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Editorial

Editorial for Special Issue on Reproducible Research

It gives us great pleasure to introduce a special issue focused on reproducible research in digital signal processing. To the best of our knowledge it appears to be the first of its kind. Debates on the integrity and legitimacy of results presented on scientific papers have been longstanding. Consequently, some authors make an effort in making their experimental testbeds publicly available. Recently, web platforms have evolved to host example data, software and even manuscripts (such as Mendeley, github or arxiv). Interestingly, despite the apparent desire for such a platform within the peer-review journal concept, to the best of our knowledge, it has not been implemented before – neither for digital signal processing, nor for another EE-CS discipline. When this idea was brought into consideration by Elsevier, our guest editorial board became very excited about the opportunity. Thanks to a successful collaboration between Digital Signal Processing and SoftwareX, a *Joint* Special Issue was formulated for this Reproducible Research concept, where the conceptual presentation would be published in DSP, and the corresponding software presentation would be published in SoftwareX. Four guest editors from DSP and two guest editors from SoftwareX made a great effort in ensuring the timely submission of quality manuscripts from the best researchers. As a result of these efforts, a total of 47 quality submissions were made to the joint special issue.

With the help of expert reviewers, only 16 of these submissions were found to be of high-quality and qualified to appear in this joint special issue. These submissions all contain one DSP and one SoftwareX paper associated with each other. Due to the fast online appearance of these papers, they became already available on the internet before assigning volume and page numbers. It gives us great joy to see that, even before this editorial text was prepared and a volume number was assigned, many of the accepted papers already made their way to the list of "most downloaded papers" in DSP! We sincerely believe that the availability of the accompanying software (with a short manuscript to explain its usage and impact) greatly increases the visibility and interest towards the publications and improves their impact.

The quality of the scientific paper is the first and foremost factor in the impact of the papers, and the existence of an accompanying paper also contributes to this impact. Regarding the quality of the included works, these papers are already the best manuscripts that present excellent contributions by the finest researchers in the field of DSP. On top of the already high requirements of Digital Signal Processing, these papers were also required to address the "impact" requirement of SoftwareX, either through true novelty, or via proven usefulness (by proven interest from the community). No need to mention that the second submission to SoftwareX was also expected to pass all of the requirements of the corresponding journal, making the acceptance rate even smaller.

1. Overview of the papers

The final list of accepted papers can be categorized into three fundamental DSP groups: 1. Transforms/Filters, 2. Detection/Spectrum Estimation/Sensors, 3. Applications. Clearly, each paper can also define its own category, and this list can be extended up to the number of accepted papers. Furthermore, the programming language utilized could result in a different categorization from a software perspective.

1.1. Category 1: transforms/filters

The first four papers can be considered in the first category of transforms and filters. In this category, the DSP paper "Fast wavelet transform assisted predictors of streaming time series", by Stocchi et al. presents an implementation of a new prediction method, Wa.R.P. (Wavelet transform Reduced Predictor), that is suitable for multiresolution analysis of streaming univariate datasets. A case study, testing a cryptocurrency exchange price series, shows that the proposed system can outperform the benchmark methods in terms of forecasting accuracy achieved. The accompanying paper, entitled "Fast wavelet transform assisted predictors of streaming time series" can be found in the SoftwareX journal.

The second paper in this category is "Short Time Fourier Transform with the Window Size Fixed in the Frequency Domain", by Mateo et al. The paper presents a variant of the STFT to convert signals from the time domain into a time–frequency representation; the modification is to fix the window size in the frequency domain instead of doing it in the time domain so as to remedy the standard STFT well-known limitations regarding time–frequency resolution. This modified STFT is simpler than other similar existing methods, such as adaptive STFT and multi-resolution STFT, as it requires neither the band-pass filter banks of multi-resolution techniques, nor the evaluation of local signal characteristics of adaptive techniques. Synthetic and real world signals demonstrate the proposed technique is more suitable for transient signals such as ECG than for frequency modulated signals. The accompanying paper, entitled "Short-Time Fourier Transform with the Window Size Fixed in the frequency domain (STFT-FD): Implementation" can be found in the SoftwareX journal.

The next paper in the same category is "Compressive sensing meets time–frequency: An overview of recent advances in time–frequency processing of sparse signals", by Sejdic et al. The paper presents a practical framework for acquiring signals at sub-Nyquist rates. Compressive sensing (CS) based time–frequency representations are reviewed followed by descriptions of CS approaches based on the polynomial Fourier transform and the short-time Fourier transform. The paper address a major issue associated

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with traditional time–frequency representations, that is, the ability to obtain a time–frequency representation of a signal using only a small number of random samples. The accompanying paper, entitled "A software companion for compressively sensed time–frequency processing of sparse nonstationary signals" can be found in the SoftwareX journal.

Finally, the paper "Deconvolution Using Fourier Transform Phase, l_1 and l_2 Balls, and Filtered Variation", by Yorulmaz et al. in the same category presents a deconvolution software based on convex sets constructed from the phase of the Fourier Transform, bounded l_2 energy and l_1 energy of a given image. Another feature of the method is that it can incorporate an approximate total variation bound called filtered variation bound on the iterative deconvolution algorithm. The main purpose of this article is to introduce the open source software called projDeconv v2. The accompanying paper, entitled "Deconvolution using Fourier Transform phase, l_1 and l_2 balls, and Filtered Variation" can be found in the SoftwareX journal.

1.2. Category 2: detection/spectrum estimation/sensors

The most populated group of papers belong to the category of detection/estimation. The excellent papers here start with "On the Numerical Generation of Positive-Axis-Defined Distributions with an Exponential Autocorrelation Function" by Bykhovsky, where a tractable general numerical solution of one sided and first order stochastic differential equations is presented. The proposed method is verified with numerical simulations and is shown to have high accuracy. The accompanying SoftwareX paper is entitled "Mathematica code for numerical generation of random process with given distribution and exponential autocorrelation function".

In the next paper by Kurt et al., entitled "A Bayesian Change Point Model for Detecting SIP-based DDoS Attacks", the problem of Distributed Denial of Service (DDoS) attack detection framework based on the Bayesian multiple change model is considered. The proposed method is shown to be capable of detecting different types of flooding attacks. Its accompanying SoftwareX paper is entitled "A Real-Time SIP Network Simulation and Monitoring System", where a probabilistic SIP network simulation system, which provides a test environment for network security tools, was proposed.

The third paper belonging to this category is "Improving Reconstruction of Time-Series Based in Singular Spectrum Analysis: A Segmentation Approach", by Leles et al. The paper presents a non-parametric framework to analyze and enhance time-series by decomposing a time-series into its meaningful components: trends, oscillations and noise. However, if the signal under analysis is nonstationary, the reliability of the reconstruction is guaranteed only when many elementary matrices are used. As a consequence, the capability to discriminate dominant structures from time-series may be impaired. To circumvent this issue, a modified method, called overlap-SSA (ov-SSA), is proposed for segmentation, analysis and reconstruction of long-term and/or nonstationary signals. The raw time series is divided into smaller, consecutive and overlapping segments, and standard SSA procedures are applied to each segment with the resulting series being concatenated. This modified SSA enables the analysis of large data-sets, avoiding the issues of concatenation of many segments. A byproduct is an enhancement of the time–frequency characterization by the SSA in terms of reconstruction fidelity; e.g. the segmented analysis can identify with more accuracy, the time when each frequency occurs in the original signal, a situation where the standard SSA can fail. The accompanying paper, entitled "A new algorithm in singular spectrum analysis framework: The Overlap-SSA (ov-SSA)" can be found in the SoftwareX journal.

The next paper is entitled "Multiresolution Alignment for Multiple Unsynchronized Audio Sequences using Sequential Monte Carlo Samplers", by Basaran et al. The paper presents a multiresolution alignment algorithm for aligning multiple unsynchronized audio sequences using Sequential Monte Carlo samplers. It uses a model based approach and a score function analogous to similarity based methods. The performance evaluation results suggest that this method is competitive with baseline methods in terms of accuracy with suitable choice of parameters. In particular, the results show that the SMC sampler based system can outperform a fingerprint based baseline system with proper choice of parameters i.e., precision, number of samples, low resolution levels, length of smoothing kernel. The accompanying paper, entitled "Multiresolution alignment for multiple unsynchronized audio sequences using Sequential Monte Carlo samplers" can be found in the SoftwareX journal.

The journal continues with "Fast Target Detection in Radar Images using Rayleigh Mixtures and Summed Area Tables", by Ozgur et al. The paper presents a proposal to model the background statistics using a Rayleigh Mixture (RM) model. Such an approach facilitates modeling of complex statistics, including but not limited to those involved in heavy tailed distributions, which are shown to be good fits especially for high resolution Synthetic Aperture Radar (SAR) images. The authors also propose an efficient method to evaluate Constant False Alarm Rate (CFAR) thresholds according to the proposed model by use of Summed Area Tables (SAT). SAT provides a remarkable efficiency as the Rayleigh distribution is represented by only one parameter that can be estimated using simple moments. Tiling and parallel implementation is also utilized for fast computation of results. The outcome is a highly-accurate, extremely fast, and adaptive target detection approach that can be seamlessly used with a variety of complex SAR scenes. The experiments compare the proposed approach with existing target detection methods and demonstrate its effectiveness as well as the benefits it provides. The accompanying paper, entitled "RmSAT-CFAR: Fast and accurate target detection in radar images" can be found in the SoftwareX journal.

Then comes "Automatic recognition of scenes with power line wires in real life aerial images using DCT-based features", by Yetgin et al. The paper presents results of power line scene detection methods that use new feature extraction/selection strategies based on Discrete Cosine Transform (DCT) of scenes obtained from aircraft-based cameras. Whenever a scene from an aircraft contains power lines (may that be a visible-light image or infrared), the spectrum image or DCT matrix naturally exhibits coefficients with large magnitudes. On the other hand, since the direction of cables is arbitrary, the location of the DCT extrema may appear in different positions. This work attacks the problem of extracting signatures from the DCT coefficients by systematically changing the DCT matrix sizes and applying known classifiers to the DCT sub-matrices. These sub-matrices were selected at seven different sizes (2×2, 4×4, 8×8, 16×16, 32×32, 64×64, 128×128) with three types of starting points: (i) top-left corner (around DC), (ii) bottom-right corner (high frequency) and (iii) block-wise scanning the complete DCT matrix. A thorough dataset that contains thousands of aerial images with cables are used for testing the efficiencies of these DCT region selection approaches. Fast and successful detection performances are obtained and presented. The accompanying paper, entitled "Feature extraction, selection and classification code for Power Line Scene Recognition" can be found in the SoftwareX journal.

The next paper in this category is a thorough review paper by Boashash and Ouelha, entitled "Designing high-resolution time–frequency and time–scale distributions for the analysis and classification of non stationary signals: a tutorial review with comparison of features performance". The paper deals with the problem of