Lecture Notes in Computer Science 7172

Commenced Publication in 1973
Founding and Former Series Editors:
Gerhard Goos, Juris Hartmanis, and Jan van Leeuwen

Sølvi Ystad Mitsuko Aramaki
Richard Kronland-Martinet Kristoffer Jensen
Sanghamitra Mohanty (Eds.)

Speech, Sound and Music Processing: Embracing Research in India

8th International Symposium, CMMR 2011
20th International Symposium, FRSM 2011
Bhubaneswar, India, March 9-12, 2011
Revised Selected Papers

Springer

Volume Editors

Sølvi Ystad
Mitsuko Aramaki
Richard Kronland-Martinet
Centre National de la Recherche Scientifique
Laboratoire de Mécanique et d'Acoustique
31 Chemin Joseph Aiguier
13402 Marseille Cedex 20, France
E-mail: {ystad, aramaki, kronland}@lma.cnrs-mrs.fr

Kristoffer Jensen
Aalborg University Esbjerg
Niels Bohr Vej 8
6700 Esbjerg, Denmark
E-mail: krist@create.aau.dk

Sanghamitra Mohanty
North Orissa University
Sriram Chandra Vihar, Takatpur
Baripada, Orissa 757003, India
E-mail: sangham1@rediffmail.com

ISSN 0302-9743 e-ISSN 1611-3349
ISBN 978-3-642-31979-2 e-ISBN 978-3-642-31980-8
DOI 10.1007/978-3-642-31980-8
Springer Heidelberg Dordrecht London New York

Library of Congress Control Number: 2012942225

CR Subject Classification (1998): J.5, H.5, C.3, H.5.5, G.3, I.5

LNCS Sublibrary: SL 3 – Information Systems and Application, incl. Internet/Web and HCI

Typesetting: Camera-ready by author, data conversion by Scientific Publishing Services, Chennai, India

Printed on acid-free paper

Springer is part of Springer Science+Business Media (www.springer.com)

Preface

The Computer Music Modeling and Retrieval (CMMR) 2011 conference was the 8th event of this international series, and the first that took place outside Europe. Since its beginnings in 2003, this conference has been co-organized by the Laboratoire de Mécanique et d'Acoustique in Marseille, France, and the Department of Architecture, Design and Media Technology (ad:mt), University of Aalborg, Esbjerg, Denmark, and has taken place in France, Italy, Spain, and Denmark. Historically, CMMR offers a cross-disciplinary overview of current music information retrieval and sound modeling activities and related topics, such as human interaction, perception and cognition and much more. CMMR built its strength on its open and multidisciplinary approach to these fields and the interaction of researchers with expertise in the CMMR areas. As such, CMMR evolves with the researchers and their openness to new trends and directions within the related fields of interest.

Frontiers of Research in Speech and Music (FRSM) has been organized in different parts of India every year since 1991. Previous conferences were held at ITC-SRA Kolkata, NPL New Delhi, BHU Varanasi, IIT Kanpur, Lucknow University, AIISH Mysore, IITM Gwalior, Utkal University, Bhubaneswar, Annamalai University, and IIDL Thiruvananthapuram to promote research activities covering many interdisciplinary research areas such as physics, mathematics, speech, musicology, electronics and computer science and their practical application. Through this symposium indigenous speech technologies applicable for Indian languages get an appropriate platform for their advancement. Indian music is multicategorical in nature in this country of multilingualism. It has rich classical music at one end and numerous ethnic and folk music at the other end. At FRSM, different aspects of Indian classical music and its impact in cognitive science are the focus of discussion. Eminent scientist from the USA, Japan, Sweden, France, Poland, Taiwan, India and other European and Asian countries have delivered state-of-the-art lectures in these areas every year at different places providing an opportunity to researchers, academicians and industrialists to enhance their knowledge and to interact with each other to share their knowledge and experience in the latest developments in the fields. Participation in FRSM has always encouraged researchers to contribute toward achieving the objectives of the symposium effectively.

This year the two conferences merged for the first time into the FRSM/CMMR-2011 symposium that took place in Bhubaneswar, Orissa, India, during March 9–12, 2011. The conference was organized by the Resource Centre For Indian Language Technology Solution, Department of Computer Science and Application, Utkal University, together with LMA and INCM (CNRS, France) and ad:mt, Aalborg University Esbjerg (Denmark). The conference featured prominent keynote speakers working in the area of music information retrieval and

automatic speech recognition, and the program of CMMR 2011 included paper sessions, panel discussions, posters, and cultural events. We are pleased to announce that in light of the location in India there was a special focus on Indian speech and music. The melting pot of the FRSM and CMMR events gave rise to many interesting meetings with a focus on the field from different cultural perspectives.

The proceedings of previous CMMR conferences were published in the *Lecture Notes in Computer Science* series (LNCS 2771, LNCS 3310, LNCS 3902, LNCS 4969, LNCS 5493, LNCS 5954 and LNCS 6684), and the present edition follows the lineage of the previous ones, including a collection of 17 papers on the topics of CMMR. These articles were specially reviewed and corrected for this proceedings volume. The current book is divided into four main chapters that reflect the high quality of the sessions of CMMR 2011, the collaboration with FRSM 2011, and the Indian influence on the topics of Indian music, music information retrieval, sound analysis synthesis and perception and speech processing of Indian languages. The Indian focus provided many interesting topics related to the Raga, from a music theory point of view to the instruments and the specific ornamentation of Indian classical singing. Another particular topic that reflects the participation of FRSM is related to the speech of different Indian languages. We are pleased to present this work of FRSM/CMMR 2011 that brings forward both fundamental research in these important areas and research with a special focus from an Indian perspective, and gives a splendid opportunity to keep up to date on these issues.

We would like to thank the Program Committee members for their valuable paper reports and thank all the participants who made CMMR 2011 an exciting and original event. In particular, we would like to acknowledge the organizers and participants in FRSM 2011 for their participation. Finally, we would like to thank Springer for accepting to publish the CMMR 2011 proceedings in their LNCS series.

April 2012

Sølvi Ystad
Mitsuko Aramaki
Richard Kronland-Martinet
Kristoffer Jensen
Sanghamitra Mohanty

Organization

The 8th International Symposium on Computer Music Modeling and Retrieval (CMMR2011) was co-organized with the 20th international Symposium on Frontiers of Research on Speech and Music (FRSM2011) by the Resource Centre For Indian Language Technology Solution, Department of Computer Science and Application, Utkal University (Orissa, India), Aalborg University Esbjerg (Denmark), and Laboratoire de Mécanique et d'Acoustique/Institut de Neurosciences Cognitives de la Méditerrannée (Centre National de la Recherche Scientifique), Marseille (France).

FRSM Symposium Co-chairs

A.K. Datta	Society for Natural Language Technology Research (SNLTR), Kolkata, India
Sanghamitra Mohanty	Utkal University, Orissa, India
S. Ray Chaudhury	ITC SRA, Kolkata, India
Phalguni Gupta	IIT Kanpur, India

CMMR Symposium Co-chairs

K. Jensen	Aalborg University, Esbjerg, Denmark
M. Aramaki	INCM-CNRS, Marseille, France
R. Kronland-Martinet	LMA-CNRS, Marseille, France
S. Ystad	LMA-CNRS, Marseille, France

Organizing Committee

A.K. Datta	SNLTR, (Chair), India
Sanghamitra Mohanty	Utkal University (Convenor), India
Sølvi Ystad	LMA-CNRS, France
Anupam Shukla	ABV-IIITM, Gwalior, India
S.R. Savithri	AIISH, Mysore, India
Shyamal Das Mandal	IIT, Khatagpur, India
A. Deb	Jadavpur University, Kolkata, India
N. Dey	ITC SRA, Kolkata, India
R. Sengupta	Jadavpur University, Kolkata, India
S. Ray Chaudhury	ITC SRA, Kolkata (Co-convenor), India
M. Chakraborty	ITC SRA, Kolkata, India

Program Committee

Phalguni Gupta	IIT Kanpur (Chair), India
Richard Kronland-Martinet	LMA-CNRS, France
Mitsuko Aramaki	INCM-CNRS, France

D. Ghosh	Jadavpur University, Kolkata, India
B. Gupta	Jadavpur University, Kolkata, India
Sanghamitra Mohanty	Utkal University, India
Anupam Shukla	ABV-IIITM, Gwalior, India
R. Sengupta	JU, Kolkata, India
N. Dey	ITC SRA, Kolkata, India

Local Organizing Committee

Ajay Kumar Bisoi	Utkal University
Bikram Keshari Ratha	Utkal University
Prafulla Kumar Behera	Utkal University
Sohag Sundar Nanda	Utkal University
Sampa Chaupattanaik	Utkal University
Soumya Mishra	Utkal University
Suman Bhattacharya	TCS, Bhubaneswar

Table of Contents

Part I: Indian Music

Part II: Music Information Retrieval

Part III: Sound Analysis-Synthesis and Perception

Part IV: Speech Processing of Indian Languages