# Editorial of Special Issue on Human Behaviour Analysis "In-the-Wild"

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## 1 Introduction

The human face and body are quite likely the most researched objects in image analysis, computer vision and signal processing. One of the main reasons behind this popularity lies in the numerous applications of automatic face and body gesture analysis algorithms, that span several fields such as Human-Computer and Human-Robot Interaction (facial expression/body gesture recognition for automatic analysis of affect), medicine and healthcare (detection of emotional and cognitive disorders), as well as biometrics (face recognition, gait recognition). Less than a decade ago, the majority of face and body analysis algorithms and systems were built and evaluated on databases captured in controlled experimental conditions, such as the FERET database for face recognition, the Cohn-Kanade and MMI databases for facial expression recognition and facial action unit detection, and the XM2VTS and BIO-ID datasets for facial landmark detection. Research has gradually shifted to the analysis of facial images captured in-the-wild with the introduction of the SEMAINE database, the Labelled Faces in-the Wild (LFW) dataset, the FDDB for face detection and 300-W series of databases for facial landmark localisation/tracking (similarly MPII database for body pose estimation). Currently, LFW is used by the majority of researchers as a benchmark for face recognition, FDDB for face detection, 300-W for facial landmark localisation and MPII for body joint estimation.

Shifting to the analysis of spontaneous facial expressions and body gestures recorded under uncontrolled settings is a crucial step towards realising the next generation of machines that can sense and interpret human emotional and social behaviour under arbitrary recording conditions. It nevertheless is more challenging, as uncontrolled settings entail the presence of artefacts or occlusions in the visual data, as well as data capturing spontaneous emotions contain much higher variability than posed emotions, with significant differences in terms of both temporal and spatial characteristics. In general, we can group research in automatic analysis of behaviour in terms of the variables that we are interested in predicting, listed in what follows: (i) recognizing a set of discrete expressions, usually confined to the recognition of the so-called six universal expressions (i.e., Anger, Disgust, Fear, Happiness, Sadness and Surprise) plus neutral, (ii) detecting particular non-universal expressions (e.g., recognition of pain and compound expressions), (iii) detectingf Facial Action Units (FAU) in expressive sequences, which relate to a standardised taxonomy of facial muscles' movement, as well as (iv) estimation of latent emotion dimensions, such as valence (how positive or negative an emotional state is), arousal (measuring the power of the activation of the emotion) and dominance (capturing sense of control over emotion).

In this special issue, we focus on recent efforts towards catalysing progress in automatic analysis of human behaviour in uncontrolled, "in-the-wild" conditions. We summarize research efforts towards the development of research methodologies, database collections and benchmarks, as well as algorithms and systems for machine analysis of human behaviour, focusing on facial expressions, body gestures, speech, as well as various other sensors. We are delighted that the special issue includes authors both from academia as well as the industry (Affectiva, Disney Research, STATS).

The special issue is organized as follows. In the paper "AM-FED+: An Extended Dataset of Naturalistic Facial Expressions Collected in Everyday Settings", D. McDuff, M. Amr and R. el Kaliouby present a public dataset containing naturalistic facial expressions collected in everyday settings. In more detail, the authors present a dataset containing more than 1000 videos, with half of them accompanied by comprehensive annotations for facial action units, as well as facial landmarks. The authors propose the utilization of this dataset as a benchmark for the evaluation of algorithms and models, while also providing a set of contextual labels as well as baseline results for action unit classification for the coded videos.

The next paper "AffectNet: A Database for Facial Expression, Valence and Arousal Computing in the


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Wild", A. Mollahosseini, B. Hasani and M. H. Mahoor present a large scale database, coined AffectNet, which contains more than 1 million facial images from the Internet using 1,250 emotion related keywords in six different languages. AffectNet is among the largest databases the provide images annotated with regards to facial expression, valence, and arousal in the wild. Two deep neural networks are used to estimate facial expressions, as well as valence and arousal.

The paper "Discriminative Spatiotemporal Local Binary Pattern with Revisited Integral Projection for Spontaneous Facial Micro-Expression Recognition", the authors X. Huang, S. Wang, X. Liu, G. Zhao, X. Feng and M. Pietikäinen present their work on detecting spontaneous facial micro-expressions from facial images. Building on previous work that incorporates spatiotemporal local binary patterns that consider dynamic texture information, the authors extend the descriptors based on an integral projection for preserving the shape-attribute of micro-expressions, using Robust Principal Component Analysis. Furthermore, a feature selection component based on the Laplacian method is introduced in order to capture discriminative information towards the recognition of facial micro-expressions, with experiments presented on several micro-expression databases, such as CASME, CASME2 and SMIC, showing very promising results.

In the paper "Estimating Audience Engagement to Predict Movie Ratings' by R. Navarathna, P. Carr, P. Lucey and I. Matthews, the authors address an interesting problem: estimating audience engagement through both subtle and coarse facial expressions and body gesture during feature length movies. This constitutes a very challenging setting, as the environment is dark during the movie, people appear at different scales and viewpoints, while movies typically last for a quite long duration. Furthermore, as the authors claim, facial expressions by the audience during the movie are short, subtle and sparse. The authors propose a method using infrared illuminated test-beds in order to detect the change in behaviour by identifying key-frames that capture audience sentiment. The authors use crow-sourced ratings to train a classifier, and use audience sentiment as a proxy for rating movies. The entire dataset consists of over 50 hours of audience behaviour, containing a large number of more than 200 subjects.

The paper "Audio-visual Emotion Recognition in Video Clips" by F. Noroozi, M. Marjanovic, A. Njegus, S. Escalera, and G. Anbarjafari presents an audio-visual approach for emotion recognition in videos. The authors extract acoustic features such as spectral and prosodic, and utilize a set of visual features on which geometric relationships are computed. Following the proposed approach, key-frames are detected in order to summarize each emotional video. Using convolutional networks, the authors end-up in a final representation that includes classifier confidence. Multiclass SVMs and Random Forest classifiers are subsequently trained on the dimensionality reduced representation, obtained by applying PCA. The authors perform extensive experiments on databases such as RML, SAVEE, and eNTERFACE'05.

Finally, the paper "Hidden Smile Correlation Discovery across Subjects using Random Walk with Restart" by H. Jiang, M. Coskun, A. Badokhon, M. Liu, and Ming-Chun Huang deals with the problem of fine-grained smile analysis. In particular, the authors propose a fine-grained smile analysis system that utilizes the head pose of the subject, and employs conditional random forests in order to handle natural head motion and orientations changes, and eventually detect fiducial points in facial images. By using random walks, the authors then present results in terms of identifying smile intensity, and uncover hidden correlations in smile patterns across subjects. The method is evaluated on datasets such as the UvA-NEMO and a selection of data from the Labelled Faces in-the-wild dataset.

We hope that this special issue has provided an opportunity for bringing together experts from both academia and the industry, towards working on several open research problems in a challenging area. The selection of papers represents a good overview of such problems, and reviews the state-of-the-art as well as various datasets that can be used for evaluating new methods.

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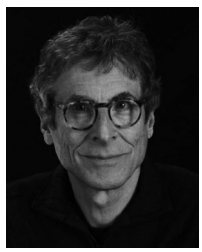

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