

WHO'S SONIFYING DATA AND HOW ARE THEY DOING IT? A COMPARISON OF ICAD AND OTHER VENUES SINCE 2009

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1. INTRODUCTION

What disciplines are applying data sonification, and what synthesis tools are they using to make the sounds? These questions are basic to understanding the state of sonification today, but they are surprisingly difficult to answer. This short review attempts to fill this gap by distilling common patterns of data sonification research. We hope that this will complement other literature reviews and give potential and current sonification researchers a sense of what is happening in the ICAD community, where there is room for new ventures, and where there is already a lot of active research to connect with. Additionally, we place ICAD in context with other academic publications.

Over its twenty years, ICAD participants have presented a wide variety of applications for data sonification. Other reviews of the literature have already given general overviews of the work in the field [1], looked at how various physical quantities have been sonified [2], and how they were evaluated [3]. Instead, we wanted to focus on the people doing sonifications to get a current sense of which disciplines are involved in applied sonification and what tools they use.

The review covered 51 articles (29 in ICAD, 22 elsewhere) applying data sonification since 2009. Some ongoing studies have several published articles associated with them; however, we analyze all papers separately. The criteria for inclusion were whether a sonification example was created in the work (as opposed to a theoretical discussion or general presentation of a software tool) and whether they used data in the example sonification. The data could be real-world data or synthesized. A full list of the papers included in the review is available at http://www.zotero.org/groups/icad_2012_sonification_tools/items.

2. COLLABORATION AND SOFTWARE AT ICAD

Applied data sonification articles at ICAD were almost always affiliated with a music or technology department. The first authors on 22 of the 29 articles had a music/technology affiliation, and three more papers had a music/technology affiliation further down the author list. Institutions associated with the applied subject area—i.e. the source of the data being sonified—were not as prevalent, but did have a narrow majority (17 papers). Twelve articles involved a collaboration between a music or technology department and department in the subject area. Physics and biology were both well-represented in the applications, but there was no social science applications besides for one economics-related article [4], despite the fact that the social sciences are rife with quantitative

data.

The prevalence of music and technology specialists in the literature is hardly surprising—sonification today invites that level of specialized knowledge to actually realize the complex sounds involved. To ease the use of sonification to explore data, several software toolkits have been created (e.g. the Sonification Sandbox, SoniPy, AesSon, and the Interactive Sonification Toolkit). Yet only one recent ICAD paper used a general sonification tool, and this paper was written by the author of the tool: David Worrall used his SoniPy framework to sonify capital trading data [4]. This echoes the frequent lament that there are no mature general-purpose data sonification toolkits [5].

Almost all of the ICAD papers used open-source computer music synthesis software to realize the sonifications (see Figure 1). SuperCollider was the most popular, accounting for 9 of the 29 papers; Pure Data, another open-source synthesizer, was almost as popular (7 papers). Csound and ChucK were rarely used, and the proprietary Max/MSP was used twice. There were no ICAD papers which used built-in MIDI software synthesis, which is one of the easiest ways to generate sound (many computers and mobile devices come with a MIDI software synthesizer). The remaining papers used a smattering of custom hardware and software for creating the sonification.

3. ICAD'S DATA SONIFICATIONS COMPARED WITH OTHER VENUES

The 22 non-ICAD papers we found had a lot of overlap in content and authorship with the ICAD community (although see *Limitations* section below). Only four of the non-ICAD papers we found had authors who had not previously appeared in ICAD; seven had authors who had all appeared in ICAD, and 11 had a mixture. However, only five articles were collaborations between music/technology departments and an institution in the applied data field. There were no sonifications that related specifically to social science data.

Pure Data was, again, a popular synthesis tool among the non-ICAD group, accounting for 5 of the 22 papers (see Figure 1). Unlike in the ICAD articles, SuperCollider was only used in 3 papers, and solutions using built-in MIDI software synthesizers were the most popular (6 papers).

In the full pool of 51 data sonification articles since 2009, authors with multiple recent publications tended to use the same tools. This suggests that the technical ease of using familiar software may override the advantages of alternate tools for different applications. Among the 22 authors who appeared on more than one publication, only 5 authors used more than one tool. For the 9

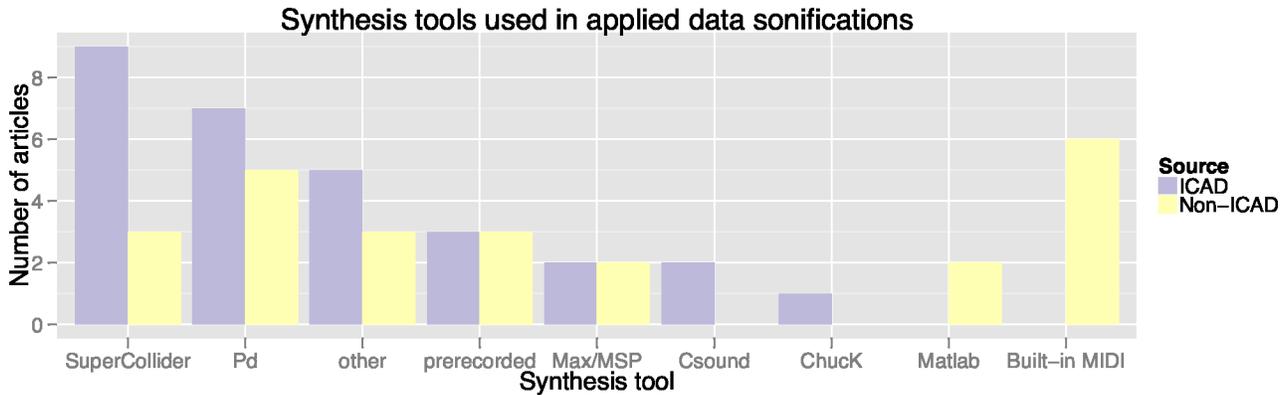


Figure 1: SuperCollider was easily the most popular synthesis tool among applied ICAD sonifications, but Pure Data (Pd) and built-in MIDI software synths were most common in non-ICAD articles.

authors who appeared first on multiple publications, there was only one exception: Nina Schaffert, who generally used Pure Data for sonification, used custom synthesis hardware in an early iteration of her rowing sonification system [6].

4. LIMITATIONS

A survey of sonification practitioners may be more effective than a literature review as a way of understanding the what, why, and how of sonification research today. It would allow us to ask people why they were conducting the research, what their original aims were, and why they used the tools they did. We initially started our review looking at other aspects of the sonifications, including the context, purpose, type of data, details of the user evaluation (if any), and the target user group. However, these were quite complex to define or were simply not well-described in the papers.

We believe that there are many other articles on sonification besides the ones we were able to find by searching for the keyword “sonification” on Google Scholar and Web of Science. The SAS Institute (a leading statistical software vendor) recently published research on auditory graphing without a single mention of the term “sonification” [7].

5. CONCLUSION

Sonification has not yet found its scientific champion. In Quetelet and other 19th-century innovators, visualization found leaders in applied fields such as economics who could also effectively promote new means of communicating and discovering their findings [8]. Also, several quantitative fields have very little representation in the sonification community, especially the social sciences. Existing sonification-specific tools are not gathering enough of a user-base beyond their authors to encourage the development of a mature piece of software. Instead, data sonification is proceeding with an interdisciplinary approach, often via collaborations between applied researchers and those with the technical and artistic expertise to use their favorite computer synthesis tool in order to realize the sonifications.

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7. REFERENCES

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