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Research Data

Journal Papers:	14
Conference Papers:	28
Citations:	595 (Google Scholar, 4 June 2019)
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Publications

Journals

J-14: Antonis Nikitakis Konstantinos Makantasis, Nikolaos Tampouratzis, and Ioannis Papaefstathiou. "A Unified Novel Neural Network Approach and a Prototype Hardware Implementation for Ultra-Low Power EEG Classification". accepted for publication in *IEEE Transactions on Biomedical Circuits and Systems, 2019*

Summary:

This paper introduces a novel electroencephalogram (EEG) data classification scheme together with its implementation in hardware using an innovative approach. The proposed scheme integrates into a single, end-to-end trainable model a spatial filtering technique and a neural network based classifier. The spatial filters, as well as, the coefficients of the neural network classifier are simultaneously estimated during training. By using different time-locked spatial filters, we introduce for the first time the notion of "attention" in EEG processing, which allows for the efficient capturing of the temporal dependencies and/ or variability of the EEG sequential data. One of the most important benefits of our approach is that the proposed classifier is able to construct highly discriminative features directly from raw EEG data and, at the same time, to exploit the function approximation properties of neural networks, in order to produce highly accurate classification results. The evaluation of the proposed methodology, using public available EEG datasets, indicates that it outperforms the standard EEG classification approach based on filtering and classification as two separated steps. Moreover, we present a prototype implementation of the proposed scheme in state-of-the-art reconfigurable hardware; our novel implementation outperforms by more than one order of magnitude, in terms of power efficiency, the conventional CPU-based approaches.

J-13: Konstantinos Makantasis, Anastasios Doulamis, Nikolaos Doulamis, and Antonis Nikitakis. "Tensor-based classification models for hyperspectral data analysis". to appear in *IEEE Transactions on Geoscience and Remote Sensing, 2018*

Summary:

In this paper, we present tensor-based linear and nonlinear models for hyperspectral data classification and analysis. By exploiting principles of tensor algebra, we introduce new classification architectures, the weight parameters of which satisfy the rank-1 canonical decomposition property. Then, we propose learning algorithms to train both linear and non-linear classifiers. The advantages of the proposed classification approach are that i) it significantly reduces the number of weight parameters required to train the model (and thus the respective number of training samples), ii) it provides a physical interpretation of model coefficients on the classification output and iii) it retains the spatial and spectral coherency of the input samples. The linear tensor-based model exploits principles of logistic regression assuming the rank-1 canonical decomposition property among its weights. For the non-linear classifier, we propose a modification of a feedforward neural network (FNN),

called rank-1 FNN, since its weights satisfy again the rank-1 canonical decomposition property. An appropriate learning algorithm is also proposed to train the network. Experimental results and comparisons with state of the art classification methods, either linear (e.g., Linear SVM) or non-linear (e.g., deep learning) indicates the outperformance of the proposed scheme, especially in cases where a small number of training samples is available.

J-12: Konstantinos Makantasis and Markos Papageorgiou. "Motorway path planning for automated road vehicles based on optimal control methods". in *Transportation Research Record, 2018*

Summary:

A path-planning algorithm for automated road vehicles on multi-lane motorways is derived from the opportune formulation of an optimal control problem. In this framework, the objective function to be minimized contains appropriate respective terms to reflect: the goals of the vehicle advancement; the passenger comfort; the prevailing traffic rules (e.g. overtaking only from left); the avoidance of obstacles (other moving vehicles) and of road departures. Each term is coupled with a weighting factor that reflects its comparative importance. For the numerical solution of the optimal control problem, a very efficient feasible direction algorithm is used. To avoid local minima, a simplified Dynamic Programming algorithm is also conceived to deliver the initial guess trajectory for the optimal control algorithm. Thanks to low computation times, the approach is readily executable within a model predictive control frame. The performance of the proposed algorithm is illustrated using two typical driving scenarios.

J-11: Konstantinos Makantasis, Antonis Nikitakis, Anastasios Doulamis, Nikolaos Doulamis, and Yannis Papaefstathiou. "Data-driven background subtraction algorithm for in-camera acceleration in thermal imagery". *IEEE Transactions on Circuits and Systems for Video Technology, 2017*

Summary:

Detection of moving objects in videos is a crucial step towards successful surveillance and monitoring applications. A key component for such tasks is called background subtraction and tries to extract regions of interest from the image background for further processing or action. For this reason, its accuracy and real-time performance is of great significance. Although, effective background subtraction methods have been proposed, only a few of them take into consideration the special characteristics of thermal imagery. In this work, we propose a background subtraction scheme, which models the thermal responses of each pixel as a mixture of Gaussians with unknown number of components. Following a Bayesian approach, our method automatically estimates the mixture structure, while simultaneously it avoids over/under fitting. The pixel density estimate is followed by an efficient and highly accurate updating mechanism, which permits our system to be automatically adapted to dynamically changing operation conditions. We propose a reference implementation of our method in reconfigurable hardware achieving both adequate performance and low power consumption. Adopting a High Level Synthesis design, demanding floating point arithmetic operations are mapped in reconfigurable hardware; demonstrating fast- prototyping and on-field customization at the same time.

J-10: Athanasios Voulodimos, Nikolaos Doulamis, Dieter Fritsch, Konstantinos Makantasis, Anastasios Doulamis, and Michael Klein. "Four-dimensional reconstruction of cultural heritage sites based on photogrammetry and clustering". *Journal of Electronic Imaging, 26(1):011013–011013, 2017*

Summary:

A system designed and developed for the three-dimensional (3-D) reconstruction of cultural heritage (CH) assets is presented. Two basic approaches are presented. The first one, resulting in an "approximate" 3-D model, uses images retrieved in online multimedia collections; it employs a clustering-based technique to perform content-based filtering and eliminate outliers that significantly reduce the performance of 3-D reconstruction frameworks. The second one is based on input image data acquired through terrestrial laser scanning, as well

as close range and airborne photogrammetry; it follows a sophisticated multistep strategy, which leads to a "precise" 3-D model. Furthermore, the concept of change history maps is proposed to address the computational limitations involved in four-dimensional (4-D) modeling, i.e., capturing 3-D models of a CH landmark or site at different time instances. The system also comprises a presentation viewer, which manages the display of the multifaceted CH content collected and created. The described methods have been successfully applied and evaluated in challenging real-world scenarios, including the 4-D reconstruction of the historic Market Square of the German city of Calw in the context of the 4D-CH-World EU project.

J-9: Konstantinos Makantasis, Eftychios Protopapadakis, Anastasios Doulamis, Nikolaos Doulamis, and Nikolaos Matsatsinis. "3d measures exploitation for a monocular semisupervised fall detection system". *Multimedia Tools & Applications, 75.22, pp. 15017-15049, 2016*

Summary:

Falls have been reported as the leading cause of injury-related visits to emergency departments and the primary etiology of accidental deaths in elderly. Thus, the development of robust home surveillance systems is of great importance. In this article, such a system is presented, which tries to address the fall detection problem through visual cues. The proposed methodology utilizes a fast, real-time background subtraction algorithm, based on motion information in the scene and pixels intensity, capable to operate properly in dynamically changing visual conditions, in order to detect the foreground object. At the same time, it exploits 3D space's measures, through automatic camera calibration, to increase the robustness of fall detection algorithm which is based on semi-supervised learning approach. The above system uses a single monocular camera and is characterized by minimal computational cost and memory requirements that make it suitable for real-time large scale implementations.

J-8: Konstantinos Makantasis, Eftychios Protopapadakis, Anastasios Doulamis, and Nikolaos Matsatsinis. "Semi-supervised vision-based maritime surveillance system using fused visual attention maps". *Multimedia Tools & Applications, 75.22, pp. 15051-15078, 2016*

Summary:

This paper presents a vision-based system for maritime surveillance, using moving PTZ cameras. The proposed methodology fuses a visual attention method that exploits low-level image features appropriately selected for maritime environment, with appropriate tracker, without making any assumptions about environmental or visual conditions. The offline initialization is based on large graph semi-supervised technique. System's performance was evaluated with videos from cameras placed at Limassol port and Venetian port of Chania. Results suggest high detection ability, despite dynamically changing visual conditions and different kinds of vessels, all in real time.

J-7: Konstantinos Makantasis, Anastasios Doulamis, Nikolaos Doulamis, and Marinos Ioannides. "In the wild image retrieval and clustering for 3d cultural heritage landmarks reconstruction". *Multimedia Tools & Applications, 75.7, pp. 3593-3629, 2016*

Summary:

One of the main characteristics of Internet era is the free and online availability of extremely large collections of images located on distributed and heterogeneous platforms over the web. The proliferation of millions of shared photographs spurred the emergence of new image retrieval techniques based not only on images' visual information, but on geolocation tags and camera exif data. These huge visual collections provide a unique opportunity for cultural heritage documentation and 3D reconstruction. The main difficulty, however, is that the internet image datasets are unstructured containing many outliers. For this reason, in this paper a new content-based image filtering is proposed to discard image outliers that either confuse or significantly delay the followed e-documentation tools, such as 3D reconstruction of a cultural heritage object. The presented approach exploits and fuses two unsupervised clustering techniques: DBSCAN and spectral clustering. DBSCAN algorithm is used to re-

move outliers from the initially retrieved dataset and spectral clustering discriminate the noise free image dataset into different categories each representing characteristic geometric views of cultural heritage objects. To discard the image outliers, we consider images as points onto a multi-dimensional manifold and the multi-dimensional scaling algorithm is adopted to relate the space of the image distances with the space of Gram matrices through which we are able to compute the image coordinates. Finally, structure from motion is utilized for 3D reconstruction of cultural heritage landmarks. Evaluation on a dataset of about 31,000 cultural heritage images being retrieved from Internet collections with many outliers indicate the robustness and cost effectiveness of the proposed method towards a reliable and just-in-time 3D reconstruction than existing state-of-the-art techniques.

J-6: Georgia Kyriakaki, Anastasios Doulamis, Nikolaos Doulamis,Marinos Ioannides, Konstantinos Makantasis, Eftichios Protopapadakis, Andreas Hadjiprocopis, Konrad Wenzel, Dieter Fritsch, Michael Klein, et al. "4d reconstruction of tangible cultural heritage objects from web-retrieved images". *International Journal of Heritage in the Digital Era, 3(2):431–452, 2014*

Summary:

The number of digital images that are available online today has reached unprecedented levels. Recent statistics showed that by the end of 2013 there were over 250 billion photographs stored in just one of the major social media sites, with a daily average upload of 300 million photos. These photos, apart from documenting personal lives, often relate to experiences in well-known places of cultural interest, throughout several periods of time. Thus from the viewpoint of Cultural Heritage professionals, they constitute valuable and freely available digital cultural content. Advances in the fields of Photogrammetry and Computer Vision have led to significant breakthroughs such as the Structure from Motion algorithm which creates 3D models of objects using their 2D photographs. The existence of powerful and affordable computational machinery enables the reconstruction not only of single structures such as artefacts, but also of entire cities. This paper presents an overview of our methodology for producing cost-effective 4D – i.e. in space and time – models of Cultural Heritage structures such as monuments and artefacts from 2D data (pictures, video) and semantic information, freely available 'in the wild', i.e. in Internet repositories and social media. State-of-the-art methods from Computer Vision, Photogrammetry, 3D Reconstruction and Semantic representation are incorporated in an innovative workflow with the main goal to enable historians, architects, archaeologists, urban planners and other cultural heritage professionals to reconstruct cost-effective views of historical structures out of the billions of free images floating around the web and subsequently interact with those reconstructions.

J-5: Christos Roumpos, Panagiotis Partsinevelos, Konstantinos Makantasis, Zacharias Agioutantis, and Antigoni Vlachou. "The optimal location of the distribution point of the belt conveyor system in continuous surface mining operations". *Simulation Modelling Practice and Theory, 47, pp. 19-27, Elsevier, 2014*

Summary:

Continuous surface mining projects are dynamic and quite complex. They are characterized by geological and spatial variability and several stochastic parameters that affect initial planning and final design. In strategic mine planning and operations management of such projects, the location of the distribution point of the belt conveyor system (BCDP) is of high importance as it directly influences mine development and the production schedule. In addition, the spatial location of the BCDP directly affects project cash flow including investment and operating costs and, as a result, the economic viability of the mining project. Therefore, the problem of the optimal location of BCDP could be defined as an economic optimization problem focusing on the material transportation cost. In this paper a model for the optimal location of BCDP in continuous surface mines is formulated based on the minimization of the transportation cost within the lifetime of the mine. A computer model was developed based on a methodological approach and was verified utilizing an actual lignite deposit which was simplified in terms of geometry and geology. Simulation results compare well with actual data available for the specific lignite mine.

J-4: Panagiotis Partsinevelos, Konstantinos Papadakis, and Konstantinos Makantasis. "Spatiotemporal graph queries on geographic databases under a conceptual abstraction scale". *Geospatial Information Science, 17(2):110–118, 2014*

Summary:

Visual queries assist non-expert users to extract information from spatial databases in an intuitive and natural approach, making Geographic information systems comprehensive and efficient for a wide range of applications. A common visual means of querying takes the form of drawings or graphs, under which many spatial ambiguity and translation errors rise. In this study, common query attributes extracted from user graphs such as spatial topology, size, cardinality, and proximity are regarded under a conceptual moderation scheme. Thus, the system/user may concentrate on various conceptual combinations of information. Furthermore, time is incorporated to support spatiotemporal queries for changing scenes and moving objects. Arbitrary, relative, and absolute scaling is possible according to the dataset and application at hand. The theoretic approach is implemented under a prototype user interface system, called ShapeController. Under this prototype, a user may extract scene-based relations in an automatically inferred fashion, or include single object-oriented relations when all possible relations seem redundant. Finally, a natural language description of the query is extracted upon which the user may select the desired query relations. Experimentation on a spatial database demonstrates the concepts of predefined draw objects, scaling relaxation, conceptual abstraction, and scene, object- and textual-oriented transitions that promote query expressiveness and restrain ambiguities.

J-3: Marinos Ioannides, Konstantinos Makantasis, et. al. "Online 4D reconstruction using multi-images available under Open Access". *ISPRS Annals of the Photogrammetry, Remote Sensing and Saptial Information Sciences, II-5 W, vol.1, pp. 169-174, 2013*

Summary:

The advent of technology in digital cameras and their incorporation into virtually any smart mobile device has led to an explosion of the number of photographs taken every day. Today, the number of images stored online and available freely has reached unprecedented levels. It is estimated that in 2011, there were over 100 billion photographs stored in just one of the major social media sites. This number is growing exponentially. Moreover, advances in the fields of Photogrammetry and Computer Vision have led to significant breakthroughs such as the Structure from Motion algorithm which creates 3D models of objects using their two dimensional photographs. The existence of powerful and affordable computational machinery not only the reconstruction of complex structures but also entire cities. This paper illustrates an overview of our methodology for producing 3D models of Cultural Heritage structures such as monuments and artefacts from 2D data (pictures, video), available on Internet repositories, social media, Google Maps, Bing, etc. We also present new approaches to semantic enrichment of the end results and their subsequent export to Europeana, the European digital library, for integrated, interactive 3D visualisation within regular web browsers using WebGl and X3D. Our main goal is to enable historians, architects, archaeologists, urban planners and affiliated professionals to reconstruct views of historical structures from millions of images floating around the web and interact with them.

J-2: Panagiotis Partsinevelos, Elias Stamboliadis, and Konstantinos Makantasis. "Image based mineral liberation simulation incorporating experimental grinding models". *CanadianMetallurgicalQuarterly, 51(4):383-389, 2012*

Summary:

Breakage and liberation evolution of multigrain particles is a complex procedure upon which decision making can be based for the exploitation of minerals. Under this study, scanned image material samples are used to estimate mineral liberation. Image processing and computational simulations provide grain phase statistics, grade distributions and liberation attitude under varying sizes and distributions. Incorporating an experimentally based breakage model to the simulation, the time or energy of a grinding procedure is associated to liberation. Since image scanned samples lack the third dimension, an error estimation of approximating material volumes through two-dimensional measured areas is conducted.

The findings verify the theoretical liberation models, while the proposed processes take into consideration the actual shapes and distributions of the particle grains as depicted from the image samples and thus establish a more reliable and realistic model.

J-1: Konstantinos Makantasis and Anastasios Doulamis. "3d measures computed in monocular camera system and svm-based classifier for humans fall detection". *TMC Academic Journal, 2011*
Summary:
Population in developed countries is aging. The quality of life for elderly is associated with their ability to live independently and with dignity without having the need to be attached to any person whose help they would they need for their daily life and social behavior. However, traumas resulting from falls have been reported as the second most common cause of death. For this reason, a major research effort has been conducted in the recent years for automatically detecting persons' falls. Such identification is prime research issue in computer vision society due to the complexity of the problem as far as the visual content is concerned. In this paper, we extend the work of (see C5) by proposing a fast, real-time computer vision algorithm capable to discriminate humans' falls in complex dynamically changing conditions in a supervised way. It exploits the motion information in the scene and 3D space's measures. This algorithm is using a single monocular low cost camera and it requires minimal computational cost and minimal memory requirements that make it suitable for large scale implementations in clinical institutes and home environments.

Conferences

C-28: Konstantinos Makantasis, Athanasios Voulodimos, Anastasios Doulamis, Nikolaos Doulamis, and Ioannis Georgoulas. "Hyperspectral Image Classification with Tensor-Based Rank-R Learning Models". in *IEEE International Conference on Image Processing (ICIP), 2019*
Summary:
In this paper, we present a general tensor-based nonlinear classifier, the Rank-R Feedforward Neural Network (FNN). In the proposed model, which is an extension of the Rank-1 FNN classifier, the network weights are constrained to satisfy a rank-R Canonical Polyadic Decomposition. By allowing a rank-R, instead of a rank-1, Canonical Polyadic Decomposition of the weights, the learning capacity of the model can be increased, which contributes to avoiding underfitting problems. The effectiveness of the proposed model is scrutinized on a hyperspectral image classification experimental setting, since hyperspectral data can naturally be represented as tensor objects. Performance evaluation results indicate that the proposed model outperforms other state-of-the-art models, including deep learning ones, especially in cases where the number of available training samples is small.

C-27: Antonios Liapis, Daniel Karavolos, Konstantinos Makantasis, Konstantinos Sfikas and Georgios N. Yannakakis. "Deep Fusion of Level and Ruleset Features for Multimodal Learning of Gameplay Outcomes". in *IEEE Conferences on Games (CoG-19), 2019*
Summary:
Which features of a game influence the dynamics of players interacting with it? Can a level's architecture change the balance between two competing players, or is it mainly determined by the character classes and roles that players choose before the game starts? This paper assesses how quantifiable gameplay outcomes such as score, duration and features of the heatmap can be predicted from different facets of the initial game state, specifically the architecture of the level and the character classes of the players. Experiments in this paper explore how different representations of a level and class parameters in a shooter game affect a deep learning model which attempts to predict gameplay outcomes in a large corpus of simulated matches. Findings in this paper indicate that a few features of the ruleset (i.e. character class parameters) are the main drivers for the model's accuracy in all tested gameplay outcomes, but the levels (especially when processed) can augment the model.

C-26: Konstantinos Makantasis, Maria Kontorinaki, and Ioannis Nikolos. "A Deep Reinforcement Learning Driving Policy for Autonomous Road Vehicles". in *8th Symposium of the European Association for Research in Transportation (hEART), 2019*
Summary:
This work regards our preliminary investigation on the problem of path planning for autonomous vehicles that move on a freeway. We approach this problem by proposing a driving policy based on Reinforcement Learning. The proposed policy makes minimal or no assumptions about the environment, since no a priori knowledge about the system dynamics is required. We compare the performance of the proposed policy against an optimal policy derived via Dynamic Programming and against manual driving simulated by SUMO traffic simulator.

C-25: Konstantinos Makantasis, Anastasios Doulamis, Nikolaos Doulamis, and Athanasios Voulodimos. "Common Mode Patterns for Supervised Tensor Subspace Learning". in *International Conference on Acoustics, Speech and Signal Processing (ICASSP), IEEE, 2019*
Summary:
In this work we propose a method for reducing the dimensionality of tensor objects in a binary classification frame- work. The proposed Common Mode Patterns (CMP) method takes into consideration the labels' information, and ensures that tensor objects that belong to different classes do not share common features after the reduction of their dimensionality. We experimentally validate the proposed supervised subspace learning technique and compared it against Multilinear Principal Component Analysis using a publicly available hyperspectral imaging dataset. Experimental results indicate that the proposed CMP method can efficiently reduce the dimensionality of tensor objects, while, at the same time, increasing the inter-class separability.

C-24: Konstantinos Makantasis, Anastasios Doulamis, Nikolaos Doulamis, Antonis Nikitakis, and Athanasios Voulodimos. "Tensor-based Nonlinear Classifier for High-order Data Analysis". in *International Conference on Acoustics, Speech and Signal Processing (ICASSP), IEEE, 2018*
Summary:
In this paper we propose a tensor-based nonlinear model for high-order data classification. The advantages of the pro- posed scheme are that (i) it significantly reduces the number of weight parameters, and hence of required training samples, and (ii) it retains the spatial structure of the input samples. The proposed model, called Rank-1 FNN, is based on a modification of a feedforward neural network (FNN), such that its weights satisfy the rank-1 canonical decomposition. We also introduce a new learning algorithm to train the model, and we evaluate the Rank-1 FNN on third-order hyperspectral data. Experimental results and comparisons indicate that the pro- posed model outperforms state of the art classification methods, including deep learning based ones, especially in cases with small numbers of available training samples.

C-23: Konstantinos Makantasis Nikolaos Doulamis, and Athanasios Voulodimos. "Recognizing Buildings through Deep Learning: A Case Study on Half-timbered Framed Buildings in Calw City". in *International conference on Computer Vision Theory and Applications (VISIGRAPP), pp. 444-450, 2017*
Summary:
Automatic detection and recognition of specific types of urban buildings is extremely important for a variety of applications ranging from outdoor urban reconstruction to navigation. In this paper we propose a system for the automatic detection and recognition of urban buildings. Most of the existing work relies on the exploitation of handcrafted features for recognizing buildings. However, due to their complex structure it is rarely a priori known which features are important for the recognition task. Our method overcomes this drawback by exploit- ing a deep learning framework, based on convolutional neural networks, which automatically construct highly descriptive features directly from raw data. We evaluate the performance of our method on the recognition of half-timbered framed buildings

in Calw city in Germany.

C-22: Eftychios Protopapadakis, Konstantinos Makantasis, George Kopsiaftis, Nikolaos Doulamis, and Aggelos Amditis. "Crack Identification Via User Feedback, Convolutional Neural Networks and Laser Scanners for Tunnel Infrastructures". in *International conference on Computer Vision Theory and Applications (VISIGRAPP), pp. 725-734, 2017*
Summary:
In this paper, a deep learning approach in conjunction with a laser scanning process are employed for the visual detection and accurate description of concrete defects in tunnels. Analysis is performed over raw RGB images; Convolutional Neural Network serves as the crack detector, during the inspection. In case of a positive detection, the tunnel's cross-section morphology is assessed via 3D point clouds, created by a laser scanner, allowing the identification of deformations in the compartment. The proposed approach, in contrast to the existing ones, emphasizes on applicability (easy initialization, no preprocessing of the input data) and provides a holistic assessment of the structure; reconstructed 3D model allows the fast identification of structural divergence from the original design, alerting the engineers for possible dangers.

C-21: Konstantinos Makantasis, Yannis Katsaros, Anastasios Doulamis, and Matthaios Bimpas. "Online indexing structure for big image data used for 3d reconstruction". in *Proceedings of the 11th Joint Conference on Computer Vision, Imaging and Computer Graphics Theory and Applications - Volume 4: RGB-SpectralImaging, (VISIGRAPP), pp. 705–714, 2016*
Summary:
One of the main characteristics of Internet era is the free and online availability of extremely large collections of images. Although the proliferation of millions of shared photos provide a unique opportunity for cultural heritage e-documentation, the main difficulty is that Internet image datasets are unstructured. For this reason, this paper aims to describe a new image indexing scheme with application in 3D reconstruction. The presented approach is capable, on the one hand to index images in a fast and accurate way and on the other to select form an image dataset the most appropriate images for 3D reconstruction, improving this way reconstruction computational time, while simultaneously keeping the same reconstruction performance.

C-20: Eftychios Protopapadakis, Christos Stentoumis, Nikolaos Doulamis, Anastasios Doulamis, Konstantinos Makantasis, Konstantinos Loupos, George Kopsiautis, and Aggelos Amditis. "Autonomous robotic inspection in tunnels". in *XXIII International Society for Photogrammetry and Remote Sensing (ISPRS), 2016*
Summary:
In this paper, an automatic robotic inspector for tunnel assessment is presented. The proposed platform is able to autonomously navigate within the civil infrastructures, grab stereo images and process/analyse them, in order to identify defect types. At first, there is the crack detection via deep learning approaches. Then, a detailed 3D model of the cracked area is created, utilizing photogrammetric methods. Finally, a laser profiling of the tunnel's lining, for a narrow region close to detected crack is performed; allowing for the deduction of potential deformations. The robotic platform consists of an autonomous mobile vehicle; a crane arm, guided by the computer vision-based crack detector, carrying ultrasound sensors, the stereo cameras and the laser scanner. Visual inspection is based on convolutional neural networks, which support the creation of high-level discriminative features for complex non-linear pattern classification. Then, real-time 3D information is accurately calculated and the crack position and orientation is passed to the robotic platform. The entire system has been evaluated in railway and road tunnels, i.e. in Egnatia Highway and London underground infrastructure.

C-19: Antonis Nikitakis, Ioannis Papaefstathiou, Konstantinos Makantasis, and Anastasios Doulamis. "A novel background subtraction scheme for in-camera acceleration in thermal imagery". in *Design, Automation & Test in Europe Conference & Exhibition (DATE), pp. 1497-1500. IEEE, 2016*

Summary:
Real-time segmentation of moving regions in image sequences is a very important task in numerous surveillance and monitoring applications. A common approach for such tasks is the "background subtraction" which tries to extract regions of interest from the image background for further processing or action; as a result its accuracy as well as its real-time performance is of great significance. In this work we utilize a novel scheme, designed and optimized for FPGA-based implementations, which models the intensities of each pixel as a mixture of Gaussian components; following a Bayesian approach, our method automatically estimates the number of Gaussian components as well as their parameters. Our novel system is based on an efficient and highly accurate on-line updating mechanism, which permits our system to be automatically adapted to dynamically changing operation conditions, while it avoids over/under fitting. We also present two reference implementations of our Background Subtraction Parallel System (BSPS) in Reconfigurable Hardware achieving both high performance as well as low power consumption; the presented FPGA-based systems significantly outperform a multi-core ARM and two multi-core low power Intel CPUs in terms of energy consumed per processed pixel as well as frames per second. Moreover, our low-cost, low-power devices allow for the implementation, for the first time, of a highly distributed surveillance system which will alleviate the main problems of the existing centralized approaches.

C-18: Konstantinos Makantasis, Anastasios Doulamis, Nikolaos Doulamis, and Konstantinos Psychas. "Deep learning based human behaviour recognition in industrial workflows". in *International Conference on Image Processing (ICIP), IEEE, 2016*
Summary:
We consider the fully automated behavior understanding through visual cues in industrial environments. In contrast to most existing work, which relies on domain knowledge to construct complex handcrafted features from inputs, we exploit a Convolutional Neural Network (CNN), which is a type of deep model and can act directly on the raw inputs, to automate the process of feature construction. Although such models are limited to handle still 2D inputs, in this paper we appropriately transform video input to incorporate temporal information into each frame. This way our model hierarchically constructs features from both spatial and temporal dimensions. We apply our model in real-world environment, on data taken from Nissan factory, and it achieves superior performance without relying on handcrafted features.

C-17: Konstantinos Makantasis, Konstantinos Karantzalos, Anastasios Doulamis, and Nikolaos Doulamis. "Deep supervised learning for hyperspectral data classification through convolutional neural networks". in *International Geoscience and Remote Sensing Symposium (IGARSS), pp. 4959–4962, IEEE, 2015*
Summary:
Spectral observations along the spectrum in many narrow spectral bands through hyperspectral imaging provides valuable information towards material and object recognition, which can be consider as a classification task. Most of the existing studies and research efforts are following the conventional pattern recognition paradigm, which is based on the construction of complex handcrafted features. However, it is rarely known which features are important for the problem at hand. In contrast to these approaches, we propose a deep learning based classification method that hierarchically constructs high-level features in an automated way. Our method exploits a Convolutional Neural Network to encode pixels' spectral and spatial information and a Multi-Layer Perceptron to conduct the classification task. Experimental results and quantitative validation on widely used datasets showcasing the potential of the developed approach for accurate hyperspectral data classification.

C-16: Konstantinos Makantasis, Konstantinos Karantzalos, Anastasios Doulamis, and Konstantinos Loupos. "Deep learning-based man-made object detection from hyperspectral data". in *Advances in Visual Computing, pages 717–727. Springer, 2015*
Summary:

Hyperspectral sensing, due to its intrinsic ability to capture the spectral responses of depicted materials, provides unique capabilities towards object detection and identification. In this paper, we tackle the problem of man-made object detection from hyperspectral data through a deep learning classification framework. By the effective exploitation of a Convolutional Neural Network we encode pixels' spectral and spatial information and employ a Multi-Layer Perceptron to conduct the classification task. Experimental results and the performed quantitative validation on widely used hyperspectral datasets demonstrating the great potentials of the developed approach towards accurate and automated man-made object detection.

C-15: Konstantinos Makantasis, Eftychios Protopapadakis, Anastasios Doulamis, Nikolaos Doulamis, and Constantinos Loupos. "Deep convolutional neural networks for efficient vision based tunnel inspection". in *International Conference onI ntelligent Computer Communication and Processing (ICCP), pp. 335–342. IEEE, 2015*

Summary:

The inspection, assessment, maintenance and safe operation of the existing civil infrastructure consists one of the major challenges facing engineers today. Such work requires either manual approaches, which are slow and yield subjective results, or automated approaches, which depend upon complex handcrafted features. Yet, for the latter case, it is rarely known in advance which features are important for the problem at hand. In this paper, we propose a fully automated tunnel assessment approach; using the raw input from a single monocular camera we hierarchically construct complex features, exploiting the advantages of deep learning architectures. Obtained features are used to train an appropriate defect detector. In particular, we exploit a Convolutional Neural Network to construct high-level features and as a detector we choose to use a Multi-Layer Perceptron due to its global function approximation properties. Such an approach achieves very fast predictions due to the feedforward nature of Convolutional Neural Networks and Multi-Layer Perceptrons.

C-14: Konstantinos Makantasis, Anastasios Doulamis, and Konstantinos Loupos. "Variational inference for background subtraction in infrared imagery". in *Advances in Visual Computing, pp. 693-705. Springer, 2015*

Summary:

We propose a Gaussian mixture model with fixed but unknown number of components for background subtraction in infrared imagery. Following a Bayesian approach, our method automatically estimates the number of components as well as their parameters, while simultaneously it avoids over/under fitting. The equations for estimating model parameters are analytically derived and thus our method does not require any sampling algorithm that is computationally and memory inefficient. The pixel density estimate is followed by an efficient and highly accurate updating mechanism, which permits our system to be automatically adapted to dynamically changing visual conditions. Experimental results and comparisons with other methods indicate the high potential of the proposed method while keeping computational cost suitable for real-time applications.

C-13: Nikolaos Doulamis, Anastasios Doulamis, Konstantinos Makantasis, Konstantinos Karantzalos, and Konstantinos Loupos. "Micro-scale thermal behavioral analysis for active evacuation routes". in *Proceedings of the 8th International Conference on PErvasive Technologies Related to Assistive Environments (PETRA), ACM, 2015*

Summary:

Evacuation is a complex process influenced by multiple parameters that have significant impact on the design and execution of an efficient Active Evacuation Route (AER). Computer vision algorithms are critical for an effective AER, since it indicates the current situation awareness of the environment. Thermal imaging is an alternative effective computer vision mechanisms for the analysis of the crowd behavior either at the micro or macro scale. Thermal imaging allows efficient determination of people from the background even if highly dynamic scenes, illumination, occlusions or content alterations. This allows micro-scale analysis of the crowds resulting in an efficient active evacuation design. Experiments on

thermal data from Athens International Airport indicate the assistive performance of our method.

C-12: Anastasios Doulamis, Nikolaos Doulamis, Konstantinos Makantasis, and Michael Klein. "A 4D Virtual/Augmented Reality Viewer Exploiting Unstructured Web-based Image Data". in *International conference on Computer Vision Theory and Applications (VISIGRAPP), pp. 631-639, 2015*

Summary:

Outdoor large-scale cultural sites are mostly sensitive to environmental, natural and human made factors, implying an imminent need for a spatio-temporal assessment to identify regions of potential cultural interest (material degradation, structuring, conservation). Thus, 4D modelling (3D plus the time) is ideally required for preservation and assessment of outdoor large scale cultural sites, which is currently implemented as a simple aggregation of 3D digital models at different time. However, it is difficult to implement temporal 3D modelling for many time instances using conventional capturing tools since we need high financial effort and computational complexity in acquiring a set of the most suitable image data. One way to address this, is to exploit the huge amount of images distributing over visual hosting repositories, such as flickr and picasa. These visual data, nevertheless, are loosely structured and thus no appropriate for 3D modelling. For this reason, a new content-based filtering mechanism should be implemented so as to rank (filter) images according to their contribution to the 3D reconstruction process and discards image outliers that can either confuse or delay the 3D reconstruction process. Then, we proceed to the implementation of a virtual/augmented reality which allows the cultural heritage actors to temporally assess cultural objects of interest and assists conservators to check how restoration methods affect an object or how materials decay through time. The proposed system has been developed and evaluated using real-life data and outdoor sites.

C-11: Eftychios Protopapadakis, Konstantinos Makantasis, and Nikolaos Doulamis. "Maritime Targets Detection from Ground Cameras Exploiting Semi-supervised Machine Learning". in *International conference on Computer Vision Theory and Applications (VISIGRAPP), pp. 583-594, 2015*

Summary:

This paper presents a vision-based system for maritime surveillance, using moving PTZ cameras. The proposed methodology fuses a visual attention method that exploits low-level image features appropriately selected for maritime environment, with appropriate tracker. Such features require no assumptions about environmental nor visual conditions. The offline initialization is based on large graph semi-supervised technique in order to minimize user's effort. System's performance was evaluated with videos from cameras placed at Limassol port and Venetian port of Chania. Results suggest high detection ability, despite dynamically changing visual conditions and different kinds of vessels, all in real time.

C-10: Konstantinos Makantasis, Anastasios Doulamis, Nikolaos Doulamis, Marinos Ioannides, and Nikolaos Matsatsinis. "Content-based filtering for fast 3d reconstruction from unstructured web-based image data". in *Digital Heritage. Progress in Cultural Heritage: Documentation, Preservation, and Protection, pp. 91-101. Springer, 2014*

Summary:

The huge amount of visual collections provides a unique opportunity for cultural heritage e-documentation and 3D reconstruction. The main difficulty, however, is its unstructured nature. In this paper a new content-based image filtering is proposed to discard image outliers that either confuse or significantly delay the 3D reconstruction process. The presented approach exploits a dense-based unsupervised paradigm applied on multi-dimensional manifolds where images are represented as image points. The multidimensional scaling algorithm is adopted to relate the space of the image distances with the space of Gram matrices to compute the image coordinates. Evaluation on a dataset of about 31,000 cultural heritage images being retrieved from Internet collections with many outliers indicate the robustness and cost effectiveness of the proposed method towards an affordable 3D reconstruction.

C-9: Anastasion Doulamis, Konstantinos Makantasis, et. al. "4D reconstruction of the past". in *First International Conference on Remote Sensing and Geoinformation of the Environment (RSCy2013), vol. 8795, 2013*

Summary:

One of the main characteristics of the Internet era we are living in, is the free and online availability of a huge amount of data. This data is of varied reliability and accuracy and exists in various forms and formats. Often, it is cross-referenced and linked to other data, forming a nexus of text, images, animation and audio enabled by hypertext and, recently, by the Web3.0 standard. Search engines can search text for keywords using algorithms of varied intelligence and with limited success. Searching images is a much more complex and computationally intensive task but some initial steps have already been made in this direction, mainly in face recognition. This paper aims to describe our proposed pipeline for integrating data available on Internet repositories and social media, such as photographs, animation and text to produce 3D models of archaeological monuments as well as enriching multimedia of cultural / archaeological interest with metadata and harvesting the end products to EUROPEANA. Our main goal is to enable historians, architects, archaeologists, urban planners and affiliated professionals to reconstruct views of historical monuments from thousands of images floating around the web.

C-8: Konstantinos Makantasis, Anastasios Doulamis, and Nikolaos Doulamis. "A non-parametric unsupervised approach for content based image retrieval and clustering". in *Proceedings of the 4th ACM/IEEE international workshop on Analysis and retrieval of tracked events and motion in imagery stream, pp. 33-40. ACM, 2013*

Summary:

Nowadays, there are available extremely large collections of images located on distributed and heterogeneous platforms over the web. The proliferation of billions of shared photos has outpaced the current technology for browsing such collections, but at the same time it spurred the emergence of new image retrieval techniques based not only on photos' visual information, but on geo-location tags and camera exif data. Although, additional image information may be proven very useful for preliminary image retrieval, the final retrieved result is necessary to be refined by exploiting visual information. In this paper we present a process for refining image retrieval results by exploiting and fusing two unsupervised clustering techniques: DBSCAN and spectral clustering. DBSCAN algorithm is used to remove outliers from the initially retrieved image set, and spectral clustering finalizes retrieval process by clustering together visually similar images. However, DBSCAN and spectral clustering require manual tunning of their parameters, which usually requires a priori knowledge of the dataset. To overcome this problem we developed a tuning mechanism that automatically tunes the parameters of both algorithms. For the evaluation of the proposed approach we used thousands of images from Flickr downloaded using text queries for well known cultural heritage monuments.

C-7: Konstantinos Makantasis, Anastasios Doulamis, and Nikolaos Doulamis. "Vision-based maritime surveillance system using fused visual attention maps and online adaptable tracker". in *14th International Workshop on Image Analysis for Multimedia Interactive Services (WIAMIS), pp. 1-4. IEEE, 2013*

Summary:

This paper presents a vision-based system for maritime surveillance using moving PTZ cameras. This system is intended to be used as an early warning system by local authorities. It fuses a visual attention method that exploits low-level image features appropriately selected for maritime environment, with an online adaptable neural network tracker, without making any assumptions about environmental or visual conditions. Systems performance was evaluated with videos from cameras placed at Limassol port and Venetian port of Chania and concerns robustness compared to dynamically changing visual conditions and different kinds of vessels, all in real time.

C-6: Yiannis Agadakos, Konstantinos Makantasis, Panagiotis Partsinevelos, George Papadakis,

and Anastasios Doulamis. "Safe urban growth: An integrated ICT solution for unstandardized and distributed information handling". in *14th International Symposium and Workshops on World of Wireless, Mobile and Multimedia Networks (WoWMoM), pp. 1-6. IEEE, 2013*

Summary:

In 2007, our planet became predominantly urban as for the first time, more than half of the world's population was living in cities. This tendency for urbanization is characterized by urban sprawl phenomena and excessive environmental pollution degrading citizens' living standards. Although intelligent and safe urban planning and management is a challenging task, latest ICT advances can offer promising solutions to the aforementioned problem by providing efficient and effective ways for handling large amounts of unstandardized and distributed information. In this paper we present an integrated, fully automatic ICT solution for acquiring, processing and representing heterogeneous, unstandardized and distributed information about underground gas pipeline networks, in order to provide a safe way for urban growth.

C-5: Konstantinos Makantasis, Anastasios Doulamis, and Nikolaos Matsatsinis. "3d measures computed in monocular camera system for fall detection". in *Proceedings of the 2nd International Conference on Advanced Communications and Computation (INFOCOMP), pp. 68-73, 2012*

Summary:

Traumas resulting from falls have been reported as the second most common cause of death. For this reason, computer vision tools can be exploited for detecting humans' fall incidents. In this paper, we propose a fast, real-time computer vision algorithm capable to detect humans' falls in complex dynamically changing conditions, by exploiting the motion information in the scene and 3D space's measures. This algorithm is using a single monocular low cost camera and it requires minimal computational cost and minimal memory requirements that make it suitable for large scale implementations in clinical institutes and home environments. The proposed scheme was tested in complex and dynamically changing visual conditions and as proved by the experiments it has the capability to detect over 92% of fall incidents.

C-4: Konstantinos Makantasis, Anastasios Doulamis, and Nikolaos Matsatsinis. "Student-t background modeling for persons' fall detection through visual cues". in *13th International Workshop on Image Analysis for Multimedia Interactive Services (WIAMIS), pp. 1-4. IEEE, 2012*

Summary:

This article presents a robust, real-time background subtraction algorithm able to operate properly in complex dynamically changing visual conditions and indoor/outdoor environments, based on a single, cheap monocular camera, like a webcam. This algorithm uses an image grid and models each pixel of the grid as a mixture of adaptive Student-t distributions. This approach makes this algorithm robust and efficient, in terms of computational cost and memory requirements, and thus suitable for large scale implementations. The proposed algorithm is applied in the problem of humans' fall detection that presents high complexity of visual content. Finally, the performances of this scheme and the scheme proposed in [C1] by the same authors, are compared.

C-3: Eftychios Protopapadakis, Anastasios Doulamis, Konstantinos Makantasis, and Athanasios Voulodimos. "A semisupervised approach for industrial workflow recognition". in *International Acadeny, Research and Industry Association, 2012*

Summary:

In this paper, we propose a neural network based scheme for performing semi-supervised job classification, based on video data taken from Nissan factory. The procedure is based on (a) a nonlinear classifier, formed using an island genetic algorithm, (b) a similarity-based classifier, and (c) a decision mechanism that utilizes the classifiers' outputs in a semi-supervised way, minimizing the expert's interventions. Such methodology will support the visual super-

vision of industrial environments by providing essential information to the supervisors and supporting their job.

C-2: Konstantinos Makantasis, Eftychios Protopapadakis, Anastasios Doulamis, Lazaros Grammatikopoulos, and Christos Stentoumis. "Monocular camera fall detection system exploiting 3d measures: a semi-supervised learning approach". in *European Conference on Computer Vision (ECCV). Workshops and Demonstrations, pp. 81-90. Springer, 2012*
Summary:
Falls have been reported as the leading cause of injury-related visits to emergency departments and the primary etiology of accidental deaths in elderly. The system presented in this article addresses the fall detection problem through visual cues. The proposed methodology utilize a fast, real-time background subtraction algorithm based on motion information in the scene and capable to operate properly in dynamically changing visual conditions, in order to detect the foreground object and, at the same time, it exploits 3D space's measures, through automatic camera calibration, to increase the robustness of fall detection algorithm which is based on semi-supervised learning. The above system uses a single monocular camera and is characterized by minimal computational cost and memory requirements that make it suitable for real-time large scale implementations.

C-1: Anastasios Doulamis and Konstantinos Makantasis. "Iterative scene learning in visually guided persons' falls detection". in *19th European Signal Processing Conference, pp. 779-783. IEEE, 2011*
Summary:
This article describes a fast real time computer vision algorithm able to detect humans' falls in complex dynamically changing visual conditions. The algorithm exploits single cameras of low cost while it requires minimal computational cost and memory requirements. Due to its affordability it can be straightforwardly implemented in large scale clinical institutes/home environments. In this paper, we evaluate the performance of this algorithm into two different real-world conditions. The evaluation was performed for long time and concerns robustness compared to other humans' activities, false positive/negative estimates, all in real time.