Editorial

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Amongst the many scientific conquests of the last century, one that clearly stands out is the acceptance of our inability to measure the real word with certainty and precision. This applies to issues ranging from something as simple as our inability to measure objective quantities such as the speed or position of a particle to our inability to handle much more complex and subjective quantities such as the detection of abstract concepts in images. Thus, uncertainty has gradually attained its own very distinct role in scientific research and scientific thought.

Uncertainty seems to have a very particular role in the field of image and multimedia in general, and in processing them, and their applications. Although a variety of techniques have been proposed in the literature as solutions to a series of practical issues, the case remains that the overall process is always inherently uncertain due to low quality of the input signals, noise, subjectivity and errors during the processing steps. Since it seems to be impossible to totally alleviate this uncertainty, we certainly need to develop the thought and the tools that will allow us to acknowledge, quantify, measure, limit and minimise it.

With this special issue we aim to provide an overview of the different areas where uncertainty has a dominant role and of the most current approaches to its handling. We have laid out the issue starting from the low-level signal basic research end and moving up towards the end of semantics and real life applications.

We start with 'Gaussian noise reduction in greyscale images', where Nachtegael et al. focus on the uncertainty related to the value of each pixel in an image when this image has been corrupted with some type of noise. There are of course quite a few known filters that help enhance an image and remove a portion of the noise, and fuzzy filters provide an even larger range of tools to this end. In their paper, Nachtegael et al. compare a wide range of different filters for different types of noise, thus providing guidelines for the choice of a proper filter for each specific case.

Romaní et al. in 'An approach to manage hue and saturation uncertainty addressed to colour segmentation algorithms' deal with the uncertainty related to hue and saturation measures. Since noise is unevenly amplified during the estimation of hue and saturation, the uncertainty underlying within them is augmented. In their work, Romaní et al. propose reliability functions that automatically quantify this uncertainty, thus opening the way for more robust image segmentation in the HSI space.

In 'Speaking with Allen relations', Wawrzyniak et al. address an issue related to subjectivity and imperfection. Specifically, they focus on using abstract linguistic spatial characterisations, such as equality or overlapping, in order to describe spatial relations automatically detected in still images. As these relations are estimated in a subjective manner by humans, the use of Alen, i.e. fuzzy, descriptions is proposed in order to provide for more natural topological annotations.

'Fuzzy homogeneity measures for path-based colour image segmentation' by Chamorro-Martínez et al. deals with image segmentation. As pixel similarity and region

boundary are both subjective notions that are imperfectly defined for a real image, Chamorro-Martínez et al. propose the definition of fuzzy path homogeneity and utilise it in order to produce a fuzzy segmentation of an image, which is much closer to what is perceived as natural by the human inspector.

Latecki et al. in 'Using spatiotemporal blocks to reduce the uncertainty in detecting and tracking moving objects in video' address the issue of object tracking in video. They reduce the uncertainty related to the process by following a block-based rather than pixel-based approach to tracking, which, as indicated by their experimental results, is not only more efficient computationally wise but also provides for results of higher quality.

Moving more to the high-level end of the field, the next two papers discuss the utilisation of knowledge in order to reduce the uncertainty of the signal-processing component. To this end, Sousa et al. in 'Old document recognition using fuzzy methods' discuss optical character recognition for old documents. As old style typeface is more difficult to handle than the typical text images fed to OCR systems, the authors incorporate a fuzzy expert system in the process in order to enhance the acquired results.

Similarly, Kosmopoulos and Maglogiannis in 'Extraction of mid-level semantics from gesture videos using a Bayesian network' use a Bayesian network representing a priori knowledge in the process of extracting semantics from the automated analysis of sign language videos. This knowledge allows for the successful alleviation of the uncertainty caused by occlusions that regularly occur in this type of input.

Approaching things from a computational point of view, Falelakis et al. in 'Complexity control in semantic identification' discuss the efficient analysis of low-level input when computing resources are limited. Through modelling of the process as a knapsack problem, tools are provided in order to either minimise uncertainty of the output, given the available computing resources, or minimise the required computing resources, given the specification of the levels of uncertainty that might be deemed as acceptable.

The next three papers reduce uncertainty by combining multiple inputs in their estimation of the overall output of their respective systems. Thus, Vassiliou et al. in 'A hybrid content-based clustering architecture: minimising uncertainty in personalised multimedia content' combine different approaches to personalisation. In this way they produce a hybrid system that is able to provide recommendations of higher quality and with greater probability to match the real interests of the user.

Rapantzikos and Tsapatsoulis in 'A committee machine scheme for feature map fusion under uncertainty: the face detection case' follow a visual attention driven approach to detecting human faces in video sequences. In order to tackle the uncertain step of fusing the different available channels they follow a dynamic committee based approach that allows for the consideration of the level of uncertainty that is linked to each feature in the process of the fusion, thus providing for higher confidence in the acquired results.

Similarly, Wallace et al. in 'Dealing with feature uncertainty in facial expression recognition' utilise anthropometric validation to quantify uncertainty in features extracted from human face images and a dynamic committee machine in order to fuse these features in the best possible way. They also propose the utilisation of a novel possibilistic approach to fuzzy rule evaluation, which allows for the incorporation of the information concerning the uncertainty of the features into the final results and makes the produced output valid even when operating with highly uncertain input.

The last two papers discuss the handling of uncertainty in the sensitive field of medical image processing. Kontos et al. in 'A tool for handling uncertainty in segmenting of regions of interest in medical images' proposes the utilisation of fuzzy connectedness in order to limit the uncertainty related to the identification of organ boundaries in 3D medical images. In this way more accurate volume calculations and functional property assessments about the organs can be acquired.

Finally, the issue concludes with 'Segmentation and classification of cervix lesions by pattern and texture analysis' by Srinivasan et al., which aims to remove the subjective factor in the diagnosis of cervical cancer. As in the conventional approach, it is a human that has to discriminate between regions to ignore and regions to forward for biopsy, the authors propose a fully automated approach to first segmenting the regions and then quantifying their levels of abnormality.

As editors of this issue, we are grateful to the anonymous reviewers for their invaluable help. They have greatly assisted both us in selecting the works to include in this issue as well as the authors to enhance their manuscripts, and thus have a major impact on the final outcome. We are also grateful to have been trusted by the authors with works of such quality and we hope that readers will also appreciate the quality of these papers.

Finally, we feel compelled to express our gratitude towards Margery Airey, the Journal Manager, for being extremely helpful in all stages of the preparation of this issue and Dr. Mohammed Dorgham, the Editor in Chief, for the trust and support he has given us.