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Evolutionary Image Analysis and Signal Processing

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Preface

The publication of this book on evolutionary Image Analysis and Signal Processing (IASP) has two main goals. The first, occasional one is to celebrate the 10th edition of EvoIASP, the workshop which has been the only event specifically dedicated to this topic since 1999. The second, more important one is to give an overview of the opportunities offered by Evolutionary Computation (EC) techniques to computer vision, pattern recognition, and image and signal processing.

It is not possible to celebrate EvoIASP properly without first acknowledging EvoNET, the EU-funded network of excellence, which has made it possible for Europe to build a strong European research community on EC. Thanks to the success of the first, pioneering event organized by EvoNET, held in 1998 in Paris, it was possible to realize that not only was EC a fertile ground for basic research but also there were several application fields to which EC techniques could offer a valuable contribution. That was how the idea of creating a single event, EvoWorkshops, out of a collection of workshops dedicated to applications of EC, was born. Amongst the possible application fields for EC, IASP was selected almost accidentally, due to the occasional presence, within EvoNET, of less than a handful of researchers who were interested in it. I would lie if I stated that the event was a great success since its very start, but it was successful enough to survive healthily for a couple of years, before reaching its present size, relevance, and popularity.

The papers selected for inclusion in this book, mostly extended versions of papers presented at EvoIASP, have no pretence of setting milestones in the history of evolutionary IASP, but they do offer readers a panoramic view of what can be currently done using EC techniques in such applications. From this point of view, what could be seen as a defect of this book, at first sight, can even become a useful and peculiar feature. In fact, this rather unstructured collection of papers samples the space of Evolutionary IASP rather extensively, albeit possibly sparsely, along different axes. The most obvious one is related to applications in different areas of IASP, as the book describes a wide variety of applications in which

EC can fruitfully be employed. However, there are less obvious ones. Amongst these, let me mention and discuss what I believe is a very important one: the 'degree of involvement' of EC in IASP applications. The book describes applications in which EC techniques play very different roles in producing the final results. Differently from how EC is most commonly looked upon, or perceived, by non-EC researchers, EC techniques can actually represent more than an external optimization tool that can be used to tune or refine parameters or components of a mostly pre-defined solution. In fact, EC techniques can be embedded more intimately into IASP applications, up to situations where the solution itself is intrinsically evolutionary. This book provides examples that are positioned at both ends of this axis. Of course, that is not the only possible ordering criterion that can be used to create a taxonomy of Evolutionary IASP. In a recent paper, I mentioned at least two more criteria, perhaps the most natural ones out of many possible: EC-based, according to the evolutionary paradigm that is used, and application-based, according to the abstraction level of the task to which EC is applied.

Deciding the ordering criterion for the contributions in this book has been no easy task, as they were mostly extended versions of papers that have been presented at EvoIASP. Therefore, there is neither a pre-established logical structure underlying their choice, nor was it possible to find any ordering with respect to which they could appear to be uniformly distributed. Because of this, I decided not to subdivide the book into sections. Nevertheless, an application-based ordering criterion is implicitly followed, with some additional constraints which reflect the presence of more work dealing with topics and applications belonging to the computer vision domain. Contributions belonging to this larger group appear first, and are ordered according to the abstraction level of the task they describe. In the following smaller set of contributions, more general and basic tasks are tackled, which, with some extension of their context, can also find effective applications in computer vision. An implicit secondary EC-based indexing criterion has also been followed by trying to keep applications based on the same or similar EC paradigms close to one another.

From the point of view of the expected audience, even if the contents of this book are derived from a workshop that is addressed mainly to EC researchers, this book does not specifically address any category of readers. Knowledge of the most basic EC paradigms is given for granted, while, possibly, some more basic detail about the specific applications is given, which may be obvious to readers who are familiar with them. However, all authors have made their best efforts to keep their contributions as balanced as possible for the reading to be enjoyable for the widest possible audience. Any variations to the basic evolutionary algorithms or application-related functions are described in details. On the other hand, details about the specific applications are usually limited to the information that is essential for their understanding.

A common problem that occurs when techniques developed within a specific community are applied to a number of fields for which other well-established communities also exist is that members of each community tend to publicize their work within their 'natural environment'. The result is that, first, similar work is often described very differently, as some authors focus mainly on applications, while others concentrate on methodology. Second, and more important, a lack of communication occurs by which researchers belonging to one community tend to keep a very partial view of the topics pertaining to the other communities. As a result, on the one hand, researchers in the application fields tend to consider basic methods to be well-established, ready-for-use, closed tools; on the other hand, those who do basic research often tend to consider application-related data as abstract benchmarks using which their results can be tested, neglecting their actual meaning in the real world. One of the most appealing features of books like this is being, in general, more universally visible and less community-specific than, for example, conference proceedings, besides, obviously, having a much narrower scope than the latter. In its first 10 years, EvoIASP has, hopefully with success, sowed the seeds for a new 'multi-cultural' community of researchers in evolutionary IASP. I do wish this book will further contribute to the widening of this community, both numerically and in terms of research interests, and that we will celebrate more successes, and the 20th edition of the workshop, 10 years from now.

Parma,
January 2009 Stefano Cagnoni

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This book is dedicated, in first place, to all those who made it possible for EvoIASP to exist and survive in good health for 10 years (which will likely be 11 when this book is published):

- Riccardo Poli, a friend and colleague, who introduced me to Evolutionary Computation and showed me the way into this fascinating field when we were still PhD students. Then, when he was already one of the most active and influential members of the EC community, it was him who proposed that I co-chaired the EvoIASP working group in the early years of EvoNET, the EU-funded Network of Excellence on Evolutionary Computation;
- Terry Fogarty, co-chair of the first editions of EvoIASP, but most of all a pioneer in the field of Evolutionary Computation, co-ordinator of EvoNET as well as a friendly and hilarious companion of pleasant after-conference chats;
- Jennifer Willies, EvoNET and Evo* coordinator, as indispensable as discrete support for all EvoNET events, gifted by an incredible ability to make the best out of the budgets she has to manage, often limited and severely constrained. Acknowledging only her professional achievements would be more than restrictive. Just ask any EvoNET member or participant in Evo* for more details on her availability, patience and motherly care in any of the (infinite) situations where her intervention is requested, and
- All those who have submitted and presented their work at EvoIASP, with particular regards to those who, after their first participation in the workshop, have been engaged in Evolutionary Image Analysis and Signal Processing and in the workshop itself. Amongst these, I would like to thank, in particular, Evelyne Lutton, Gustavo Olague, Jean Louchet and Mengjie Zhang, as well as all who contributed to the workshop as reviewers.

I would also like to thank very warmly all authors of the chapters included in this book for their patience in preparing excellent extensions of their work presented at EvoIASP, and especially for coping with my slowness in turning their contribution into the volume you are reading.

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