Space and Digital Reality - Ideas, Representations/Applications
and Fabrication, within the framework of Tallinn Architecture Biennale TAB 2019.

Robotic Braille and Spatial Maps -Combining tactile and visual Narratives

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People experience spaces differently according to who they are – their social, cultural and economic background, but most importantly, their abilities to process visual and tactile information. As has been argued, we experience space with all our senses (Rasmussen 1964), yet Western culture is dominated by vision (Classen 1998; Pallasmaa 2005). Significantly, blind or partially sighted people decode and choreograph an array of sensory interactions in public spaces so they are able to produce an organized and meaningful understanding and awareness of the space around them. In this context, hypermedia environments can support users in navigating between textual and carthographic information nodes in order to get a well-documented, multi-faceted representation of space (Milleret Raffort 1995). Whereas pictorial, raised form images can support blind or partially sighted people to understand objects, situations, and events, more importantly, spatial perception can be derived both through sight and touch (Kennedy 1993). By adopting universal design principles (Preiser

2001), different sensory cues can be provided for spatial mapping and wayfinding in urban, public or built environments, so that people with different sensory capacities to navigate and enjoy space (Herssens, Heylighen 2012).

This paper discusses empirical research into computational design and robotic milling for spatial and interpretative mapping, using pixel and line based textures and patterns for adoption as information, narratives and meta-text for spaces and public areas. The research pilot study is carried out to develop resources for use of tactile maps in order to allow people to identify and memorize routes and topography, display itineraries of possible interest, or thematic data for use by a diverse audience. Two distinct approaches were investigated for robotic fabrication; a) tactile Braille text and b) combined visual and haptic information. The research adopted standard Braille Grade 1 text as a tactile writing system, based on a 2 x 3 vertical grid (Braille cell) with six dots positioned to formulate alphabet, numbers, punctuation and special symbols (Braille characters), and defined distances between dot size, spacing within cell, between words, and distancing lines. Here, text is displayed through Braille coding, in a sequence of subtracted points (pixels) filled with ball bearings (1.5-4mm ball bearings, steel). Different types of tactile maps and data for combined visual and haptic information (ranging from maps for mobility, topology, orientation to general references and thematic maps) were scripted in Grasshopper GH for robotic toolpaths. Samples and prototypes produced in timber (beech) with robotic manufacturing were using a standard six-axis robot (ABB IR 120), coupled with off-shelf milling tools and routers (1-8mm). In the surface patterning, maps and topographical information is robotically milled as contour lines, coupled with pixelated visuals displayed through depth, with gradients of shades translate to darker and lighter areas. Further sets of GH scripts were developed to translate visual data into three-dimensional haptic reliefs, and adopting robotic programming for control and variability of tools applications and robotic path (Axis), end-effector angle and depth, and sequenced informed point grid to achieve volumetric complexity.

Through this series of samples and prototypes geared towards urban furniture and infrastructures, tactile and visual experiences were produced that are useful in building a mental image of the environment and display information. Developed with The Institute for the Blind and Partially Sighted (IBOS), the research contributes to orientation and learning movement through space and public environments, and provides narratives, so that relationships with physical references in the space and understanding of context can be established. In this manner, the research contributes to the transactional relationship between people and embedded sensory characteristics in the built environment, and provides inclusive design for a diverse audience.

This research was developed at the RoboticsLab, Aarhus School of Architecture, Aarhus, in discussion with The Institute for the Blind and Partially Sighted (IBOS), Copenhagen, Denmark. The authors would like to thank the members of the HardCourse2019_W4 for their contributions and engagement: Mette Holm, Cecilie Elmholdt Smidt, Rikke Friis Sørensen, Klaus Schytt Simonsen, Max Arpe-Sørensen, Adam Marcel Nielsen, Brita Melander, Bastian McLean Gosvig, Christian Bjerrum Poulsen, Marie Hjulmand Emborg, Lena Mortensen, Anna Vidje Lundahl, Jo Giæver Suul, said boujakhrout, Andreas Ørbæk Damm, Marc Frederik Roi Bak.

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[Keywords]
blind, Braille, inclusive design, robot milling, spatial maps, tactile and visual perception