

# Preface and Acknowledgments

In writing this book I must first pay tribute to two leading researchers in the evolutionary robotics field, Dario Floreano and Stefano Nolfi, whose book *Evolutionary Robotics* formed the de facto reference and touchstone for researchers in the evolutionary robotics domain since its publication in 2000. In particular I would like to thank Prof. Dario Floreano, the director of the Laboratory of Intelligent Systems at the École Polytechnique Fédérale de Lausanne (EPFL) in Switzerland. I had the very good fortune to serve a short sabbatical as a guest researcher with Dario and his group in the “Pavilion Jaune” at EPFL in the winter of 2000/2001. Indeed, it was at precisely this time that Dario and Stefano’s book was to be published, and I remember at least every second day going across to the bookshop at EPFL to see if a copy was available. Alas, due to unforeseen publishing delays I was not able to purchase my own copy until not long before the end of my all-too-short sabbatical stay. Dario, with great grace, wrote a short dedication, together with Stefano:

We hope that you will find this book stimulating and develop this approach much further.

While I cannot claim to have made major advances, or to have taken this approach that much further, things have moved on quite a bit since 2001. I sincerely hope that in this book I have taken this advice to heart, in describing my own and other researchers’ work in the application of evolutionary techniques to the ever more important and prevalent domain of humanoid robotics. I follow on, to a certain extent, where their text left off in the penultimate chapter of their book entitled “Complex Hardware Morphologies: Walking Machines”. The focus of this chapter was, however, on 4-, 6-, and 8-legged locomotion rather than bipedal locomotion that most “humanoid” robots use.

I would also like to thank Prof. Dave Cliff, now at the University of Bristol, but who was at the University of Sussex when I met him first at a mechatronics conference in Halmstad, Sweden in 1993. At this stage I had just completed my Ph.D. thesis entitled “Genetic Algorithms and Neural Networks for Control Applications”, and was actively interested in looking at ways in which the neural and, in particular, the evolutionary approach could be applied in the field of mobile

robots. My thesis had been concerned mainly with the application of these techniques to theoretically defined problems in the control area, where systems were precisely specified by differential equations of different orders, sometimes incorporating time delays of varying magnitudes. The results obtained using the neuro-genetic approach were then compared to those obtained using either theoretically derived time-optimal solutions, or those using empirically derived control parameters such as the Ziegler–Nichols and refined Ziegler–Nichols rules for Proportional–Integral–Derivative (PID) control systems.

Dave Cliff's work (along with that of his colleagues at the University of Sussex) opened up a whole new domain for the application of this new neuro-genetic approach to control applications which were not so precisely specified, and which could incorporate many degrees of freedom, and potentially operate successfully in real-world, noisy environments. I had the good fortune to have Dave accept an invitation to the University of Limerick in the winter of 1993, where he gave a talk entitled "Evolving Visually Guided Robots". This talk was very well received and his research and that of his colleagues at the University of Sussex formed one of the main motivations for my subsequent research interests in the field of evolutionary robotics, as it had recently become known.

Moving closer to the present time, I would like to express my sincere thanks to Ronan Nugent of Springer, without whose enthusiasm this project would never have got off the ground, and to also extend my appreciation to the Series Editors for their helpful and constructive comments. Also, I would like to thank my head of department, Annette McElligott, for her support throughout the enterprise, and finally my wife, Patricia, for her understanding through what must, at times, have seemed like a neverending process.

There is little that is actually new in this text. What I have tried to do is to collect the various strands encompassing the fields in this diverse and rapidly evolving subject, and to hopefully present them in a reasonably coherent and concise manner to the moderately educated reader. Where mathematical formulae or intricacies are perceived as essential to the presentation of the topic these are included, but efforts have been made to avoid any unnecessary mathematical complications in order to make the text accessible to as wide an audience as possible.

Although I have endeavoured to be as objective as possible in my treatment of the subject matter herein, as in all works of this nature, certain preferences and biases must, of their nature, creep in. Of course, a text of this size cannot purport to be comprehensive. However, a representative cross-section of references to the most current material, together with material of historical interest, is given, and pointers to the literature are provided at frequent intervals in the text.

## Intended Audience

This book is intended to be of use to the following categories of readers:

- Researchers looking for an up-to-date and concise review of key aspects in the state of the art in the field of evolutionary robotics in general, following on from Stefano Nolfi and Dario Floreano's groundbreaking text *Evolutionary Robotics*
- Researchers involved in the evolutionary robotics field who require a brief introduction to the humanoid robotics area and how they might apply their expertise to this domain
- Researchers involved in the humanoid robotics field who are curious about how evolutionary robotics might have some applications in their area
- Researchers in the biological sciences field interested in recent advances in this bioinspired area of research
- Researchers who are already involved in the EHR area who would like a concise reference “handbook” to their field with a comprehensive set of references together with a concise summary of major strands of research in their field from its inception to the present time
- Educators at the advanced undergraduate/postgraduate level who require an up-to-date concise introduction to/survey of the field of evolutionary robotics or humanoid robotics
- Educators at the postgraduate/advanced postgraduate level who want a text specifically in the area of the application of evolutionary techniques to humanoid robots, tying together all of the most recent research in this field in a cohesive manner, and by a single author
- The general informed (and reasonably well educated) reader, who realises that certain issues raised in this book's content may have significant implications on society within their lifetimes and beyond.

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