Editorial Introduction to the Special Issue on Evolutionary Computer Vision

At the time the first edition of EvoIASP, the workshop on applications of Evolutionary Computation to Image Analysis and Signal Processing, was held in Göteborg (Sweden) in 1999, Evolutionary Computation (EC) was still much in search of application fields that could benefit from the powerful features of its techniques. This meant that any attempt to apply EC techniques could still be considered worth pursuing. Nine years later, in a much more mature scenario for the field, EvoIASP has just celebrated its 10th edition and is going for the 11th.

This preamble is not only a proud recognition of the success of the event by two of the members of the Programme Committee and its organizer. Instead, it is meant to witness of the possibly small, but stable, niche that, through the years, applications of EC to computer vision, and, more generally, to image and signal processing, have been able to conquer. This is why, nowadays, one can properly talk about Evolutionary Computer Vision with no need to include such a term in quotes and with a reasonable certainty of being understood by the audience.

As happens with all disciplines whose actors come from different communities, even in the presence of dedicated events, research work is scattered among conferences generally dedicated to EC and more specific events on computer vision. A regular publication of special issues dedicated to evolutionary computer vision is therefore a useful way to sample the state of the art of the discipline, setting some landmarks along the path through which it is progressing, and give an idea of the degree of its competitiveness with respect to other more classical techniques. After a premature attempt in 1997, which only led to the publication of a couple of regular papers in the following two years, two very successful special issues have been published in the last four years in journals whose main topics are signal processing and pattern recognition. This is the first special issue on evolutionary computer vision that appears in a journal dedicated to Evolutionary Computation.

With this special issue, we wish to offer an up-to-date overview of ongoing research in evolutionary computer vision, which can highlight the main characterizing features of the most recent work in the field. In particular, we wish this special issue could help readers increase their consciousness of the many different ways in which EC can be used and of the extent to which EC techniques can help in solving computer vision problems. In fact, there is still a rather widespread belief that EC techniques can be applied to computer vision as no more than just a set of techniques that can be used to optimize the parameters that regulate the behavior of some algorithm previously designed by hand. This belief is shared by members of both communities and, in both cases, can be caused by lack of knowledge of the "other" research field. While this is partially true, as parameter optimization is actually the most basic and direct application of EC to any field, there are several applications in which the interaction between EC and computer vision techniques is much more complex and intriguing. The five papers of this issue, selected

among 21 excellent ones that have been submitted (two more were rejected since they were clearly out of scope), are a very good way to demonstrate this. In fact, three of these papers use Genetic Programming (GP) to automatically develop new methods and operators, which confirms how successful such an evolutionary paradigm has been in this field: EvoIASP usually dedicates a full session to applications of GP, and many of the best papers awards have been assigned to papers on GP applications. The other two papers, despite relying on evolutionary methods to solve more "traditional" parameter optimization problems, apply two relatively recently developed evolutionary paradigms, Particle Swarm Optimization and Differential Evolution, which can have extremely high performance in favorable conditions, besides being generally easier to implement than more traditional paradigms such as Genetic Algorithms.

The paper by Jaśkowski, Krawiec, and Wieloch proposes a multitask learning method for visual primitives recognition. Using multi-objective genetic programming learning (i.e., maximize true positives/minimize false-positive), the authors experimentally demonstrate on real data that knowledge can be shared (via primitive reuse) between individuals that solve different learning tasks. This approach implements a sort of task decomposition for visual recognition.

Song and Ciesielski also use genetic programming learning, but for texture segmentation. The main advantage of their approach is that it does not require any a priori feature extraction, and is thus faster than traditional techniques. Even if the method does not make any prior assumptions on texture models, the results demonstrate that genetic programming can capture discriminant pattern regularities to provide fast and efficient texture classifiers, well suited for real-time applications.

The paper by Trujillo and Olague introduces genetic programming as a methodology for designing image operators that solve the problem of interest point detection. This work provides 15 new image operators that match state-of-the-art results considering repeatability and point dispersion as criteria for fitness evaluation. The outlined methodology opens a new research avenue in feature extraction.

Ivekovič, Trucco, and Petillot rely on Particle Swarm Optimization (PSO) to estimate body pose for application in immersive videoconferencing environments. The method they describe can be easily extended to other applications, such as sign language recognition systems, of which pose estimation and tracking are fundamental parts. PSO is shown to outperform other more traditional optimization techniques in this task.

Tirronen, Neri, Kärkkäinen, Majava, and Rossi use enhanced memetic differential evolution to design image filters to solve a problem of paper defect detection within a real industrial process. Defect detection is achieved by the combination of an evolutionary algorithm with three local search algorithms: this approach tunes two Gabor filters using exploratory logic and pivot rule. The proposed industrial solution provides designs with high performance that can offer real-time performance without the cost of extra hardware components.

Finally, we would like to take the opportunity to express our sincere gratitude to the editor-in-chief Marc Schoenauer, for his valuable support in the preparation of this issue, and to all reviewers who have helped us in the hard selection work with their competent and constructive comments. We would like, as well, to apologize to all authors for the lengthy process that was necessary to sort out such good papers and keep their number within the space allowed for one issue of the journal.

S. Cagnoni, E. Lutton, and G. Olague, Guest Editors
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