WCL-IT

Newsletter
Wire Communications and Information Technology Laboratory (WCL-IT)

Newsletter Date: January 2024 **2024**

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Research Groups

www.wcl.ece.upatras.gr/

Note from Editor

Research during the COVID pandemic

WCL-IT continues its tradition of academic excellence with basic research, solutions to cutting edge problems, new endeavors and with the onboarding of a new generation of scientists and engineers that will shape the future of communications and information technology.

In this issue a glimpse of the latest WCL-IT lab activities is highlighted. Ranging from an international Master's program on Biomedical Engineering that has attracted more than 1000 applicants all over the world, to leading European Research projects led by WCL-IT members, to top tier cutting edge publications in leading journals like Nature Communications, Nature Scientific Reports and IEEE Transactions, to student research awards and contribution to the regional cultural domain, WCL-IT lab continues to serve as a hub of research creativity to its members and students.

Konstantinos Moustakas

Professor, WCL-IT Director

WCL-IT Research Groups

- Artificial Intelligence Group
- Audio and Acoustic Technology Group
- Communication Networks, Teletraffic Engineering and Applications Group
- Communications and Telematic Applications Group
- Digital Transmission and Coding Group
- Network Architectures and Management Group
- Visualization and Virtual Reality Group (VVR)

Research and Innovation

VVR Group

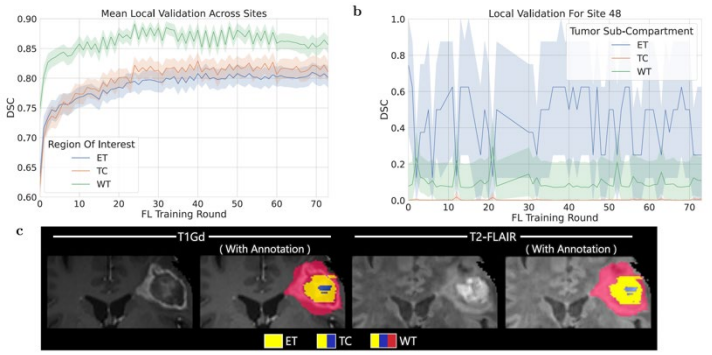
vvr.ece.upatras.gr

https://ieeexplore.ieee.org/document/9120202

Research and Innovation

Research publication in Nature Communications

WCL-IT is one of the more than 50 groups and institutions worldwide that participate in a federated learning for Cancer Detection flagship initiative. The research is lead by Spyridon Bakas from the University of Pennsylvania. The article titled "Federated learning enables big data for rare cancer boundary detection" presents the largest Federated Learning study to-date, involving data from 71 sites across 6 continents, to generate an automatic tumor boundary detector for the rare disease of glioblastoma, reporting the largest such dataset in the literature ($n = 6,314$). We demonstrate a 33% delineation improvement for the surgically targetable tumor, and 23% for the complete tumor extent, over a publicly trained model. We anticipate our study to: 1) enable more healthcare studies informed by large diverse data, ensuring meaningful results for rare diseases and underrepresented populations, 2) facilitate further analyses for glioblastoma by releasing our consensus model, and 3) demonstrate the FL effectiveness at such scale and task-complexity as a paradigm shift for multi-site collaborations, alleviating the need for data-sharing.



S. Bakas, …, S. Alexiou, E. Zacharaki, K. Moustakas, et. al, "Federated Learning Enables Big Data for Rare Cancer Boundary Detection", Nature Communications, vol. 13, article 7346, 2022.

Research publication in Nature Scientific Reports

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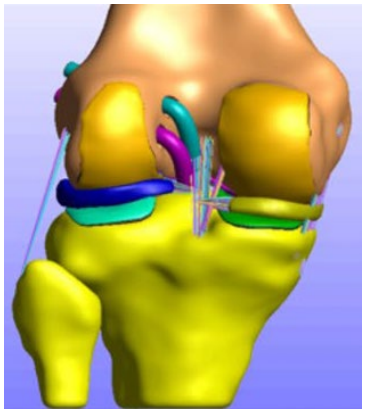
https://ieeexplore.ieee.org/document/9459476



The article titled "*Evaluation of anterior cruciate ligament surgical reconstruction through finite element analysis*" authored by K. Risvas, D. Stanev, L. Benos, K. Filip, D. Tsaopoulos and K. Moustakas was published in the Nature Scientific Reports journal. Research focuses *on an automated modeling framework that accepts subject-specific geometries and produces finite element knee models incorporating different surgical techniques. A plethora of "what-if" simulations are performed, comparing responses with the reference model. Interesting findings include (a) increasing graft pretension and radius reduces relative knee displacement, (b) the correlation of graft radius and tension should not be neglected, (c) graft fixation angle of 20◦ can reduce knee laxity, and (d) single- versus double-bundle techniques demonstrate comparable performance in restraining knee translation. In most cases, these findings confirm reported values from comparative clinical studies.*

The numerical models are made publicly available, allowing for experimental reuse and lowering the barriers for meta-studies. The modeling approach proposed here can complement orthopedic surgeons in their decision-making.

K. Risvas, D. Stanev, E. Benos, D. Tsaopoulos and K. Moustakas, "Evaluation of Anterior Cruciate Ligament Surgical Reconstruction Through Finite Element Analysis", Nature Scientific Reports, vol. 12, article 8044, 2022.

VVR Group

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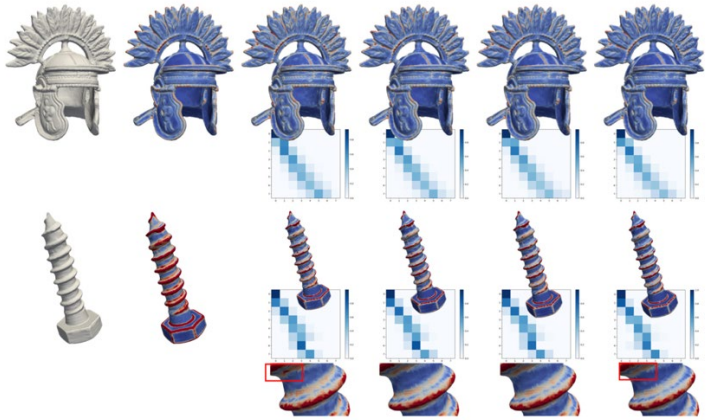
https://doi.org/10.1038/s41598-022-06407-0

Deep Saliency Mapping for 3D Meshes and Applications

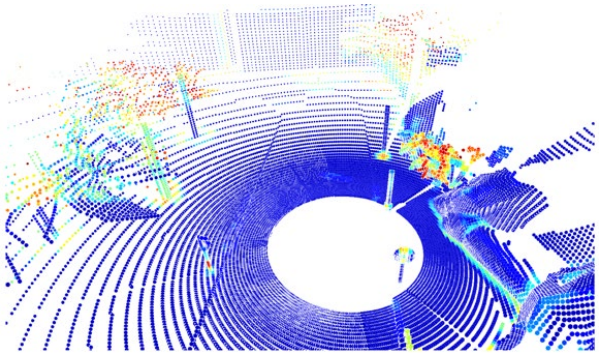
Nowadays, three-dimensional (3D) meshes are widely used in various applications in different areas (e.g., industry, education, entertainment and safety). The 3D models are captured with multiple RGB-D sensors, and the sampled geometric manifolds are processed, compressed, simplified, stored, and transmitted to be reconstructed in a virtual space. These low-level processing applications require the accurate representation of the 3D models that can be achieved through saliency estimation mechanisms that identify specific areas of the 3D model representing surface patches of importance. Therefore, saliency maps guide the selection of feature locations facilitating the prioritization of 3D manifold segments and attributing to vertices more bits during compression or lower decimation probability during simplification, since compression and simplification are counterparts of the same process. In this work, we present a novel deep saliency mapping approach applied to 3D meshes, emphasizing decreasing the execution time of the saliency map estimation, especially when compared with the corresponding time by other relevant approaches. Our method utilizes baseline 3D importance maps to train convolutional neural networks. Furthermore, we present applications that utilize the extracted saliency, namely feature-aware multiscale compression and simplification frameworks.

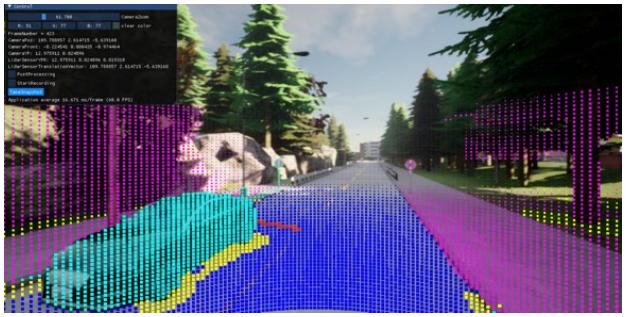


S. Nousias, G. Arvanitis, A.S. Lalos, K. Moustakas, "Deep Saliency Mapping for 3D Meshes and Applications", ACM Transactions on Multimedia Computing Communications and Applications, vol. 19, no. 2, article 71, March 2023.

Cooperative Saliency-based Pothole Detection and AR Rendering for Increased Situational Awareness

Autonomous vehicles are expected to operate safely in real-life road conditions in the next years. Nevertheless, unanticipated events such as the existence of unexpected objects in the range of the road, can put safety at risk. The advancement of sensing and communication technologies and Internet of Things may facilitate the recognition of hazardous situations and information exchange in a cooperative driving scheme, providing new opportunities for the increase of collaborative situational awareness. Safe and unobtrusive visualization of the obtained information may nowadays be enabled through the adoption of novel Augmented Reality (AR)





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Audio and Acoustic Technology Group

interfaces in the form of windshields. Motivated by these technological opportunities, we propose in this work a saliency-based distributed, cooperative obstacle detection and rendering scheme for increasing the driver's situational awareness through (i) automated obstacle detection, (ii) AR visualization and (iii) information sharing (upcoming potential dangers) with other connected vehicles or road infrastructure. An extensive evaluation study using a variety of real datasets for pothole detection showed that the proposed method provides favorable results and features compared to other recent and relevant approaches.

G. Arvanitis, N. Stagakis, E.I. Zacharaki and K. Moustakas, "Cooperative Saliency-based Pothole Detection and AR Rendering for Increased Situational Awareness", IEEE Transactions on Intelligent Transportation Systems, accepted for publication. https://arxiv.org/pdf/2302.00916.pdf

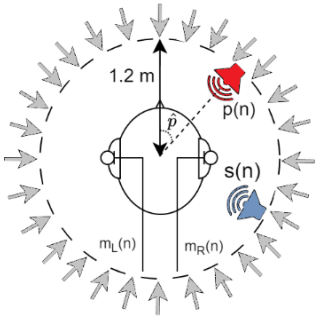
Perceptual Modeling of Spatial Audio System Reproduction

The research concerns modeling and interpretation of the underlying mechanisms governing sound perception, especially in the context of spatial (3D or immersive) audio systems. Such models can be applied to optimal production / reproduction of audio content for music, audiovisual and VR applications. Novel methodologies have been proposed for assessing perceptual and affective (e.g. emotions, preference) sound attributes in a dynamic continuous and ecologically valid way, and interpretable machine learning models have been developed for modeling either perceptual or affective attributes, providing further insight on how high-level representations of the environment and states of the listeners are formed.

Moiragias, G., Mourjopoulos, J. (2023). A listener preference model for spatial sound reproduction, incorporating affective response. Plos one, 18(6), e0285135.

Perceptual Optimization for headphone listening

This research focuses on smart headphones that exploit psychoacoustic phenomena to improve the listening experience of a headphone user. An Active Noise Control (ANC) system that utilizes the spectral masking effect has been developed, as well as a spatially-aware ANC methodology that relies on Time-Domain Beamforming and an Encoder-Decoder Machine Learning localization model to successfully attenuate sources (e.g. noise) that are considered especially annoying to the listener.



Zachos P., Kamaris G, Mourjopoulos J., "Feedforward Headphone Active Noise Control Utilizing Auditory Masking", Journal of the Audio Engineering Society, accepted Dec, 2023

VVR Group

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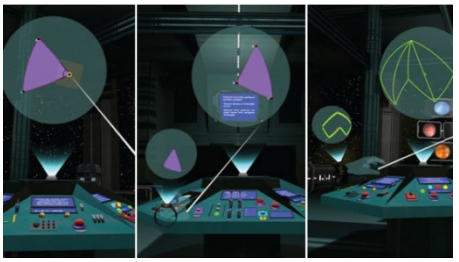
More information:

https://www.vvr.ece.upatras.gr/awards/finalists-ieee-vr-2022-3dui-contest/

Communication Networks, Teletraffic Engineering and Applications Group

Honors-Awards-Distinctions

Winners IEEE VR 2024 – 3DUI contest



VVR group members Agapi Chrysanthakopoulou (ECE graduate), Theofilos Chrysikopoulos, Leandros-Nikolaos Arvanitopoulos (undergraduate students) supervised by Prof. Konstantinos Moustakas were selected as finalists and won the second place of the 3DUI contest of the IEEE VR 2024 conference. The conference was held in Orlando, Florida on March 18-21, where the team demonstrated their innovation. The purpose of the contest was to stimulate innovative and creative XR solutions to challenging educational mathematical problems. Participants were asked to create and submit an original 3DUI project. This could include XR(VR/AR/MR)-driven 3DUI systems that IEEE VR attendants can run with their own devices.

The awarded VVR submission was entitled "Beyond Euclid: An Educational VR Journey into Spherical Geometry" and introduced an innovative educational virtual reality (VR) experience aimed at immersing users in the complexities of spherical geometry and non-Euclidean spherical trigonometry. Focused on spherical triangles, navigation methods, and map projections, the VR journey offers an interactive platform for learning about Earth's unique geometry. Users engage in modules that explore the properties of spherical triangles, challenges in earth navigation, and the intricacies of map projections, providing them with insights into geodesics and their practical applications. An innovative calculator is designed that allows users to use a spaceship's control system for doing calculations, thus creating a more intuitive and engaging experience.

A. Chrysanthakopoulou, T. Chrysikopoulos, L. -N. Arvanitopoulos and K. Moustakas, "Beyond Euclid: An Educational VR Journey into Spherical Geometry," 2024 IEEE Conference on Virtual Reality and 3D User Interfaces Abstracts and Workshops (VRW), Orlando, FL, USA, 2024, pp. 1100-1101, doi: 10.1109/VRW62533.2024.00344.

ETSI launches First Software Development Group based on University of Patras open-source work

ETSI announced the establishment of its first Software Development Group, called OpenSlice. With this group, ETSI positions itself as a focal point for development and experimentation with network slicing. OpenSlice is creating an open-source, service-based Operations Support System (OSS) to deliver Network Slice as a Service (NSaaS) in alignment with specifications from leading Standards Development Organizations, including

3GPP, TM Forum, and GSMA. As part of ETSI's broader efforts in Future Networks, OpenSlice joins forces with Open Source MANO and TeraFlowSDN to enrich the suite of ETSI open source components. This comprehensive framework designed to facilitate experimentation, proofs-of-concept, integration, and testing, delivers valuable early and regular feedback to the standardization process. (https://www.etsi.org/newsroom/press-releases/2263-etsi-launches-first-software-development-group)

Keynotes and Editorials

Prof. Michael Logothetis, Guest Editor and Deputy EIC in IET Networks,

Michael Logothetis, João Paulo Barraca, Shigeo Shioda, and Khaled Rabie, "Guest Editorial: Special Issue on Network/Traffic Optimization towards 6G Network", in IET Networks.

Micheal Logothetis, Deputy Editor in Chief, IET Networks journal (2023-Present).

Prof. John Mourjopoulos, Keynote speaker

John Mourjopoulos, New Horizons in Audio Technologies, National Conference of Hellenic Institute of Acoustics "Acoustics 2022".

Students and Education

EMMBIOME: New Erasmus-Mundus MSc program on Biomedical Engineering

http://emmbiome.eu

The historic Biomedical Engineering MSc program of the University of Patras that is led by the Electrical and Computer Engineering department and the WCL-IT lab is being internationalized within the context of the EU Erasmus-Mundus framework. Within the new EMMBIOME International MSc program three universities with long tradition in Biomedical Engineering and respective MSc programs join forces in an international 2-year and 120 ECTS Joint-MSc program. University of Patras, University of Kragujevac and University Gregore Popa of Iasi are the founding members of EMMBIOME. Students will spend one semester in each institution, while they will perform their diploma thesis at the institution of their choice.

For the academic year 2023-2024 EMMBIOME received more than 350 applications. After a thorough procedure including interviews 17 students were selected from 11 countries spanning the globe. Students spend the spring semester of 2024 at the University of Patras.

Joint PhD procedures with the Vrije University of Brussels in place

Artificial Intelligence Group

The WCL-IT lab of the Electrical and Computer Engineering Department is leading discussions with the Vrije University of Brussels for a Joint-PhD program and agreement. Discussion are concluding and early in 2024 the first student of WCL-IT will start a joint-PhD with the VUB. Similar research internationalization efforts with other significant EU academic institutions are in progress allowing for easier mobility and international collaboration of PhD studies.

NVIDIA workshop on Deep Learning (Sgarbas: any similar event?)

AI-Hub Collaboration with the Simon Fraser University

The AI-Hub has announced its collaboration with the SNF Centre for Hellenic Studies at Simon Fraser University (SFU), Canada. The two partners will join forces in order to develop an intelligent interactive agent (Study Buddy) that will help students learn Modern Greek as a second language. The agent will employ modern transformer-based language models and will be able to initiate natural conversation with the student.

2nd Artificial Intelligence Contest of the AI-Hub

In November 29, 2023, the Award Ceremony of the 2nd Artificial Intelligence Contest of the AI-Hub has held at the Science and Technology Museum of the University of Patras. The contest is held yearly for undergraduate students of the University of Patras who develop and present projects related to Artificial Intelligence. This year's prizes were awarded to the students: Konstantinos Skantzis, 1st prize, for his project "Smart-Data-Enabled Maintenance Strategies: A Path to Operational Excellence", Ilias Ouzounis, 2nd prize, for his project "AI Guess the Elo", and Ioannis Tsampras and Stavros Kanias, 3rd prize, for their project "Digital Twins for Industrial Greenhouses".

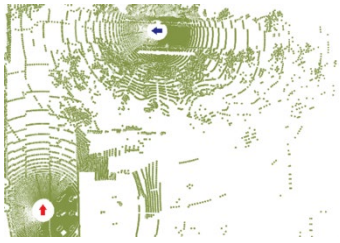
Spotlight on our Research- R&D Projects

VVR Group

Spotlight on our Research – R&D Projects

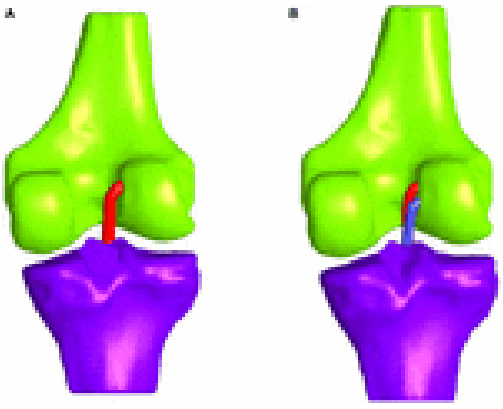
Didymos-XR

WCL-IT is at the forefront of the Digital Twins basic and applied research in Europe. The VVR group is a leading partner in one of the four Horizon-Europe projetcs funded from the EU in the field of Digital Twins for eXtended Reality. Within Didymos-XR the WCL-IT is performing cutting edge research in the field of Point Cloud processing, understanding, registration, compression, interaction and rendering while special focus is given on realistic XR rendering of dynamic point cloud and mesh information. WCL-IT research has already been published in top international journals (IEEE Transactions on Intelligent Transportation systems) and conference venues (EuroXR). The developed algorithms and systems will be deployed in the Idealworks ware house (BMW group) and the city of Etteln (Germany) and Vilanova (Spain).



Audio and Acoustic Technology Group

Health Hub



WCL-IT ia a member of one of the six "*innovation hubs"* funded in Greece. Health hub is the only hub where the University of Patras is involved in. The hub will implement activities related to innovation and exploitation of mature researh activities that can be provided to the medical and innovation community. WCL-IT will promote its awarded tools related to computation biomechanics, modeling and simulation and Mixed Reality in Health. The Health Hub will be connected with similara innovation hubs in Europe shareing similar foci, thus generating a pan-european network on health realted innovation.

Digital Center for Audiovisual Heritage

The VVR and Audiogroup of WCL-IT participated in a Municipality of Patras project for the Digital Center for Audiovisual Heritage, planned in the site and refurbished buildings of the old Patras Municipal Hospital. Professor Konstantinos Moustakas and Emeritus Professor John Mourjopoulos joined as technical experts the interdisciplinary group of this project which laid down the required facilities and equipment especially for the planned audiovisual, VR and AR applications and functionalities of this center.

AUDIOSAT project

The Audiogroup has started a research collaboration with the Satways Ltd., a private company based in Athens, Greece. The project concerns passive sensing (detection, classification, identification, and tracking) of noise sources (ground and acoustic noise) in land and sea. The project will focus on array processing techniques for estimating the Direction of Arrival (DOA) of sound sources, on denoising of background noise interference and finally on time-frequency-space classification and identification algorithms. The case studies concern data from Underwater and land Distributed Acoustic Sensing (DAS), Underwater hydrophone arrays and Land Unattended Ground Sensor (UGS) from geophone arrays.

Ancient Theatre Acoustics - measurement and analysis of Epidaurus Ancient Theatre

The Audiogroup continues the self-funded exploitation of ancient theatre acoustics and Prof. John Mourjopoulos co-chaired the 2nd Symposium of Anceint Theatre Acoustics held in Verona on July 2022. On May 2023, an updated set of acoustic measurements and recordings was carried out at the ancient theatre of Epidaurus with the support of Renesas (Patras) company engineers. These measurements also concerned the acoustic effect of ancient theatrical masks and this visit included a team supported by the Norwegian Institute of Athens, consisting of Thanos Vovolis, scenografer and Assistant Professor at Deree, The American College of Greece, Øystein Elle,

Associate Professor -Music and Theatre Faculty, Norwegian Theater Academy, Østfold University, Norway, Janne Hoem, Performance director and interdisciplinary artist and Elfi Sverdrup, Singer of traditional Norwegian, Sami and Inuit vocal techniques.
The Audiogroup has published new research findings concerning the effect of sound diffraction in the acoustics of the ancient theatres, with reference to the theatre of Epidaurus. It is increasingly evident that in such theaters, sound diffraction at the edges of the multiple tiers generates significant source signal amplification.

K. Kaleris, G. Moiragias, P. Hatziantoniou & J. Mourjopoulos, Time-frequency diffraction acoustic modeling of the Epidaurus ancient theatre, Acta Acustica, 7, 67 (2023) https://doi.org/10.1051/aacus/2023059

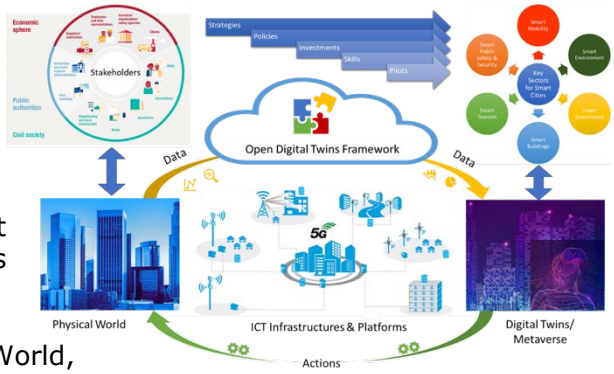
Prometheus project

The Audiogroup and VVR-groups of WCL participated in the project "Context-aware Adaptive 3D Projection based on Motion and Activity Estimation for the Immersive and Interactive Experience of Ancient Drama Performances"-Prometheus funded by ESPA, in collaboration with IRIDA Labs and coordinated by the National Theatre of Northern Greece.

The WCL groups designed and implement 3D projection tools, which can be driven in real-time via traced objects – actors to provide augmented reality aids for the live performances of the theatrical plays.
The project was completed on October 2023.

MetaCities Excellence Hub in South-Eastern Europe

METACITIES is an Excellence Hub for future cities and regions in Southeast Europe, built upon Digital Twins and metaverse technologies, through cross-border collaboration focusing on innovation and engaging all different categories of actors of the Quadruple Helix. The four year project is coordinated by University of Patras and Prof Spyros Denazis



Starting from the Physical World, representing the actual city or region, METACITIES propose a series of system blueprints and recommendations that can be used to successfully build their Digital Twins and Metaverses. METACITIES conceptual model represents an evolution of the notion of smart city, which usually implies the use of Information Communication Technologies for the processing of data and their statistical manifestations in the form of dashboards. As Digital Twins are directly and in real time, interconnected and interacting with the physical city, exchanging processing data and making decisions, they can execute actions on the city's operations that may affect its daily life.

https://metacities-hub.com/

5GASP Project

5GASP aims at shortening the idea-to-market process through the creation of a European testbed for SMEs that is fully automated and self-service, in order to foster rapid development and testing of new and innovative 5G Network Applications built using the 5G NFV based reference architecture. Building on top of existing physical infrastructures, 5GASP intends to focus on innovations related to the operation of experiments and tests across several domains, providing software support tools for Continuous Integration and Continuous Deployment (CI/CD) of VNFs in a secure & trusted environment for European SMEs capitalizing in the 5G market. 5GASP targets the creation of an Open Source Software (OSS) repository and of a VNF marketplace targeting SMEs with OSS examples and building blocks, as well as the incubation of a community of Network Application developers assisted with tools and services that can enable an early validation and/or certification of products and services for 5G. We focus on inter-domain use-cases, development of operational tools and procedures (supporting day-to-day testing and validation activities) and security/trust of 3rd party IPR running in our testbeds.

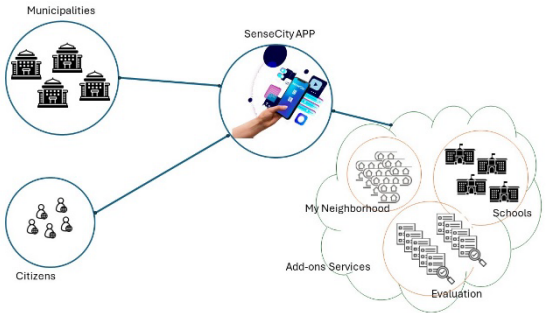
5G-VICTORI Project

The 5G-VICTORI consortium concluded on June 27th in Patras, Greece, its ultimate Field Trials and, as the last event of the project, a Workshop dedicated to 5G and vertical industries was held in Athens, Greece on June 28th. These two events spanned from Monday, June 26th, to Wednesday, June 28th.

During the first two days, the group gathered at the University of Patras with representatives from the European Commission. The main goal was to present and demonstrate the results of the trials taking place in Greece, including final on-site demonstrations of Use Cases (UCs): UC #1.1 (Enhanced Mobile Broadband under High Speed Mobility) and UC #3 (Media Services provisioning in Railway Environment) at Hellenic Train facilities; UC #2 (Factories of the Future), at ADMIE facilities; and, finally, results of UC #4 (Energy Metering). These results showed how 5G technology can meet the needs and Key Performance Indicators (KPIs) of different industries, such as Transportation, Energy, Media and Factories of the Future.

SenseCity

The sense.city platform provides tools for citizen engagement, enhancing creativity, planning, and communication. Its goal is to involve citizens in addressing city problems, inform the municipality and fellow citizens about issues in real-time, and manage these issues through municipal services. By using the platform, citizens become the sensors of the city, strengthening the immediacy in the relationship between the municipality and the citizens. The solution includes applications for reporting issues, a



management environment for processing them, and providing statistics. With technologies tested in Greek municipalities like Patras, sense.city improves the daily lives of citizens and the efficiency of municipalities.

Recent Publications

https://www.vvr.ece.upatras.gr/projects/didymos-xr/

https://didymos-xr.eu

Recent Publications

K. Risvas, D. Stanev, E. Benos, D. Tsaopoulos and K. Moustakas, "Evaluation of Anterior Cruciate Ligament Surgical Reconstruction Through Finite Element Analysis", Nature Scientific Reports, vol. 12, article 8044, 2022.

S. Bakas, …, S. Alexiou, E. Zacharaki, K. Moustakas, et. al, "Federated Learning Enables Big Data for Rare Cancer Boundary Detection", Nature Communications, vol. 13, article 7346, 2022.

S. Nousias, G. Arvanitis, A.S. Lalos, K. Moustakas, "Deep Saliencey Mapping for 3D Meshes and Applications", ACM Transactions on Multimedia Computing Communications and Applications, vol. 19, no. 2, article 71, March 2023.

E. Moustridi, K. Risvas and K. Moustakas, "Predictive Simulation of Single-Leg Landing Scenarios for ACL Injury Risk Factors Evaluation", Plos One, vol. 18, no. 3, e0282186, March 2023.

I. Loi, E.I. Zacharaki and K. Moustakas, "Machine Learning Approaches for 3D Motion Synthesis and Musculoskeletal Dynamics Estimation: A Survey", IEEE Transactions on Visualization and Computer Graphics, accepted for publication.

G. Arvanitis, N. Stagakis, E.I. Zacharaki and K. Moustakas, "Cooperative Saliency-based Pothole Detection and AR Rendering for Increased Situational Awareness", IEEE Transactions on Intelligent Transportation Systems, accepted for publication.

Moiragias, G., Mourjopoulos, J. (2023). A listener preference model for spatial sound reproduction, incorporating affective response. Plos one, 18(6), e0285135.

Moiragias, G., & Mourjopoulos, J. (2023, May). An Evaluation Method for Temporal Spatial Sound Attributes. In Audio Engineering Society Convention 154. Audio Engineering Society.

K. Kaleris, G. Moiragias, P. Hatziantoniou & J. Mourjopoulos, Time-frequency diffraction acoustic modeling of the Epidaurus ancient theatre, Acta Acustica, 7, 67 (2023)

K. Kaleris, E. Kaniolakis-Kaloudis, N. Aravantinos-Zafiris, D. T. G. Katerelos, V. Dimitriou, M. Bakarezos, M. Tatarakis, J. Mourjopoulos, M. M. Sigalas & N. A. Papadogiannis, Acoustic metamaterials characterization via laser-plasma sound sources, submitted to Nature Photonics (2023).

P., Zachos, G., Moiragias, J., Mourjopoulos, "Targeted Beamforming Active Noise Control Based on Disturbance Metrics", Forum Acusticum, Sep 2023, Turin, Italy.

P., Zachos, J., Mourjopoulos, "Beamforming headphone ANC for targeted noise attenuation", Audio Engineering Society Convention 154. Audio Engineering Society (2023).

P. Hatziantoniou, G. Kamaris, K. Kaleris, G. Moiragias, P. Zachos, S. Agorgianitis, J. Mourjopoulos (2022). "Evaluation of 3D sound rendering in a Cave Automatic Virtual Environment (CAVE)", Proceedings of 10th National Conference «Acoustics 2022» (in Greek), 14-16 Oct. 2022, Thessaloniki, Greece.

P., Zachos, J., Mourjopoulos, D., Mermingas , "Large scale headphone analysis for digital filter design". Proceedings of 10th National Conference «Acoustics 2022» (in Greek),Thessaloniki, Greece, 14-16 October 2022.

P. Zachos., G. Kamaris, J. Mourjopoulos "Binaural data reduction for robust direction of arrival estimation via convolutional neural network for reverberant signals". Proceedings of 10th National Conference «Acoustics 2022» (in Greek), Thessaloniki, Greece, 14-16 October 2022.

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