

Sound and Music Computing at KTH

Roberto Bresin, Anders Askenfelt, Anders Friberg, Kjetil Falkenberg Hansen and Sten Ternström

Sound and Music Computing Group, KTH Royal Institute of Technology

Extended Abstract

The SMC Sound and Music Computing group at KTH (formerly the Music Acoustics group) is part of the Department of Speech Music and Hearing, School of Computer Science and Communication. In this short report we present the current status of the group mainly focusing on its research.

Long term vision

The long term vision of the SMC group is “to understand human communication and interaction by sound and music so as to make them a natural part of everyday technology”. For example in 10 years from now it will be natural to use non-speech sound feedback instead of graphics when interacting with a mobile device. In addition to the technical foundation the research field of SMC includes behavioural science disciplines for the study of perception, cognition, embodiment, and emotion. We also look at artistic expression, and social aspects of music. For the realization of our vision we consider the SMC roadmap, which was written by eleven European research centres, including our group, for a common research path up to year 2020¹.

Research - trends

Three are the research areas in which the SMC group has been working during the last years:

Voice science - technical vocology: The research trends in this field are the use of integrated physics-based simulation for a more realistic voice synthesis, and the development of tools and methods for the analysis and diagnosis of voice function.

In the field of voice synthesis we are investigating the possibility of unified-domain physics simulation of voice by applying methods from both Numerical Analysis and Computational Biology through collaborations with related research groups at KTH.

In the VR funded project Phonatory Dynamics and States, we are investigating oscillatory

states and hysteresis phenomena of the vocal folds.

In collaboration with Karolinska Institutet and industry we are working on a project funded by Vinnova and FAS for the methodological and commercial validation of VoxLog – a portable voice logger.

Music performance: The research trends in this field are mainly MIR – Music Information Retrieval, Emotions in music, and Technology for music therapy applications. We have been investigating the possibility of using new perceptually based features for characterising music in audio files in a project funded by VR – The Swedish Research Council: SEMIR – Semantic Music Information Retrieval.

Under the coordination of the Kunstuniversität Graz we are working in a project on expression, emotion and imagery in music, in which we further develop our Director Musices system for expressive music performance.

During the period 2008-2011, we have been partners of the SUM - systematic Understanding of Music Nordic network, coordinated by Aalborg University, Denmark. Topics investigating in SUM have been the relationships between music, emotion, composition, and realtime interaction. We continuously collaborate in artistic projects that involve analysis, control, modification, and synthesis in interactive computer-aided expressive music performance.

Sound in interaction – motion analysis: The research trends in this field are mainly the understanding of complex control movements in music performance (e.g., control of musical instruments, expression of emotions), sonification of body movements, use of sound in diagnosis, rehabilitation, and therapy (ex: athletes, children with reduced abilities), and design of innovative musical instruments and sound-based interfaces.

In the field of complex control movements, we are investigating the possibility of gesture-based synthesis of violin sounds by analysing violinist bow movements via machine learning. We have also been looking at the acoustics and performance of DJ scratching by analysing and modelling DJs’ musical gestures on vinyl. The lat-

¹<http://smcnetwork.org/roadmap>

ter research has resulted in a PhD thesis by Kjetil Falkenberg Hansen in 2010.

Sonification of body movements is the main theme of the VR funded project SOM - Sonification of body motion. Sonification is also being applied in the improvement of the performance of athletes in the SONEA - Sonification of elite athletes project.

Ljudskrapan, funded by Promobilia, and Ljudparken (funded by PTS, The Swedish Post and Telecom Authority) are two projects that focus on the design of new methods for sonic stimulation Deaf and Hard-of-Hearing, and especially for children with impaired functions. Our paper describing the research work in the Ljudskrapan project received the best paper award at the SMC Conference 2011.

In the field of sound design we have been working in the ISHT – Interior Sound Design of Highspeed Trains project funded by KK-stiftelsen (The Knowledge Foundation) and coordinated by Konstfack. Our task in the project was the realization of innovative sound-based tools for the communication of information in train travel.

We have currently eight active projects, and our research activity has generated about 57 publications since January 2010, 28 of which have been published in international peer-reviewed journals. More information about our research can be found at http://www.speech.kth.se/smc/smc_research_topics.html.

Art-related research

The SMC group is partner of the Center for Opera and Technology, which is a joint collaboration between KTH and The University College of Opera, Stockholm. Our role in the Center is that of contributing to the technical development of operatic art, including singing voice distance teaching, and new means of expression. Extending Opera, research project by singer and composer Carl Unander-Scharin, was one of the successful activities of the Center during 2011, which also involved a master thesis work by Ludvig Elblaus.

Since 2011 professor Gerhard Eckel from IEM/KUG, Graz has been working within our group with the *Dancing the Voice* project that had its premiere at Folkoperan in Stockholm on March 29th 2012. *Dancing the Voice* is a sound sculpture that creates links between phonetics and dance and it is based on motion capture technology. The project is a collaboration between the SMC group, Stockholm University, and the University of Dance and Circus, and is supported by Wenner-Gren Stiftelserna.

We have also a continuous collaboration with KMH Royal College of Music including teaching

of music acoustics courses at undergraduate level, co-supervision of PhD students, and organization of international workshops and conferences.

During the years Anders Friberg has been collaborating in number of artistic productions including the recent *Flying Carpet*, a dance installation in collaboration with Anna Källblad, presented at the Art's Birthday Party, Södra Teatern, Stockholm, January 2011.

Outreach: Highlights

Our research results have frequently been noticed by media, and this resulted in a number of appearances in forms of radio, TV, newspaper interviews, reportage, and invited talks.

The biggest impact in 2011 was the cover and full story in the culture section that newspaper SvD Svenska Dagbladet dedicated to our group in March 2011.

In July 2009, Scientific American Mind magazine published an interview with Roberto Bresin on our research on emotions and music in a feature story about music and emotion.

The New York Times cited Anders Friberg in a feature story about music and motion (March 2011).

In December 2011, Kjetil F. Hansen was invited to present the Soundscaper project at TEDxKTH *ICT as a Game Changer* (3500 on-line viewers).

We have been invited to present an installation based on motion capture for music creation at Forskarfredag 2011 (*2011 Researchers' Night* organized by the European Commission). This installation was visited by about 5500 people in one day, and it was also invited to be presented at the 10 year anniversary of Vetenskap & Allmänhet at Färgfabriken in Stockholm, March 21st 2012.

Researchers of the SMC group have appeared in many SR and SVT programmes, for example Hjärtslag (12 episodes on music- and sound research produced by SR P2).

In 2011 we have started a new collaboration with SR Radio Theatre for the developing of new tools for designing sound effects.

Hosting international symposia and conferences 2010–2013

In the period 2010-2012 we have been organizing thematic workshops such as *Sound is Motion* (Feb 2010), *Music is Motion* (Jun 2011) and *ISon 2010 - Interactive Sonification workshop* (Apr 2010). *ISon* was the third *ISon* after those organized in Bielefeld and York. *ISon 2010* attracted around 60 people (proceedings are available on-line), and

resulted in a special issue of the Journal on Multimodal User Interfaces, which will be published during 2012. In 2010 we organized the international conference *PAS 5 - Physiology and Acoustics of Singing* (August 2010), and in 2012 the first *Sound and Music Computing Sweden* (April 2012).

In the near future we are going to organize the international conference *SMC - Sound and Music Computing Conference 2013*, including the SMC

Summer School, in parallel to the fourth decennial international conference *SMAC - Stockholm Music Acoustics Conference 2013* (July-August).

More information about our publications, staff and other activities can be found at <http://www.speech.kth.se/smc>

Keywords

Sound and Music Computing, Music Acoustics, KTH