

# Preface

A motion is perceived by others from its completion into the physical space. At the same time, the same motion originates within the personal body space. Identifying what is happening in the body when a person is moving is not an easy task. Human motion analysis focuses on the relationship between physical space and body space. How to bridge both physical and body spaces? As biomechanists or neuroscientists, roboticists face the same but differently worded question: For roboticists, the physical space is the task space or the operational space in which robot actions are expressed; the body space is the control space or the configuration space according to the considered robotic system. The question is related to robot programming, i.e., to the competition between abstract symbol manipulation and physical signal processing.

In the dance field, tools for analyzing and transcribing human movements, i.e., the so-called dance notation systems, have been developed to enhance dancer performance. The main purpose of dance notations is to store choreographic works and knowledge of dance techniques by translating movements into specific ways as abstract symbols, letters, abbreviations, musical notations, stick figures, etc. In Western culture, there are almost 90 dance notation systems, from the first appearance in fifteenth century to the present. Among the currently used ones, we find the Kinetography Laban, the Benesh Movement Notation, and the Eshkol-Wachman Movement Notation.

In this context, it is natural to gather roboticists, computer scientists, neuroscientists, dance notation system researchers, and choreographers, in order to promote a multidisciplinary research on human motion analysis. This was the objective of the workshop “Dance Notations and Robot Motion” held at LAAS-CNRS in Toulouse in November 2014.<sup>1</sup> How an anthropomorphic action is decomposed into a sequence of motions? How an emotional state is reflected in a motion? How to

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<sup>1</sup>The workshop took place in the framework of the Anthropomorphic Motion Factory launched by the European Project ERC-ADG 340050 Actanthrope devoted to exploring the computational foundations of anthropomorphic action.

describe a dance in terms of a sequence of elementary motions? Such questions and many others were the ingredients for stimulating discussions. The first challenge of the meeting was to reach a mutual understanding allowing a choreographer to access robotics concepts, or a computer scientist to understand the subtleties of dance notation.

This book intends to keep traces of this unique meeting. It results from the willingness of authors to share their own experiences with others.

The reader is then introduced to the basics of dance notations. At the same time, it can delve into chapters reporting dancing robot performances. Computational issues in motion notation are introduced via the dual perspective of both automated motion scoring and dance scoring-based motion generation. Motion segmentation appears as a way to better program robots. Cognitive dimensions are reflected in chapters dealing with gestural languages, behavioral objects, or robot interaction. The reader will recognize the multidisciplinary character of the research through the heterogeneous style of the textbook.

We thank all the authors for their effort in making their own research field accessible to others. We thank also the reviewers and the editorial committee (Marion Bastien, Antonio Camurri, Henner Drewes, Kozaburo Hachimura, Dana Kulic, Shelly Saint-Smith, and Gentiane Venture) for their help in editing the book.

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