Project summary
Multi-modal Cues for Virtual Sketching and Related Tasks (MMSketchCues)

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Sketching is central to many stages of problem solving and creative design in a wide range of application domains. The pervasive nature of this activity has prompted researchers and designers of virtual interactions to try to create its digital equivalent, in the hopes of enabling users to merge the possibilities which stem from a human affinity to develop ideas from raw sketches on the one hand, and computer assisted processing and storage on the other. Through decades-long research and analysis, three primary components of sketching have been distinguished in the literature: feedback, oversketching and incremental refinement. *Feedback* refers to the ability of the drawer to obtain (visual) feedback throughout the progress of the sketch, allowing him or her to constantly make comparisons between the sketch and a gradually evolving mental image. *Oversketching* – also referred to in the literature as e.g., overdrawing, overtracing, re-sketching, etc. – is a process in which existing parts of a sketch are drawn over, allowing the drawer to emphasize certain aspects while de emphasizing others. Finally, *incremental refinement* refers to the process of developing an idea based on the interplay of the former two components.

In this project, our goal was to develop an extension to an immersive virtual sketching application that supports oversketching, and provides associated augmented feedback through an audio-based CogInfoCom channel. CogInfoCom channels are structured multi-sensory messages which carry information on semantic concepts. Mappings between semantic concepts and CogInfoCom channels can be created in a number of different ways. To enhance earlier implementations of CogInfoCom channels in this particular scenario, our goal was to use the so-called structural mapping technique besides various forms of direct mapping in order to ensure that the feedback audio signals better suit the spatio-temporal character of user interactions.

More specifically, as a mapping of the concept of 'curviness' onto the audio-based CogInfoCom channel, both low-level and high-level direct techniques, as well as structural techniques were used. Variations in the slope of line segments were mapped onto pitch (low-level direct mapping), and increasing 'curviness' was represented by gradations of increasingly complex harmonic structure (thus, icons of 'simplicity' were used to characterize straight line segments, while icons of 'complexity' were used to characterize line segments with many direction changes, resulting in a high-level direct representation). Quick and abrupt user interventions were marked by relatively higher tempi and shorter sounds, whereas the sounds associated with slow oversketching motions were comparatively relaxed (structural mapping). Also in line with the technique of structural mapping, the spatial context of the drawing to which the sounds pertained was restricted to the area manipulated in the most recent user interactions.

In our implementation, we used the TUI framework – developed at the Virtual Product Creation Lab of Fraunhofer IPK – and some of the peripheral tools associated with it, including a Bezier-curve drawing tool, a pair of head tracking glasses, and a software component that implements a virtual sketching application. The audio component of the application was implemented by a wrapper to SuperCollider – a general-purpose audio synthesis engine. The Spiral Discovery Method was used to explore various parameter value combinations for sound synthesis. At the end of the project, user experience was explored using the AttrakDiff questionnaire, allowing for the future comparison of various CogInfoCom channel based mapping techniques.