grids and interconnects, where positive copper ions migrate from the cathode of the wire to the anode, i.e. in the direction of the current. The change in material density creates a deficit and accumulation of copper respectively, resulting in an increase in the resistance of the conductors up to an open circuit at certain points. The assessment of this problem is an essential part of the sign-off checks during the production of an IC, although the methods are empirical, imprecise and often incorrect for modern technologies, since they are designed for older generation circuits. This talk focuses on the analysis of the EM problem with modern physics-based models as well as efficient smoothing of it using smart algorithms to increase reliability based on modern design methods.

Key-words

Integrated-Circuits, Longterm-Reliability, Electromigration

2nd Session: Algorithms and Analysis

2.2. Static Timing Analysis Based Single Event Transient Analysis & Optimisation

Christos Georgakidis

Department of Electrical and Computer Engineering

Abstract

The manufacturing of modern Integrated Circuits (IC), resistant to faults caused by ionising radiation, has become quite challenging due to the rapid advancement of VLSI technology. The current methodology used by the industry for the analysis of the circuit sensitivity to Single Event Transients (SET) performs electrical simulation of the circuit by striking it with different particles, at different circuit nodes and for various states of the circuit. This methodology even though it is very accurate requires a significant amount of execution time, making it not feasible for large industrial circuits. The focus of this research is the development of an Electronic Design Automation (EDA) approach for SET analysis by utilizing the principles of the industry-proven Static Timing Analysis (STA). Our STA-based SET analysis achieves a significant x25,222 speed-up, while providing a tight upper bound with 5% relative error against electrical simulation. Beyond the analysis of the circuit sensitivity to SETs it is also important to achieve radiation hardness. In the industry special RadHard libraries are used, however, they are more expensive compared to the standard libraries. Thus, in our research an investigation of several SET-driven optimisation techniques is performed using standard cell libraries, like gate resizing, replication, logic restructuring, etc. Finally, our fast and accurate SET analysis enables to perform SET-driven optimisations in an automated closed loop, where first SET analysis is performed and a list of sensitivity metrics are exported which are used during the SET-driven optimisation step.

Key-words

Single Event Transients, Radiation Hardening, Static Timing Analysis, Electronic Design Automation, VLSI Circuits

2nd Session: Algorithms and Analysis

2.3. Automatic Sign Language Recognition Algorithms and their Incorporation into a Greek Sign Language Educational Platform

Katerina Papadimitriou

Department of Electrical and Computer Engineering

Abstract

This presentation focuses on the problem of automatic sign language recognition (SLR) from video, with a use-case of learning Greek Sign Language (GSL) through a properly designed platform with integrated functionality of automatic GSL recognition. The SLR problem is complex and challenging, due to the multitude of articulators, the complexity of its formation, the variation of the articulation process among signers, the difficulty of robust visual detection and tracking in a variety of non-ideal environments with often low-quality camera sensors, as well as the lack of large-volume SLR databases. At the same time, the process of learning sign language as a "2nd language" requires a very significant effort and student-teacher interaction both during learning as well as objective assessment of students by their teachers, both lacking appropriate supporting tools. The main innovation and contribution of this work lies in the combination of these two problems, i.e. both in the development of innovative and effective algorithms for SLR and their successful integration into a GSL learning platform, demonstrating success both through the evaluation of recognition on various SLR databases, as well as the evaluation of the learning platform objectively and subjectively by a large number of learner users. Moreover, in the context of this work, the largest GSL database to date has been collected, allowing the training and evaluation of SLR models, while also made available to the scientific community to further advance the field.

Key-words

Visual detection and tracking, feature extraction, sequence learning, Greek sign language recognition, language learning technologies

2nd Session: Algorithms and Analysis

2.4. On the Implementation of a Cross-Layer SDN Architecture for 802.11 MANETs

Ilias Syrigos

Department of Electrical and Computer Engineering

Abstract

The presentation discusses the design and implementation of a Software Defined Networking (SDN) framework integrated into 802.11 MANETs to address inherent challenges of mobile ad-hoc networks, such as dynamic topologies and decentralized nature. The SDN approach helps unify the control and enhances flexibility in traffic management and network resilience by leveraging cross-layer design that incorporates MAC layer statistics for improved routing accuracy. The results showcase enhanced network management and performance, establishing a novel integration method of SDN within MANET environments.

Key-words

SDN, MANET, Resilience, Cross-layer, 802.11

2.5. Non-standard acoustic measurements for architectural design and ambiance-making

Petros Flampouris

Department of Architectural Engineering

Abstract

The presented paper is an ongoing PhD research that aims to investigate new tools and techniques to study the sound environment, the sound ambiance, and the sound events of a place to incorporate it in early design (architectural, design, planning) stages. The research anticipation is to investigate new tools and methods to supplement traditional acoustic measurements and develop new qualitative criteria specific to the site and to the sound phenomena that one can experiment. The equipment used consists of sophisticated instruments such as measuring microphones, sound analyzers, and other test systems, some of them industry-developed to measure acoustic aspects (building/ area/ environment/ materials) such as frequency response, sound pressure and sound frequency. The rest research tools used follow a D.I.Y ethos to develop measuring equipment (custom mics, antennas, speakers, transmitters, sensors, microcontrollers, etc). The methodologies are stretched among different architectural scales aiming from regional/ public to human scale/ private building sound analysis. Involving different sets: urban, rural or semi-rural, open field or high density, abandoned or inhabited and thus different sound phenomena. The expected results are measurable sound phenomena confirmed through the study of the recordings and measurements (audio extracts will also accompany the work) that can work as a foundation for new acoustic criteria or further research. Design-wise it is believed that the rendered sound phenomena and results derived from this research benefit the related architectural design strategies.

Key-words

architecture, acoustics, ambiance, sound phenomena, sound qualities, soundscape

2nd Session: Algorithms and Analysis

2.6. Remote Sensing and SAR data: Monitoring building activity by Persistent Scatterer Interferometry

Vasilis Letsios, Ph.D.

Department of Planning and Regional Development

Abstract

A new innovative methodology is presented with the aim of identifying newly constructed buildings and estimating their heights over the urban area of Papagos-Cholargos Municipality in Athens, Greece using free Sentinel-1 SAR satellite data and the Persistent Scatterer Interferometry technique. Additionally, for the purposes of the research, a high-resolution Digital Elevation Model was created using Pleiades-1B tri-stereo satellite images. The proposed method is based on the Residual Height parameter and the smart selection of a reference point. The Bayesian change-point step detector algorithm and the parameters Temporal Coherence and Radar Cross Section were used. Data from the Hellenic Cadastre, through the Inspire platform, played a significant role in the research. The results highlight the contribution of the research and provide an insight into the trend of construction activity, which constitutes an important layer of spatial data for urban planning in a rapidly developing world. In summary, the accuracy rate for identifying newly constructed buildings was 71.43%, and the height calculations show a Mean Absolute Error of 2.35 meters. To verify the results, data were collected from three platforms. The first is the Google Earth Pro platform, which in its advanced version offers high-accuracy images with a refresh rate of three images per year; the second is the e-adeies portal of the Technical Chamber of Greece, through which building permits and building sections were collected; and the third is the urban planning data portal of the study area, which incorporates the Mapillary platform that offers relatively recent street-view photos.

Key-words

PSI, Change detection, new building, building heights

2nd Session: Algorithms and Analysis

2.7. Regional frequency analysis of annual maximum daily rainfall and uncertainty study with Bayesian MCMC

Marios Bilios

Department of Civil Engineering

Abstract

Annual maximum daily rainfall data are needed for various applications, such as infrastructure planning, flood risk assessment and water resource management. However, estimation of extreme rainfall faces challenges due to limited data availability, non-stationarity, and spatial variability. To address these challenges, this study applies the regional frequency analysis (RFA) methodology while focusing on quantifying the uncertainty associated with the process using Bayesian statistics. In this context, homogeneous regions are found from the mean-weighted rainfall data in the region of Thessaly. Subsequently, the data of these homogeneous regions are clustered from which the parameters of the joint quantile function are estimated. For this uncertainty study the Monte Carlo Markovian Chain Method (MCMC) and in particular the Metropolis algorithm is used to sample from the posterior distribution of the parameters governing the probability distribution of extreme rainfall GEV. The research aims to contribute to the advancement of statistical methods for extreme rainfall analysis and provide valuable information on the uncertainty associated with RFA. The results will help in decision-making on water resources management, climate change adaptation and infrastructure resilience to extreme rainfall events.

Key-words

Bayesian statistics, Uncertainty, Regional analysis, Extreme rainfall

3rd Session: Planning

3.1. The architecture of the city of Volos from the liberation to the modern movement 1881-1930

Kostis Maniatis

Department of Architectural Engineering

Abstract

The present study investigates the historical and socio-political framework through which the new city of Volos was created in relation to the architectural production from its liberation in 1881 until the prevalence of modernism by the end of 1930s.

The enlightenment and the liberalism of the era are spread from the repatriated merchants from Pelion region and are the starting point for the development of the new city. As a result of the demand of the increasing trade and the initiative from regions' residents; Volos has evolved into a powerful industrial city at the beginning of 20th century. The urbanization and the socioeconomic transformations elevated the new emergent middle class that had a strong presence through its active participation in the local and social hierarchy whereas it turned its interest in sectors of cultural expression, education and art. The architectural standards of Academism are deployed by the official state and dynamically change the image of the Ottoman province; while the upper class that initially adopts the neoclassicism is looking afterwards for new standards due to its wish for social distinction and promotion. The modern streams of that era such as eclecticism, Art Nouveau, Art Deco and idioms from the local tradition of other countries (regionalism) will enrich the architectural repertoire of the wider area, while the local architectural tradition will diminish by the effort to release from the Ottoman past until the appearance of the movement "Return to the roots" during the 1930s.

This study was based on literature research, public and private data and on-the-spot survey. It is an attempt to record the architectural production of the examined period in regards demolished or existing buildings. The classification is based on the type of each building (typology) and its morphological characteristics (morphology) in public or publicly operated buildings and houses.

Key-words

architecture, history, Volos

3rd Session: Planning

3.2. Transitional Household: Exploring Domesticity with the Non-Human, in the Case of the Semi-Nomadic Vlach Herders of Thessaly

Elina Letsiou

Department of Architectural Engineering

Abstract

Recent work grounded in Posthuman and New Materialism theory offers a transformative perspective on the concept of the household, emphasizing the agency and interconnectedness of both human and non-human agents within domestic spaces. This approach challenges traditional anthropocentric understandings and the divisions between nature/culture and object/subject, exploring the dynamic, often non-linear relationships that constitute domesticity. This research examines household structure as a hybrid assembly of natural, artificial, organic, and inorganic actors and environments, which entangle the social and emotional fabric of everyday life. It argues that notions of "co-domestication" and "care" serve as mechanisms for producing subjectivities. Three case studies are investigated, highlighting food processing practices as fundamental to household composition: (a) the household-grocery of the researcher's mother, (b) the last four Vlach semi-nomadic herders of Strata between Tyrnavos, Larissa, and Smixi, Grevena, and (c) the prehistoric settlement of Sesklo, Magnesia. Through a bihistorical approach and the recording of alternative narratives of households, dominated by practices of cultural intimacy between human and non-human actors, this thesis aims to create a record of domestic techniques genealogies. It proposes an atlas of domestic biodiversity conservation as a database for the development of architectural design mechanisms for modern accommodation protocols.

Key-words

household, non-human actors, livestock, co-domestication, care, Genealogy

3.3. Flexible sustainable business parks

Chrysanthi Tsourapi

Department of Planning and Regional Development

Abstract

This PhD research focuses on the role and identity of "3rd generation" Business Parks by exploring the possibility of creating flexible models of Sustainable Business Parks that can be adapted and evolve over time. Business Parks that will present a studied spatial and temporal entrepreneurship.

The Business Park (EB) is an organically integrated receptor of structures and services that operate in the Secondary and Tertiary Sector together with all the infrastructures that ensure the orderly functioning of these structures. Some of the research questions that are investigated in this thesis, considering the current state-of-the-art, are as follows:

1) Investigating the key role of Business Parks in supporting regional development.
2) Investigating the key role of Business in formulating and implementing modern spatial policies.
3) Investigating the impact of Digital Transformation and Industry 4.0.
4) Determining the appropriate establishment of Flexible Sustainable Business Parks.
5) Indicator toolbox creation of the flexibility and sustainability of Business Parks.

Key-words

Flexible model, spatial planning, flexible Business Parks, Sustainability

3.4. The connection between tourism sustainability and regional development in the light of spatio-temporal concentrations

Pelagia Moloni

Department of Planning and Regional Development

Abstract

One notable aspect of hospitality and tourism industry is its unequal spatial distribution and seasonal variations in tourist flows. Key contributing factors include social and cultural elements like school holidays, as well as environmental ones like location or climate. This has as a result a number of detrimental effects on society, environment, employment and the economy. Tourist destinations can face resource depletion and overcrowding during the peak season. On the other hand, lower demand during off season might result in underutilized resources and unstable employment. Despite the literature focusing on the causes of this phenomenon, the policies in place do not seem to tackle it, although it is considered one of the key issues affecting the sustainability of the industry. The research will focus on the Mediterranean as the highest, constantly increasing levels of seasonality, while the pattern of sun, sea and sand is adopted by the Mediterranean tourism destinations with tourism activity mainly taking place during the summer season. To approach the issue, a review and evaluation of the measures implemented in Mediterranean regions with the aim to mitigate seasonal variations, will be carried out followed by a statistical analysis in order to evaluate their effectiveness. The uniqueness of the research, lies in the fact that there is no extensive literature between tourism seasonality and space in combination with sustainable development. The model that will be developed will provide the possibility of creating a framework for action, which will lead to the implementation of policies about Greece.

Key-words

Seasonality, regional development, Mediterranean, Policy responses

3rd Session: Planning

3.5. The negative consequences of the unlimited tourism growth in medium to large scale cities

Eleni Komninou

Department of Planning and Regional Development

Abstract

Overtourism is a neologism but not a new phenomenon. Debates over the extensive tourism growth and the consequences on the destinations have been on the table for decades. However, the recovery of tourism following the pandemic crisis of Covid -19, which is considered as a positive sign of growth and resilience of the sector, revived the discussion of the tourism overcrowding.

Consequences of which are evident in leading destinations worldwide. Having also in mind the predictions for further tourism growth in the upcoming years, the need to manage and tackle the phenomenon, agreeing for its existence, is more urgent and imperative than ever. Preceding of the solutions is understanding the phenomenon, its causes and consequences.

This doctoral thesis aims to enrich the existing knowledge about overtourism by studying the phenomenon, the international experience and its existence in Greece via a spatial planning approach and answer whether overtourism is a result of the way planning and policies are being implemented via their evaluation and reaching finally in an overtourism management toolbox.

Key-words

overtourism, spatial planning, toolbox, policies, management

3.6. Quantifying levels of energy poverty vulnerability in Europe: A preliminary approach

Nikolaos Kokosis

Department of Planning and Regional Development

Abstract

The energy crisis triggered by the outbreak of war between Russia and Ukraine has contributed to the intensification of socio-economic inequalities in the European area and the emergence of new forms of poverty beyond material deprivation. Energy poverty is a multidimensional phenomenon affecting an increasing number of households. The phenomenon is spatially heterogeneous and dynamic in nature. Energy poverty focuses on the financial difficulties that households or individuals face in accessing energy services due to their inability to cover their energy costs. The purpose of this study is twofold. In a first phase, a comprehensive methodological framework will be developed, taking into account all the determinants whose presence can trigger the fragility of spatial units. Five thematic fields comprise the vulnerability framework, covering aspects of (a) economic hardship, (b) energy costs, (c) building characteristics, (d) socio-economic conditions of the population and households' composition, and (e) climatic conditions and location of dwellings. A statistical tool (composite indicator) to quantify levels of vulnerability in the European area will be developed in a second phase. The composite indicator will consist of 25 sub-indices following the methodology proposed by the Organization for Economic Co-operation and Development (OECD). This tool will form the basis for the development of an observatory that will record the evolution of vulnerability levels over time, enabling decision-makers to develop and design effective mitigation strategies.

Key-words

energy poverty, energy deprivation, vulnerability, composite indicator

3.7. Next generation of composite materials for sustainable structural retrofitting: Experimental and analytical study

Ioanna Skyrianou

Department of Civil Engineering

Abstract

This thesis focusses on the development of novel geopolymer mortar mixes as a sustainable alternative to cement-based mortars that are used as a matrix in composite materials used in structural strengthening applications. The experimental programme includes the development of the mix design of geopolymer mortars after a brief optimisation process. The mortars are designed using precursors with a lower carbon footprint than cement with a goal to optimise both their strength and workability. Then, significant mechanical properties, such as the compressive and flexural strength, elastic modulus and their durability after exposure to chemicals and environmental changes of the optimal geopolymer mixes are measured in an effort to evaluate their compatibility to be used in composites. Subsequently, the designed geopolymer mortars are used as a matrix in textile-reinforced mortars and basic properties such as their tensile strength and bond behaviour on a concrete substrate are evaluated. Moreover, the newly developed composites are used for flexural strengthening of reinforced concrete beams to assess their performance in structural strengthening in comparison to conventional cement-based composites. To complement the experimental programme, analytical models describing the cohesive material law and the strengthening effectiveness of the novel composite materials are developed.

Key-words

geopolymer, textile-reinforced mortar, RC strengthening, material characterization, durability

3rd Session: Planning

3.8. Structural design and analysis of masonry infilled RC frames retrofitted with advanced composite materials

Matthildi Monastiridou

Department of Civil Engineering

Abstract

The behavior of TRM-strengthened masonry infilled RC frames subjected to cyclic loading has been experimentally investigated widely in the past. However, very few analytical models have been developed until now to simulate their behavior when subjected to in-plane or out-of-plane seismic loading. These models have, also, not been sufficiently validated against experimental data.

This PhD research aims to develop a realistic and simple analytical simulation for this type of structure, when subjected to in-plane or/and out-of-plane loading. Emphasis will be placed on their interaction, since in-plane damage significantly impairs the structure's resistance to out-of-plane loading. Afterwards, the seismic response of typical multi-storey existing RC framed structures through non-linear parametric time history analyses will be studied.

To date, an investigation has been conducted to determine the ability of materials following different hysteresis laws to capture the experimental response of a 3-story masonry infilled RC frame, using the open-source software OpenSees. Also, to assist the validation of existing models and/or the development of design formulations, an experimental database was developed. Data from more than 90 specimens have been collected from literature, along with details related to their geometry, reinforcement, strengthening, failure mode, and cyclic response characteristics. Moreover, an experimental campaign will be carried out to investigate the effectiveness of externally bonded TRM jackets in single-story masonry infilled RC frames with and without openings. Regarding the strengthening scheme, a combination of basalt fiber textile and standard expanded polystyrene thermal insulation system (EPS) will be used.

Key-words

Reinforced Concrete (RC), Masonry Infills, Textile-Reinforced Mortar (TRM), Analytical Modeling, Seismic Design

3rd Session: Planning

3.9. On the seismic fragility and resilience of retaining walls and slopes of road networks

Apostolos Panagos

Department of Civil Engineering

Abstract

Retaining structures and slopes are often found on road and rail transport networks. Seismically induced damage on these systems may lead to significant downtimes of these networks, resulting in significant losses. Therefore, it is important to assess the vulnerability and resilience of these systems to seismic hazard, especially in earthquake-prone countries such as Greece. This research aims at proposing an innovative numerical methodology for the seismic vulnerability and resilience assessment of slopes and retaining wall-slope systems of road networks. In particular, representative systems will be examined numerically, under plain strain conditions, accounting for salient parameters affecting the response and vulnerability namely the geometry of the examined systems, the spatial distribution of ground properties, the water table, the characteristics of seismic motion, as well as potential ageing phenomena on the examined retaining walls. In the frame of this research, analytical fragility functions will be developed for the examined configurations and for various damage states. Additionally, a novel methodology will be developed to assess and quantify, via adequate practical indexes, the resilience of the examined configurations, accounting for the seismic hazard at the location of the examined configuration and its seismic vulnerability.

Key-words

retaining walls, slopes, seismic behavior, seismic vulnerability, fragility function

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