>hot_strings SIG<

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ABSTRACT

Many fascinating new developments in the area bowed stringed instruments have been developed in recent years. However, the majority of these new applications are either not well known, used or considered in a broader context by their target users. The necessary exchange between the world of developers and the players is rather limited. A group of performers, researchers, instrument developers and composers was founded in order to share expertise and experiences and to give each other feedback on the work done to develop new instruments. Instruments incorporating new interfaces, synthesis methods, sensor technology, new materials like carbon fiber and wood composites as well as composite materials and research outcome are presented and discussed in the group. This paper gives an introduction to the group and reports about activities and outcomes in the last two years.

Keywords

Interdisciplinary user group, electronic bowed string instrument, evaluation of computer based musical instruments

1. INTRODUCTION

The evaluation of new instruments presented at NIME plays an important role in the process of development [9]. Possibilities to measure the instruments in order to provide evidence of their usability, have for example been presented in [11] or in [2]. While many new instruments have been used by their developers in concerts and presentations, the majority have not been used in a broader way by other musicians, seeking to widen musical expression by using new interfaces and new instruments.

If an instrumentalist selects an instrument, one may think it is obvious, that a personal evaluation of the quality and potential of the instrument is undertaken. However, her or his selection is not based on a scientific measurement providing a normalized result, that would be the same for everyone at any time and at any place in the world. One might say that the evaluation is based on personal criteria of the musician including all the subjectivity coming with such an approach. A musician may develop these criteria according to her or his artistic background. This raises the question, whether a development process based on scientific measurement and on average well designed principles of construction, will be able to satisfy a musician who wants a personal profile in her or his music. The creation of this profile often starts already with the selection of an instrument. If not based on scientific findings, where would one get ideas on how to construct new musical instruments?

As presented in [12] or in [1], collaborations between researchers and composers are helpful for all participating parties. While this approach is important, those collaborations may have the drawback, focusing mainly on hardware and software solutions, which are already in advanced stages of development. Composers, and then performers are expected to make use of the new possibilities, independently of their own ideas of how a newly constructed instrument ideally might look like and function.

Facing this problem, it might be helpful to involve the intended users, the performers, in the design process at very early stages. A close feedback loop between developers and the target group might be helpful, in order to achieve a technical solution, which matches closely the needs of the users. In order to facilitate such a feedback process, a group of interested performers, willing to cooperate with researchers and instrument developers would be ideal.

This paper reports about such an interdisciplinary group, its goals, its activities, experiences of participants, outcome and future plans. Discussions, statements and the test of instruments are presented and analyzed. A collaboration is described and conclusions for the development of new instruments are presented.

2. RELATED WORK

Working closely together with users during system development is a well known principle in computer science. 'Participatory Design' for example is a method, where end-users are involved in several stages of the development process [5]. A broad population of users is incorporated, starting already in the phase of initial exploration and problem definition. This collaboration continues until system evaluation at the end of the development. Similarly a close interplay between users and developers is found in the DIA cycle (Design, Implementation, Analyze), a method that integrates these three stages and incorporates users in the analyzing phase [3].

Collaborations are of course done also in research and developments of string instruments. An example may be found in the STRAD group, hosted by the Center for Research in Music and Acoustics (CCRMA) [10]. Research has been done on bowed string modeling, controllers for playability of virtual bowed strings. Another example is the 'Catgut Acoustical Society', a large group that is interested in the application of scientific principles to the construction of instruments in the violin family [4]. Projects involving researchers, composers and musicians such as the Hyperstring Trilogy [6] should be mentioned here as well. However, to the

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knowledge of the authors, these projects focus on specific developments, related to and inside of an institutional framework. A community open to any interested professional performer, researcher or composer is still missing.

3. THE GROUP

In 2004 the first author invented a group called >hot_ strings SIG< . SIG stands for "Special Interest Group". The impetus for the group was the fact that many of exciting developments in the field of new computer based stringed instruments, were little known in the world of string players. Performers, researchers and instrument developers, known by the founder, were asked, whether they were interested to share their needs, experiences, outcome and future plans and to discuss those.

3.1 Organization and Participants

A mailing list was set up in order to communicate organizational information as well as to discuss topics relevant for the members. The list currently contains 34 members from France, United Kingdom, Sweden, Denmark, Germany, Spain, Belgium and the US. The majority are professional string players; the next biggest group is researchers. Additionally there are several composers as well as one traditional violinmaker.

Participants are associated with institutions such as the Bavarian Radio Symphony Orchestra Munich, the opera orchestras of Cologne and Dortmund, the University of Birmingham, the European Chamber Music Academy, the Pompeu Fabra University Barcelona, the Julliard School in New York and IRCAM Paris.

The SIG is completely self-financed and supported by the time, money and enthusiasm the participants put into it.

3.2 Initial Goals and Questions

The organization seeks to strengthen the exchange among people involved in thinking and working on the future of bowed stringed instruments. Starting from the belief, that materials like computer hard- and software, synthetic fiber, mechanical resonators or similar material offer a huge potential for the creation of musical instruments, it is a further goal to use these materials and to investigate how they might be used in order to improve bowed stringed instruments in a meaningful way.

Since all the developments are intended for practical musical use, the group also works to organize and present concerts including compositions that make use of presented developments. Besides these general goals, there are personal and specific questions the participants bring into the group.
Here are examples of questions by the first author (a researcher):
- How will the performers react when being confronted with videos of new computer based bowed stringed developments?
- What kind of responses will be heard when developments will be presented to and tested by the performers?
- Will there be common convictions about what criteria a computer based stringed instrument will have to meet?
- What topics will be mainly discussed?
- Will presented instruments be useful for the personal musical expression of the performers?
- Will the language and descriptions the performers use, be transmittable to the languages and descriptions commonly used in computer music?

Asking performers about personal goals and questions, the hope to get in touch with like-minded people, to find meaningful new sound-technologies, to share knowledge, experiences and repertoire, to find possibilities to do concerts were mentioned. An additional goal is to initiate collaborations thereby fostering new ideas and inspiration for the ongoing individual work.

4. SIG MEETINGS

In order to facilitate broad exchange between members, meetings are held twice a year. The following five meetings have taken place:
1. 5th of December 2004 in Hannover, Germany
2. 17th of March 2005 Hannover, Germany
3. 23rd of October 2005 Media-House Hannover, Germany
4. 7th of April 2006 Academy of Media Arts Cologne, Germany
5. 23rd of October 2006 IRCAM, Paris, France

4.1 Meeting Topics

The programs of the meetings included:
- Discussing and defining the main goals and structure of >hot_strings SIG<.
- Giving an overview on string related developments, showing up in the past 20 years at ICMC and NIME Conferences.
- Presenting developments and research results of meeting participants.
- Testing, subjective evaluation and discussion of these instruments.
- Presentation of compositions (for those new instruments) and discussing those.

4.2 Discussions Among Participants

Working on these topics, discussions emerged immediately. Recapitulating, one may say, the main focuses were: the needs of a high quality instrument, the future of music and thus the related instrumental needs, missing qualities in the presented developments, aesthetics of presented compositions using new developments, possibilities and limitations of presented developments, new playing-techniques and new gestures, the need to forward the collected developments, experiences, and knowledge to the world of string players.
Several questions came up. These were for example:
- What is the essence, the kernel or the core of a good instrument?
- How can one define 'string specific playability' and 'string specific sound'?
- How far from the traditional instrument should a new one be in terms of playability, sound, feeling and technical complexity?
- How could one describe the warmth, the intimacy, the depth or the roundness of a tone in a physical way?
- Are there objective quality criteria of violin family instruments and - if yes - what are they?
- How can the knowledge about new developments be integrated in the present education of string players?

5. OUTCOME

Besides obvious results such as gathering new knowledge of developments or new repertoire, participants reported that the presented new instruments as well as the discussions have been a significant source of inspiration. As expected, collaborations between developers, performers and composers were started, which have lead to a new composition for computer based violin or a new violin synthesizer used by the second author (see chapter 5.3).

5.1 Presentation of Developments

When faced with videos and demonstrations of new computer based instruments, performers reacted with critical interest. A more important problem was caused by the fact, that video demonstrated instruments could not be tested personally. Another problem was to distinguish between the composition and the potential of the instrument demonstrated. To summarize the discussions, the following outcome may be mentioned here:

- Many developments presented, were felt to be 'cold' in the sound. Something essential of the string sound was said to be missing. Using such an instrument, one would be limited to create the achieved personal variety in musical expression.
- It was often mentioned that developments coming out of the world of computer music were perceived to be either 'toy-like' or more useful in a scientific context than for producing meaningful music.
- It was a general held opinion that knowledge about the new developments should be presented in the traditional education of string players no matter how 'cold' or 'scientific' an instrument was. It was expected that new technologies would lead sooner or later to instruments being used in a broader way. However, despite the fact that more participants were seeking new sounds and instruments, they were on the whole not convinced enough to adopt the presented instruments.
- Sounds of a demonstrated synthesizer viola that were considered by the first author to be very close to the traditional viola (and therefore suggested not to be interesting) were felt to be very interesting and accurate by some players.
- Concerning the feel of an instrument that is - due to the obvious connection to the physical response of the interface - often considered as a matter of primary importance for the interface, it is important to mention, that a differentiation between the sound and the interface was not accepted by a lot of participants. As soon as the sound was felt to be poor, the instrument itself was felt to be poor, even if a good modulation of the sound was still possible with the interface.

5.2 Statements of Participants

While there were rough similarities in the opinions concerning some issues to instruments, a different field of opinions about other topics was found as well. Some statements have been reported in [8]. In addition to show this broad spectrum, some statements of participants are presented here as well.
- I do not think that these new developments will be used in a broader way, if they are introduced to classical players. In order to get them onto the market you will have to bring them to pop-musicians.
- Beside the importance of a string specific playability it is important to have a string specific sound. The question of the playability or feel of instrument cannot be separated completely from the sound.
- The missing warmth, roundness and depth of the sounds in computer based string instruments could be achieved by adding resonances that feed back to the string. I think it is impossible to get a convincing sound and feel of a string instrument without the feedback of resonances to the string via the bridge.
- I actually don't see a way to get computer based string instruments that give me what I need in playability and sound. What we could do is to contrast different worlds of sounds.
- When using computer based string instruments, I am interested to have a completely different sound than the traditional violin. I accept limitations in playability and expressive range.
- Tracking bow speed and bow acceleration does not make a lot of sense. In my experience string players think very different about bow-speed and bow-acceleration compared to what we measure.
- I am not convinced of the often proposed linearity between gesture and sound. I can do similar sounds with very different gestures and very different sounds with similar gestures. In terms of a string player, it might make more sense to find different concepts in order to describe the connection between physical action and sound.

Using available instruments and working on sounds, players estimated to be meaningful, very different results were obtained. Differences in opinions on how exactly a useful instrument should look, were found as well. Concerning the questions mentioned in chapter 3.2 this leads to the conclusion, that common convictions on how a computer based stringed instrument should look like, were not found. Similarly, the question whether available instruments are useful for the personal expression was answered differently.

Asking for the reasons for such different opinions, it became clear that different aesthetic positions as well as different experiences with electronic instruments were crucial.

5.3 Example of Collaboration

Listening to the presentation of a synthesizer violin using the principle of 'Audio Signal Driven Sound Synthesis' [7] the second author Günter Marx, concertmaster of the Dortmund Philharmonic Orchestra, became interested in starting a collaboration with the first author.

While common synthesis methods are controlled completely by explicit and discrete parameters, the sound synthesis used here is mainly driven with the rough and unanalyzed audio signal. This allows the player to use playing parameters (such as warmth or sharpness of timbre) that are implicitly laying in the audio signal even if not being tracked. Besides that, problems of tracking mistakes and latency are reduced.

It was the goal to create sounds that were convincing for the violinist and to study how sounds using the principle of 'Audio Signal Driven Sound Synthesis' were felt in terms of playability and potential for musical expression.

A program was written that incorporated five different synthesis methods. The program includes parameter driven synthesis methods (two) as well as audio signal driven ones (three). The violinist uses a Zeta violin. Sounds were developed at first together and later by the violinist himself.

Interesting were problems occurring in the initial phase of the collaboration. It was often the case, that a development was expected to be of high importance for the performer, but in fact it was not. Also issues, that were expected to be less important, were sometimes crucial for the performer. A win-win situation could be achieved by modifying the software using several ideas from the performer. The technical complexity of these unplanned modifications was mostly rather small. This lead to a better understanding of the performer's quality criteria and helped to build a system, that was in fact able to widen the expressive range of the musician.

The performer selected personal sounds by studying the possibilities of the various synthesis methods. It became clear be examining the performer's selection that sounds of signal driven synthesis methods were used as well as parameter driven ones. The majority were the signal driven ones. Asking for the reasons, it was said that the ability to modulate the sound and to form it with the bow and fingers was felt to be stronger in signal driven sounds. However, since the parameter driven ones had a specific character in timbre, these sounds were of importance as well.

An improvisation using the developed sounds was performed on the 5th SIG meeting (see figure 1). A collaboration with a composer of the SIG has been started. The composition will be performed on a SIG-concert in June 2007.

6. CONCLUSIONS

As described in chapter 5.1, the current state of developments presented in meetings seem still to be lacking essentials, a lot of string players consider to be necessary. While words like 'too cold' or 'missing string specific sound' are used, it remains unclear what exactly is meant in terms of a translation to the physical domain of

Figure 1: Günter Marx presenting signal driven synthesis methods.

sounds. It could be a fruitful are for further investigation attempt to accurately define these terms and determine what kind of sounds will be perceived as usable and interesting for the intended musicians.

In comparison to the subtle in timbre differences of presented acoustic instruments, built from new combinations of wood and carbon fiber, the timbre of presented synthesizer instruments are - physically seen - much more varied. However, on a perceptual level, the fine timbre and volume-differences of presented acoustic instruments were found to be similarly meaningful, compared with the larger differences of synthesized sounds. One may conclude, that a method, which describes the sounds and their properties from a perceptual point of view, might be helpful for a better understanding of the sound-quality some participants were missing.

Concerning participants who were already working with their own electronic instruments, it became clear, that they were more interested to work on their current needs and wishes, instead of using completely new instruments. In this case a collaboration means that the developer has to concentrate more on a performer-oriented and personal work, than on research topics defined by the developer. While this may be a problem for a researcher, it has the advantage of working in a close feedbackloop with the performer. As found in the described collaboration (chapter 5.3), being in the feedback loop with the performer, will allow the researcher to go further into the question why and why not the performer considers a sound, an interface or an instrument as to be meaningful or musically useful.

This experience seems to indicate, that methods used in 'Participatory Design' (see chapter 2) may be in fact of use in development strategies of new interfaces for musical expression. As discussed with researchers of the SIG, this performer-oriented approach contrasts the often found composer- or researcher- centric approach.

A SIG composer mentioned the problem to find performers, who understand and are able to play the often highly complex and specific new computer based instruments, evolving out of the developments done by researchers and composers. Starting with a close collaboration between developers and performers, and later on, incorporating composers, seems to be a helpful strategy to come up with instruments satisfying for both, the performer and the composer.

7. OUTLOOK

Following the goals of chapter 3.2, a SIG concert will be given on the 26th of June 2007 at the Academy of Media Arts in Cologne, Germany. It is planned to do workshops with string players to pass on gathered developments, knowledge and repertoire. Since the technical knowledge of string players is often rather small, it is planned to build simple units like signal driven synthesizer programs or vst plugins to download from the SIGs website.

An important factor will it be to find people that want to act as a kind of bridge builders, in order to enable interested string players, lacking of technical know how, new playing techniques and repertoire, to work with the developments presented here. Another important issue is a better understanding of the psychoacoustical factors, that are crucial in the string player's evaluation of new bowed stringed instruments.

8. ACKNOWLEDGMENTS

The authors wish to thank all the participants of the >hot_strings SIG<, the Media House Hannover, the Academy of Media Arts Cologne, IRCAM Paris and Carter Williams for copy editing.

9. REFERENCES

[1] F. Bevilacqua, N. H. Rasamimanana, E. Fléty, S. Lemouton, and F. Baschet. The augmented violin project: research, composition and performance report. In *Proceedings of the 2006 Conference on New Interfaces for Musical Expression*, pages 402–406, Paris, France, June 4-8 2006.

[2] D. Birnbaum, R. Fiebrink, J. Malloch, and M. M. Wanderley. Towards a dimension space for musical artifacts. In *Proceedings of the 2005 Conference on New Interfaces for Musical Expression*, pages 192–195, Vancouver, Canada, May 26-28 2005.

[3] J. Borchers. Designing interactive systems. Courese Wintersemester 2006/07, RWTH Aachen, 2006.

[4] Catgut. Catgut acoustical society. http://www.catgutacoustical.org/.

[5] J. Greenbaum and M. Kyng, editors. *Design at Work, Cooperative Design of Computer Systems*. Lawrence Erlbaum Associates, Inc., Mahwah, NJ, USA, April 1992.

[6] T. Machover. Booklet. In *CD Hyperstring Trilogy*, Shutesbury, MA, USA, 2003. Oxingale Records.

[7] C. Poepel and R. B. Dannenberg. Audio signal driven sound synthesis. In *Proceedings of the 2005 International Computer Music Conference*, pages 391–394, Barcelona, Spain, 2005.

[8] C. Poepel and D. Overholt. Recent developments in violin-related digital musical instruments: Where are we and where are we going? In *Proceedings of the 2006 Conference on New Interfaces for Musical Expression*, pages 390 – 395, Paris, France, June 2006.

[9] I. Popurev, M. J. Lyons, S. Fels, and T. Blaine. Workshop proposal: New interfaces for musical expression. In *Proceedings of the 2001 Workshop on New Interfaces for Musical Expression*. Sig CHI, April 1-2 2001.

[10] S. Serafin. Strad (sistema tempo reale archetto digitale). http://www-ccrma.stanford.edu/ serafin/strad.html.

[11] M. M. Wanderley and N. Orio. Evaluation of input devices for musical expression, borrowing tools from hci. *Computer Music Journal*, 26(3):62–76, 2002.

[12] D. Young, P. Nunn, and A. Vassiliev. Composing for hyperbow: A collaboration between mit and the royal academy of music. In *Proceedings of the 2006 Conference on New Interfaces for Musical Expression*, pages 396–401, Paris, France, June 4-8 2006.