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Annelies Braffort Rachid Gherbi  
Sylvie Gibet James Richardson  
Daniel Teil (Eds.)

# Gesture-Based Communication in Human-Computer Interaction

International Gesture Workshop, GW'99  
Gif-sur-Yvette, France, March 17-19, 1999  
Proceedings



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## Series Editors

Jaime G. Carbonell, Carnegie Mellon University, Pittsburgh, PA, USA  
Jörg Siekmann, University of Saarland, Saarbrücken, Germany

## Volume Editors

Annelies Braffort  
Rachid Gherbi  
Sylvie Gibet  
Daniel Teil  
LIMSI-CNRS  
BP 133, 91403 Orsay cedex, France  
E-mail: {braffort,gherbi,gibet,teil}@limsi.fr  
James Richardson  
Université Paris Sud, LPM  
91405 Orsay, France  
E-mail: james.richardson@lpm.u-psud.fr

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# Preface

The need to improve communication between humans and computers has been instrumental in defining new modalities of communication, and new ways of interacting with machines. Gestures can convey information for which other modalities are not efficient or suitable. In natural and user-friendly interaction, gestures can be used, as a single modality, or combined in multimodal interaction schemes which involve speech, or textual media. Specification methodologies can be developed to design advanced interaction processes in order to define what kind of gestures are used, which meaning they convey, and what the paradigms of interaction are. Research centred on gesture interaction has recently provided significant technological improvements, in particular: gesture capture and tracking (from video streams or other input devices), motion recognition, motion generation, and animation. In addition, active research in the fields of signal processing, pattern recognition, artificial intelligence, and linguistics is relevant to the areas covered by the multidisciplinary research on gesture as a means of communication.

Resulting from a three-day international workshop in Gif-sur-Yvette, France, with 80 participants from ten countries all over the world, this book presents contributions on gesture under the focus of human-computer communication. The workshop was run by Université Paris Sud, Orsay, on the lines of GW'96 at York University, UK, and GW'97 at Bielefeld University, Germany. Its purpose was to bring together scientists from research and industrial organisations working on all aspects of gesture modelling and interaction. The book is organised in six sections, covering human perception and production of gesture, gesture localisation and movement segmentation, vision-based recognition and sign language recognition, gesture synthesis and animation, and multimodality. It addresses a wide range of gestures, which are not restricted to the motion of hands and arms, but include facial expressions, motion of different parts of the body, and eye movements. Papers on major topics of interest for gesture recognition and synthesis are included from four invited speakers: Winand Dittrich, University of Hertfordshire, a cognitive neuroscientist known for his work on biological motion; Thomas Huang, University of Ohio, whose work on recognition systems is internationally renowned; Christian Cuxac, Université Paris VIII; a psycholinguist and a specialist of French sign language; and Ipke Wachsmuth, University of Bielefeld, whose interests lie in AI and multimedia systems. In addition, 17 full papers and 7 short papers, reviewed and selected after the workshop, have been included.

The first section on Human Perception and Production of Gesture presents a large panel of studies with three papers and two short papers: a presentation of the mechanisms underlying biological motion perception; the establishment of the link between gestural expressions and the sense of smell; the analysis of gestures produced by musicians playing wind instruments, and the way these

gestures influence sound; affordances and gesture variability, the adaptation of muscle synergies in producing gestures.

The second section on Localisation and Segmentation is composed of three long papers and one short paper. The four papers present various vision-based segmentation systems used to extract human body features: extraction of 3-dimensional hand posture based on fingertip gesture recognition, finding and tracking the human teacher's grasping fingertip in order to teach a robot to imitate human gestures, identification of human body features using both low level image processing measurements and high level segmentation heuristics, and a modelling of image space discretisation based on face detection and body anthropometry.

The next section, concerned with Vision-Based Recognition, contains a paper which surveys the state of the art of visual interpretation of hand gestures in the context of human-computer interaction, followed by three papers and two short-papers, representing a variety of types of gestures, recognition techniques, and applications: person localisation and posture recognition by means of neural networks; statistical recognition of face and graphical gestures; pointing and waving gesture recognition using a time-delay neural network; pointing gesture recognition based on hidden Markov models; graphical gesture recognition for interaction with in-vehicle systems.

Four papers illustrate the fourth section on Sign Language Recognition: a proposition of the structural form of french sign language; two approaches for sign language recognition, based on hidden Markov models, and one relating the relationships between words.

The fifth section deals with Gesture Synthesis and Animation. It contains three papers and two short papers: two of them link a proposition of specification of sign language gestures to the generation of motion and the animation of a virtual avatar; the presentation of a motion generation system which reacts to changes in the user's position and direction of gaze; the description of a methodology to design complex movements requiring co-ordination mechanisms, such as juggling or walking, and an investigation into how inhabitants of collaborative virtual environments can communicate with each other through gaze, gesture, and body postures.

The final section, devoted to Multimodality, is composed of three papers. The first one is an analysis of the communicative rhythm in gesture and speech by the use of multimodal user interface on the basis of time agent systems. The second presents the integration of a symbolic representation of gestures by the way of a rule-based system in unimodal or multimodal user interfaces. The last paper describes the framework of a multimodal interface that incorporates 3D hand gestures and speech recognition systems for the user to interact in a virtual environment.

The workshop provided an occasion for lively discussions and the planning of future collaboration on research into the use of gestures as means of communication. The organisers would like to thank the participants, especially the contributors to this volume and the article reviewers. The meeting was sponsored

by Université Paris-Sud, the National Center of Scientific Research (CNRS), and the Ministry of Defence (DGA/SREA), and we are very grateful for their generous financial support. The CNRS Gif-sur-Yvette also contributed generously to the local organisation of the workshop at the Château de Gif.

This volume, the third in the series, reports on the recent work in a dynamic field of research with considerable potential for application in future generations of man-machine interfaces. The editors hope that the readers will find the papers stimulating and an encouragement to participate in the multi-disciplinary area of gesture-based communication.

March 1999

*Annelies Braffort, Rachid Gherbi,  
Sylvie Gibet, James Richardson, Daniel Teil*

*Notes:*

Information about the previous workshops can be found on the following websites :

- <http://www.limsi.fr/GW99>
- <http://www.TechFak.Uni-Bielefeld.DE/GW97>
- <http://www.cs.york.ac.uk/gw96>

The next International Gesture Workshop is planned for the end of 2000 and information can be found on the website of the next organisers:

- <http://www.gw2000.sdu.dk/>

## Reviewers

|                         |  |
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