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Exploring the Aesthetics and Utility of Sonification with Isomorph– Interactive Sonification for Molecular Physics

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***Abstract*— This paper presents the Isomorph project, in which we are developing a set of open sonification tools for scientists and others exploring molecular dynamics in realtime simulations. Here we outline our work with a VR-based system, and a study to systematically work towards data-to-sound mappings which are aesthetically satisfying but transparent, ergonomic and demonstrably meaningful.**

I. BACKGROUND

We discuss our experiences in combining our prototype sonification tools with NarupaXR [1], a system developed at the University of Bristol that allows multiple users to interactively build and manipulate complex molecular structures using VR headsets and controllers.

We have explored a number of applications using the system. These include a drug docking application (Fig. 1), where small ligand molecule - a candidate for a novel drug design - must be positioned within a larger protein molecule This is a complex spatial task that we believe can be greatly aided by sonification.

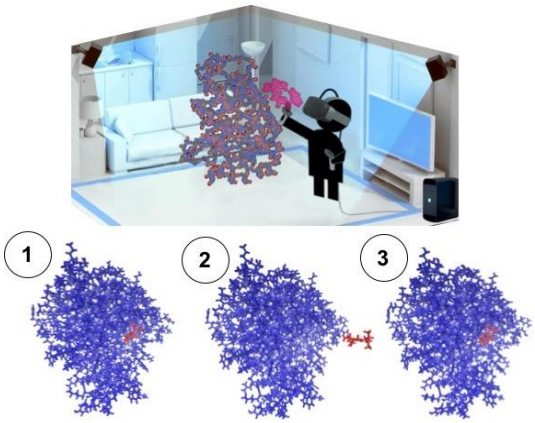

Figure 1. Drug docking experiment: (1) illustrates the ligand (magenta) in its original position, (2) unbound from the protein (purple), and (3) in its final pose after user has docked it to the protein.

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II. SONIFICATION

A key focus of Isomorph project is the aesthetics and ergonomics of sonification. We believe that sonification can enrich the apprehension of data in the media-rich environment of VR, but only if fit for purpose. Whilst accurate representation of the data is paramount, sonifiation should also exhibit the qualities of good (sound) design, being perceptually congruent [2], meaningfully interactive and suitable for prolonged use without aural fatigue.

III. STUDY

In order to explore a variety of sound design approaches, we undertook a two-part controlled study. In the first part, we invited a number of professional sound designers, working in film, TV, gaming, VR and music, to use a variety of sound materials and techniques to sonify key featuress exposed by the Narupa system in a series of auditory representations.

In the second part, these representations formed the basis of a blind/acousmatic test with representative end users. Their responses were measured, and their impressions of the sonification as part of the Narupa simulation were discussed through in-depth interviews.

IV. FINDINGS

In this paper we focus on qualitative data gathered from the end user interviews, which have guided us towards the formation of a prototype aesthetic framework for sonification in with Narupa. We have used this framework to develop a number of sonifications based on the simulation, which we will present to illustrate the paper.

REFERENCES

[1] O'Connor MB, Bennie SJ, Deeks HM, Jamieson-Binnie A, Jones AJ, Shannon RJ, Walters R, Mitchell TJ, Mulholland AJ, Glowacki DR (2019) Interactive molecular dynamics in virtual reality from quantum chemistry to drug binding: An open-source multi-person framework. The Journal of Chemical Physics 150 (22):220901. doi:10.1063/1.5092590

[2] Ferguson, J. and Brewster, S. (2018) Investigating Perceptual Congruence Between Data and Display Dimensions in Sonification. In: 2018 CHI Conference on Human Factors in Computing Systems, Montréal, QC, Canada, 21-26 Apr 2018, p. 611. ISBN 9781450356206 (doi:10.1145/3173574.3174185)