S3P-2017 Summer School on Signal Processing

Signal Processing meets Deep Learning - Sept. 4-8, 2017 @ Capri, Italy

IEEE-EURASIP S3P-2017

STUDENT POSTER LIST

IEEE

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EURASIP EUROPEAN ASSOCIATION FOR SIGNAL PROCESSING

DIETI UNINA

GRIP Image Processing Research Group

cnit consorzio nazionale interuniversitario per le telecomunicazioni

POSTER LIST

1) ESTIMATING CONFIDENCE MAPS FOR TOF-STEREO FUSION USING DEEP LEARNING
Agresti G., Minto L., Marin G., Zanuttigh P.

2)
MODELING AND CLASSIFICATION OF TRAJECTORIES BASED ON AGAUSSI AN PROCESS DECOMPOSITION INTO DISCRETE COMPONENTS
Campo D., **Baydoun M.**, Marcenaro L., Cavallaro A., Regazzoni C. S.

3) WAVE DIGITAL MODELING OF NONLINEAR SYSTEMS
Bernardini A.

4) CROWD ANALYSIS: FROM REAL TO SYNTHETIC
Bisagno N.

5) DEEP NETWORKS USING NORMAL FACTOR GRAPHS
Buonanno A., Di Gennaro G., Palmieri F.A.N.

6) MAXIMUM LIKELIHOOD TECHNIQUES FOR RSS-BASED LOCALIZATION
Carlino L., Bandiera F., Coluccia A., Ricci G., Jin D., Muma M., Zoubir A. M.

7) PREDICTIVE LEARNING MODELS OF HUMAN AGENTS MOVING IN COMPLEX ENVIRONMENTS
Coscia P., Castraldo F., Ballani L., Palmieri F.A.N., Alahi A., Savarese S.

8) RECASTING RESIDUAL-BASED LOCAL DESCRIPTORS AS CONVOLUTIONAL NEURAL NETWORKS: AN APPLICATION TO IMAGE FORGERY DETECTION
Cozzolino D. Poggi G., Verdoliva L.

9) ON THE COMPRESSION OF NOISY SPARSE SOURCES: SYNDROME ENCODING AND MODEL SELECTION
Elzanaty A., Giorgetti A., Chiani M.

10) A ZERO-LEAKAGE FUZZY EMBEDDER: FROM THE THEORETICAL FORMULATION TO REAL DATA
Hine GE., Maiorana E., Campisi P.

11) CONTEXT-AWARE CLUSTERING AND ASSESSMENT OF PHOTO COLLECTIONS
Kuzovkin D., Pouli T., Cozot R., Le Meur O., Kervec J., Bouatouch K.

12) END-TO-END CONVOLUTIONAL NEURAL NETWORK-BASED VOICE PRESENTATION ATTACK DETECTION
Muckenhirn H., Magimai. Doss M., Marcel S.

13) RESIDUAL-BASED FORENSIC COMPARISON OF VIDEO SEQUENCES
Mullan P., Riess C., Cozzolino D., Verdoliva L.

14) WORKING LOCALLY THINKING GLOBALLY: THEORY AND ALGORITHMS FOR CONVOLUTIONAL SPARSE CODING
Papyan V., Sulam J., Romano Y., Elad M.

15) A FAMILY OF SYNCHROSQUEEZING TRANSFORMS FOR MULTICOMPONENT SIGNALS ANALYSIS
Pham D.H., S. Meignen

16) CONTRAST ENHANCEMENT FOR MEDICAL IMAGE ANALYSIS WITH CONVOLUTIONAL NEURAL NETWORKS
Savelli B., Marchesi A., Bria A., Marrocco C., Molinara M., Tortorella F.

17) AUTHENTICATION OF BANKNOTES BY MAGNETIC CODED THREADS
Schulte J., Stöckli A.

18) MULTI-LAYER CONVOLUTIONAL SPARSE CODING: PURSUIT AND DICTIONARY LEARNING
Sulam, J., Romano, Y., Papyan V., Elad M

19) KERNEL REGRESSION FOR SIGNALS OVER GRAPHS
Venkitaraman A., Chatterjee S., Hãndel S.

20) STEGANALYSIS WITH DEEP LEARNING
Yedroudj M., Chaumont M., Comby F.

POSTER 1

TITLE:
ESTIMATING CONFIDENCE MAPS FOR TOF-STEREO FUSION USING DEEP LEARNING

AUTHOR LIST:
Agresti G., Minto L., Marin G., Zanuttigh P.

ABSTRACT:
We propose a novel framework for the fusion of depth data produced by a ToF camera and stereo vision system. The key problem of balancing between them is solved by extracting confidence maps using deep learning. We introduce a synthetic dataset representing the data acquired by the proposed setup and use it to train a CNN. Confidence maps are used to fuse the two depths by enforcing the local consistency. Experimental results show that the proposed approach allows to obtain accurate depth data.

POSTER 2

TITLE:
MODELING AND CLASSIFICATION OF TRAJECTORIES BASED O N A GAUSSIAN PROCESS DECOMPOSITION INTO DISCRETE COMPONENTS

AUTHOR LIST:
Campo D., **Baydoun M.**, Marcenaro L., Cavallaro A., Regazzoni C. S.

ABSTRACT:
A method to model and classify trajectory data that come from surveillance videos is proposed. Observations of the locations of moving entities are used to estimate their expected velocity in the scene. Such estimation is performed by
a Gaussian process that enables to approximate probabilistically the expected velocity of entities given some observed evidence in the scene. Regions where estimations have high certainty are decomposed into zones by superpixel segmentation. Each zone represents a region where motions of entities can be explained by a quasilinear dynamical model.

POSTER 3

TITLE:
WAVE DIGITAL MODELING OF NONLINEAR SYSTEMS

AUTHOR LIST:
Bernardini A.

ABSTRACT:
Many linear and nonlinear systems can be modeled using electric circuits. Traditional descriptions of analog circuits based on Kirchhoff variables present significant computability problems, as they are characterized by multidimensional implicit equations. The goal of this research project is to derive explicit (or semi-explicit) digital models of nonlinear circuits based on wave digital filters principles. Applications include: Virtual Analog modeling, simulation of dynamical systems, filtering and efficient implementations of digital signal processing algorithms.

POSTER 4

TITLE:
Crowd Analysis: from Real to Synthetic

AUTHOR LIST:
N. Bisagno

ABSTRACT:
The automated analysis of crowds and the identification of anomalies are important for predicting dangerous situations during events, for appropriately designing public spaces, and for the real-time management of people flows.

A unified framework for the validation and evaluation of crowd analysis algorithms is still not present, because of the fragmentation of real video datasets. To solve this problem, my research focuses on developing a simulation framework for crowds

POSTER 5

TITLE:
DEEP NETWORKS USING NORMAL FACTOR GRAPHS

AUTHOR LIST:
Buonanno A., Di Gennaro G., Palmieri F.A.N.

ABSTRACT:
In this work a Bayesian Multi-Layer Network, using the Factor Graphs in Reduced Normal Form (FGrn) paradigm, has been applied to a two-dimensional lattice.

Several Latent Variable Models (LVMs) are arranged in a quadtree hierarchy built on top of a bottom layer of random variables that represent a collection of spatially distributed discrete variables (e.g. pixels of an image or a feature map).

The hierarchical data representation built by the multi-layer architecture can be used, via belief propagation, for learning and inference tasks as pattern completion, correction and classification.

The FGrn paradigm provides great flexibility and modularity and appears as a promising candidate for building deep networks: the system can be easily extended by introducing variables with different cardinality and of different type. Prior knowledge, or supervised information, can be introduced at different levels.

POSTER 6

TITLE:
MAXIMUM LIKELIHOOD TECHNIQUES FOR RSS-BASED LOCALIZATION

AUTHOR LIST:
Carlino L., Bandiera F., Coluccia A., Ricci G., Jin D., Muma M., Zoubir A. M.

ABSTRACT:
In the context of Wireless Sensor Networks (WSNs), we deal with the problem of localizing one or more wireless nodes (blind nodes or agents) based on Received Signal Strength (RSS) using a statistical path loss model for the measurements and the Maximum Likelihood (ML) criterion.
Measures between nodes with known position (anchors) may also be available. Two different scenarios are considered. In the first, anchor-anchor measures are assumed to be available and used to estimate the model's parameters and a single, possibly moving agent, is present. A centralized ML algorithm is used to estimate the blind node position/trajectory. In the second, a multi-agent scenario is considered, anchor-anchor measures are not available and links between nodes may be LOS (Line Of Sight) or NLOS (Non LOS). A distributed ML algorithm, using a gaussian mixture approach, is proposed here as a solution. Numerical simulations show that both algorithms achieve high accuracy without requiring the so-called calibration, nor range estimates as in range-based algorithms. Moreover, simulations show that the distributed ML algorithm is also robust to non-gaussian noise present in NLOS links.

POSTER 7

TITLE:
PREDICTIVE LEARNING MODELS OF HUMAN AGENTS MOVING IN COMPLEX ENVIRONMENTS

AUTHOR LIST:
Coscia P., Castraldo F., Ballani L., Palmieri F.A.N., Alahi A., Savarese S.

ABSTRACT:
Human path prediction is a central problem in computer vision, robotics and decision systems. A wide range of real-world applications, such as autonomous cars and human-like robots, could benefit from the merging of predictive models and data acquired by the numerous sensors available both on-board and on the scene. For example, robots that interact with humans may gain advantage by predicting motion intentionality to improve their social tasks for everyday situations. Anomaly situations could be managed in advance by unveiling uncommon or non-standard actions.

The task appears quite challenging for long time intervals such as predicting what will happen within minutes rather than seconds. The forecasting is further complicated by modeling human internal motivations which guide a person towards a specific point since no physical law could describe intentions or thoughts.

Two different prediction techniques are considered:

• paths driven by circular distributions exploiting past observed patterns and semantic scenes segmentation. A ray-launching procedure avoids collisions and nearly-constant velocity dynamics smooth the acceleration progression;

• paths driven by a dynamic model based on attractive and repulsive forces generated by points of interest, obstacles and other agents.

POSTER 8

TITLE:
RECASTING RESIDUAL-BASED LOCAL DESCRIPTORS AS CONVOLUTIONAL NEURAL NETWORKS: AN APPLICATION TO IMAGE FORGERY DETECTION

AUTHOR LIST:
Cozzolino D. Poggi G., Verdoliva L.

ABSTRACT:
Local descriptors based on the image noise residual have proven extremely effective for a number of forensic applications, like forgery detection and localization. Nonetheless, motivated by promising results in computer vision, the focus of the research community is now shifting on deep learning. In this paper we show that a class of residual-based descriptors can be actually regarded as a simple constrained convolutional neural network (CNN). Then, by relaxing the constraints, and fine-tuning the net on a relatively small training set, we obtain a significant performance improvement with respect to the conventional detector.

POSTER 9

TITLE:

ON THE COMPRESSION OF NOISY SPARSE SOURCES: SYNDROME ENCODING AND MODEL SELECTION

AUTHOR LIST:

Elzanaty A., Giorgetti A., Chiani M.

ABSTRACT:

We provide two practical approaches for We provide two practical approaches for source compression of noisy sparse and compressible sources. The proposed schemes are based on channel coding theory to construct a source encoder that minimizes the number of transmitted bits while preserving the fidelity of the reconstructed signal by exploiting its sparsity. In addition, a model order selection scheme is proposed to detect the non-zero elements of sparse vectors embedded in noise. Also, we provide accurate analysis of the operational distortion rate function for the proposed schemes. The encoding rate of our approaches is close to the entropy bound and the distortion is lower than that obtained by compressed sensing.

POSTER 10

TITLE:
A ZERO-LEAKAGE FUZZY EMBEDDER: FROM THE THEORETICAL FORMULATION TO REAL DATA

AUTHOR LIST:
Hine GE., Maiorana E., Campisi P.

ABSTRACT:
We present a novel biometric cryptosystem obtaining perfect security, that is not leaking any information about the employed secret key from the knowledge of the stored helper data. We investigate the applicability of the proposed framework to practical scenarios while managing a trade-off between privacy and recognition performance. Experimental tests conducted on real fingerprint data prove the effectiveness of the proposed scheme.

POSTER 11

TITLE:

CONTEXT-AWARE CLUSTERING AND ASSESSMENT OF PHOTO COLLECTIONS

AUTHOR LIST:
Kuzovkin D., Pouli T., Cozot R., Le Meur O., Kervec J., Bouatouch K.

ABSTRACT:
Organizing large collections and selecting the best pictures among similar variants is a tedious task faced by numerous photographers. The existing automatic methods assess each picture in a collection independently, without taking into account the influence of surrounding photos, which define the photo context. We propose the context-aware photo assessment, where the context is modelled using a hierarchical clusteringapproach, and statistics of the extracted context and the entire photo collection guide identification of low-quality photos.

POSTER 12

TITLE:
END-TO-END CONVOLUTIONAL NEURAL NETWORK-BASED VOICE PRESENTATION ATTACK DETECTION

AUTHORS:
Muckenhirn H., Magimai.-Doss M., Marcel S.

Abstract:
Speaker verification (SV) systems aim to verify an identity claim based on an individual's voice. While current state-of-the-art SV systems are robust to zero-effort impostors, they are vulnerable to more sophisticated attacks, called presentation or spoofing attacks. Development of countermeasures to detect such attacks is a challenging and open research problem. Typically, this problem is approached by extracting features through conventional short-term speech processing and feeding them to a binary classifier. In this poster, we present a convolutional neural network-based approach that learns in an end-to-end manner the block processing, the features and the binary classifier from the raw signal.

POSTER 13

TITLE:
RESIDUAL-BASED FORENSIC COMPARISON OF VIDEO SEQUENCES

AUTHOR LIST:
Mullan P., Riess C., Cozzolino D., Verdoliva L.

ABSTRACT:
Video content can be acquired with off-the-shelf hardware, and is thus increasingly used to record events. With the growing role of videodata used to communicate to large audiences we need tools to ensure the authenticity of video content.
In this work, we propose a method for statistically comparing two video sequences. Per sequence, intra- and inter-frame residuals are computed. Additionally, optical flow is used to compensate for motion artifacts on inter-frame residuals. We use one sequence to build a statistical model, and compare it to the second sequence. Manipulations can be accurately localized if both sequences are subsequences of the same video as shown in evaluating the proposed method on greenscreen splices.

POSTER 14

TITLE:
WORKING LOCALLY THINKING GLOBALLY: THEORY AND ALGORITHMS FOR CONVOLUTIONAL SPARSE CODING

AUTHOR LIST:
Papyan V., Sulam J., Romano Y., Elad M.

ABSTRACT:
The celebrated sparse representation model has led to remarkable results in various signal processing tasks in the last decade. However, despite its initial purpose of serving as a global prior for entire signals, it has been commonly used for modeling low dimensional patches due to the computational constraints it entails when deployed with learned dictionaries. A way around this problem has been recently proposed, adopting a convolutional sparse representation model. This approach assumes that the global dictionary is a concatenation of banded Circulant matrices. While several works have presented algorithmic solutions to the global pursuit problem under this new model, very few truly-effective guarantees are known for the success of such methods. In this work, we address the theoretical aspects of the convolutional sparse model providing the first meaningful answers to questions of uniqueness of solutions and success of pursuit algorithms, both greedy and convex relaxations, in ideal and noisy regimes. To this end, we generalize mathematical quantities, such as the L0 norm, mutual coherence, Spark and RIP to their counterparts in the convolutional setting, intrinsically capturing local measures of the global model. On the algorithmic side, we demonstrate how to solve the global pursuit problem by using simple local processing, thus offering a first of its kind bridge between global modeling of signals and their patch-based local treatment.

POSTER 15

TITLE:
A FAMILY OF SYNCHROSQUEEZING TRANSFORMS FOR MULTIC OMPONENT SIGNALS ANALYSIS

AUTHOR LIST:
Pham D.H., S. Meignen

ABSTRACT:
This study puts forward a generalization of the short-time Fourier-based Synchrosqueezing Transform using a new local estimate of instantaneous frequency. Such a technique enables not only to achieve a highly concentrated time-frequency representation for a wide variety of AM-FM multicomponent signals but also to reconstruct their modes with a high accuracy. Numerical investigation on synthetic and gravitational-wave signals shows the efficiency of this new approach.

POSTER 16

TITLE:
CONTRAST ENHANCEMENT FOR MEDICAL IMAGE ANALYSIS WI TH CONVOLUTIONAL NEURAL NETWORKS

AUTHOR LIST:
Savelli B., Marchesi A., Bria A., Marrocco C., Molinara M., Tortorella F.

ABSTRACT:
Medical images are often affected by luminance non-linearities or irregular illumination which decrease the visibility of anatomical structures. For this reason, image enhancement plays an important role in the automated analysis process. This applies specifically to CNNs that have recently achieved state-of-the-art performance in many computer vision and medical image analysis applications. In our work, we focus on two-well--known medical image analysis problems that have been recently faced with CNNs: (i)microcalcification detection on mammographic x-ray images and(ii) retinal vessel segmentation on colour fundus images

Moving from the connection between haze, usually present in outdoor images, and the characteristics of the image under consideration we propose a new family of contrast enhancement techniques and we investigate their influence on the performance of three CNNs inspired by the popular Alexnet and VGGnet

POSTER 17

TITLE:
Authentication of banknotes by magnetic coded threads

AUTHOR LIST:
Schulte J., Stöckli A.

ABSTRACT:
Magnetic coded threads are machine readable security features in banknotes. The discrimination between genuine and counterfeited threadscan be formulated as the following signal processing problem: A thread delivers a periodic signal which is corrupted by noise, several measuring biases and disorders from other sources like production variations and degradation in circulation. The signal length is typically only one and a half to two periods. We estimate the period length and features of the signal shape in one period to authenticate if they are genuine. Algorithms are based on signal processing methods but the potential of deep learning shall be discussed.

POSTER 18
TITLE:
MULTI-LAYER CONVOLUTIONAL SPARSE CODING: PURSUIT AND DICTIONARY LEARNING

AUTHOR LIST:
Sulam, J., Romano, Y., Papyan V., Elad M.

ABSTRACT:
The recently proposed Multi-Layer Convolutional Sparse Coding (ML-CSC) model, consisting of a cascade of convolutional sparse layers, provides a new interpretation of Convolutional Neural Networks (CNNs). Under this framework, the computation of the forward pass in a CNN is equivalent to a pursuit algorithm aiming to estimate the nested sparse representation vectors -- or feature maps -- from a given input signal. Despite having served as a pivotal connection between CNNs and sparse modeling, a deeper understanding of the ML-CSC is still lacking: there are no pursuit algorithms that can serve this model exactly, nor are there conditions to guarantee a non-empty model. While one can obtain signals that approximately satisfy the ML-CSC constraints, it is not known how one can simply sample from the model, and it remains unclear how to train the convolutional filters from real data. In this work, we propose a sound pursuit algorithm for the ML-CSC model by adopting a projection approach. We provide new and improved bounds on the stability of the solution of such pursuit and we analyze different practical alternatives to implement this in practice. We show that the training of the filters is essential to allow for non-trivial signals in the model, and we derive an online algorithm to learn the dictionaries from real data, effectively resulting in cascaded sparse convolutional layers. Last, but not least, we demonstrate the applicability of the ML-CSC model for several applications in an unsupervised setting, providing competitive results.

Our work represents a bridge between matrix factorization, sparse dictionary learning and sparse auto-encoders, and we analyze these connections in detail.

POSTER 19

TITLE:
KERNEL REGRESSION FOR SIGNALS OVER GRAPHS

AUTHOR LIST:
Venkitaraman A., Chatterjee S., Händel S.

ABSTRACT:
My research is in the area of signal processing over graphs. Signal processing over graphs is an emerging notion aimed at unified treatment of data that lies over networks or irregular grids, and is based on concepts from spectral graph theory. One of the fundamental driving forces in this field is to investigate if conventional tools of signal analysis such as Fourier transforms and filtering may be extended to nonuniform data, lying on irregular grids. From wavelets to bilateral filters, a large wealth of signal processing concepts have been extended for graph signals. My research is currently focussed on bringing together machine learning aspects into analysis of graph signals. In particular, we consider the case of learning from input-output pairs using the knowledge that the output or target lies over a specified graph. The learnt model is then used to make predictions for outputs for new/unknown inputs. We perform this by proposing kernel regression for graph signals, which is shown to outperform conventional kernel regression at low training data sizes and under noisy training. We also simultaneously consider the problem of estimating a graph, given the graph signals.

POSTER 20

TITLE:
STEGANALYSIS WITH DEEP LEARNING

AUTHOR LIST:
Yedroudj M., Chaumont M., Comby F.

ABSTRACT:
Spatial steganalysis with a well designed CNN.