Rethinking Sonic Interaction

The Physicality of Sound

(Digital Tangibility through Dynamic Audiotactile FeedbacK)

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NOKIA
Connecting People

Multimodality
Crossmodality

Vision (graphic) - Light
Touch (haptic) - Touch
Hearing (auditory) - Sound

Chemical senses (Taste, smell)
Others senses

Previous experience

Cognition, expectation, personal goals,

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Classic Sonic Interaction Design

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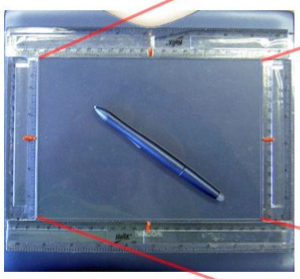

82990	81252	78202	80073	78202	80629	80255
77327	80137	76129	78329	78172	80083	79115
72362	75306	74039	73644	72402	74290	73509
77424	72057	74503	73522	72173	75398	73257
74293	76649	75002	76224	74151	75046	74220
74206	76178	75438	74967	76843	76949	77625
79122	81579	80229	81620	77252	77768	81480
80447	78475	78504	82942	79679	81552	81867
77977	76932	78888	81039	80918	80666	81894
75282	76220	77252	75390	76861	76280	76456
78360	80530	78793	82061	78002	82644	82537
81930	82683	78879	80409	82399	82789	82653
80493	79647	78670	77294	80160	80124	78071
77126	72833	75770	73530	76117	72447	72588
70609	71454	69448	71382	67003	71334	69089
71935	68943	73637	70015	72224	70106	73368
74309	74096	74880	70932	74154	74302	71128
74457	74277	71373	72871	73069	71640	73715
78268	74478	76823	78169	77840	76497	77895
81803	83956	83704	83566	79876	83833	79497
83424	85723	85555	82359	82403	85446	83026
85210	85985	85159	86189	83203	83936	81797
79231	82386	81356	80109	81761	79581	83029
80642	76131	78330	78139	80482	79480	75770

Kildal, J. and Brewster, S.A. *Providing a Size-Independent Overview of Non-Visual Tables*. ICAD'06, (2006), 8-15.

Kildal, J. and Brewster, S.A. *High-Density Sonification: Overview Information in Auditory Data Explorations*. Sonic Interaction Design: Fresh Perspectives, K. Franinovic and S. Serafin Eds. MIT Press (2013), 299-306.

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High-Density Sonification (HDS)

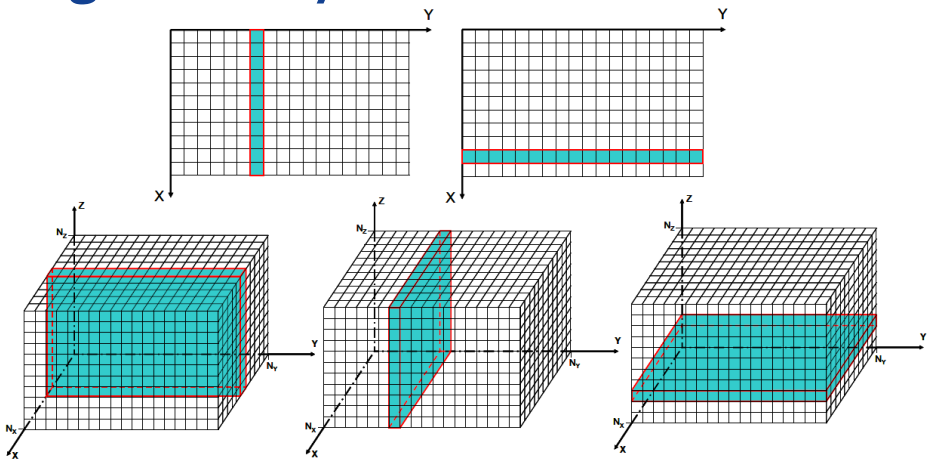

Figure 5. Data subset patterns for canonical HDS of 2D-tables (above) and 3D-tables (below). The canonical sonification of 2D-tables generates two complementary views of the data set, whereas for 3D-tables it generates three complementary views.

Kildal, J. and Brewster, S.A. *High-Density Sonification: Overview Information in Auditory Data Explorations.* Sonic Interaction Design: Fresh Perspectives, K. Franinovic and S. Serafin Eds. MIT Press (2013), 299-306.

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Integrated Sonic Interaction Design

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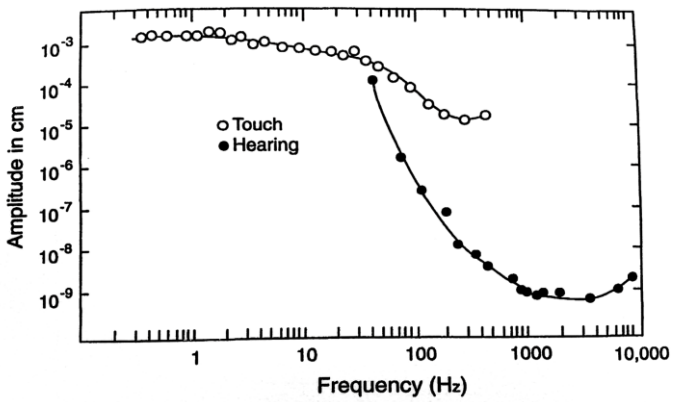

FIG. 2.7. Amplitude of vibration of the skin of the hand needed to feel the stimulus (Bolanowski, Gescheider, Verrillo, & Checkosky, 1988) and amplitude of vibration of the eardrum needed to hear (Wilska, 1935.)

Gescheider, G.A. *Psychophysics. The Fundamentals*. LEA (1997).

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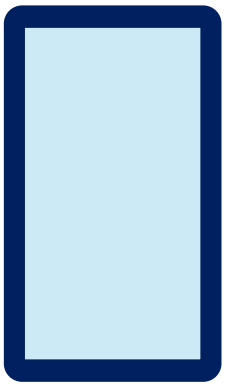

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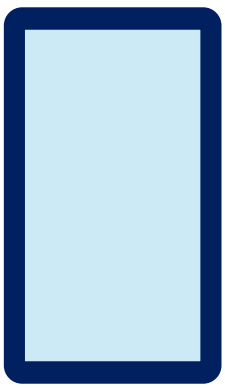

*"I call this technology **Pictures Under Glass**."*

"Pictures Under Glass sacrifice all the tactile richness of working with our hands"

Victor, B. A *Brief Rant on the Future of Interaction Design*. worrydream.com (2011).

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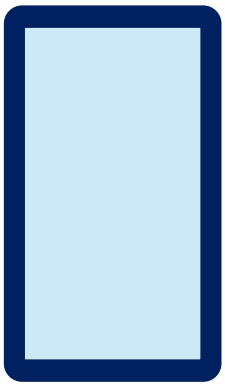

Physicality?

"Physicality is the way in which matter gets expressed when interacting with it"

Büscher, M. Making the Digital Palpable. *Proc. First International Workshop on Physicality*, (2006).

$$\varphi = \varphi_{Haptic} + \varphi_{Audio} + \varphi_{Visual}$$

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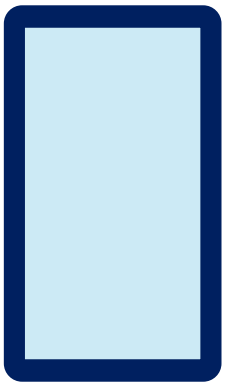

Physicality is Multimodal

$$\varphi = \varphi_{Haptic} + \varphi_{Audio} + \varphi_{Visual}$$

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Deceptive Physicality

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http://www.bestartificial.co.uk/

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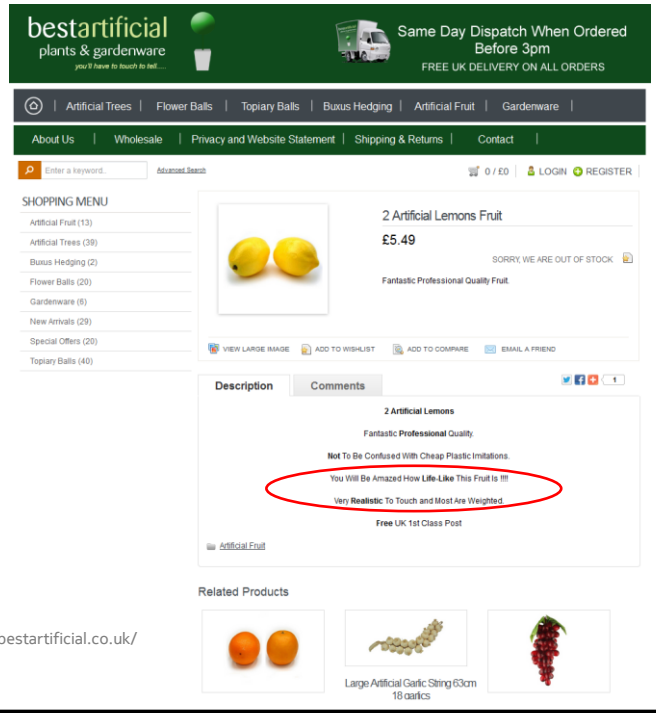

http://www.bestartificial.co.uk/

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REVOL ceramics, France

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ROSENTHAL (Tapio Wirkkala)

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Programmable Physicality

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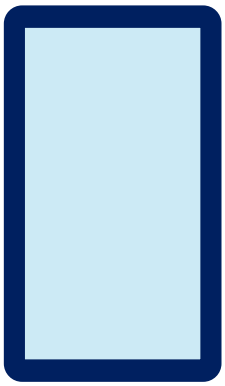

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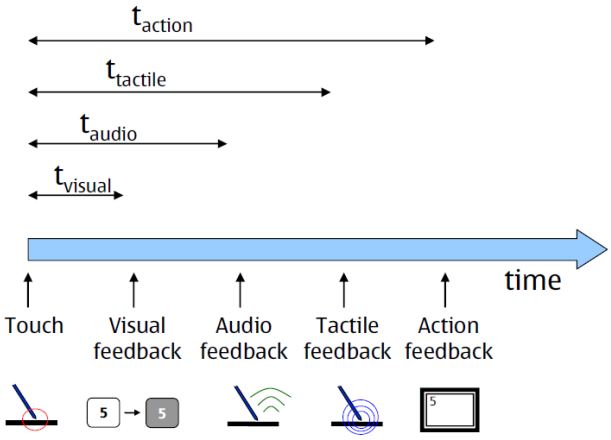
Latency Research: Multimodal Touch



Kaaresoja, T. and Brewster, S. *Feedback is... late: measuring multimodal delays in mobile device touchscreen interaction.* Proc. ICMI'10, ACM, (2010)

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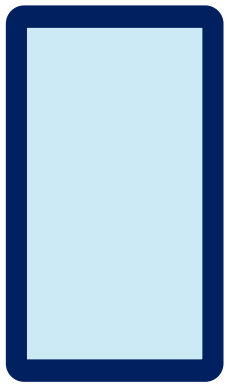
Connecting People



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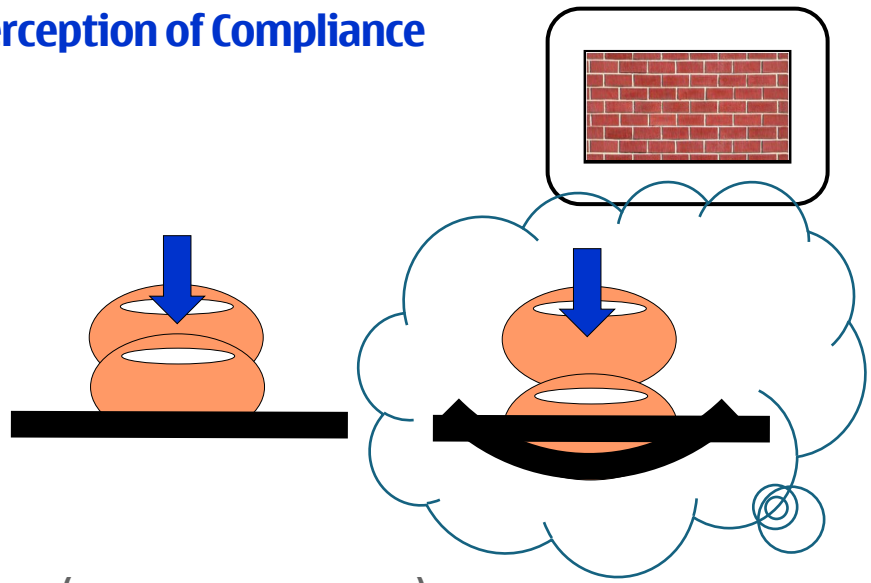
Perception of Compliance



$$\varphi = (\varphi_{Tactile} + \varphi_{Kinesth}) + \varphi_{Audio} + \varphi_{Visual}$$

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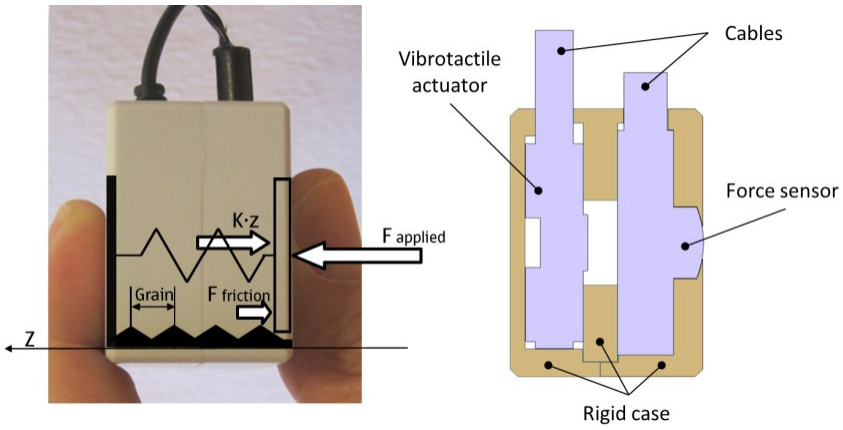
Creating Haptic Illusions --- *Kooboh*



Kildal, J. Kooboh: Variable Tangible Properties in a Handheld Haptic-Illusion Box. *Proc. Eurohaptics '12*, P. Isokoski and J. Springare Eds. Springer, (2012), 191-194.

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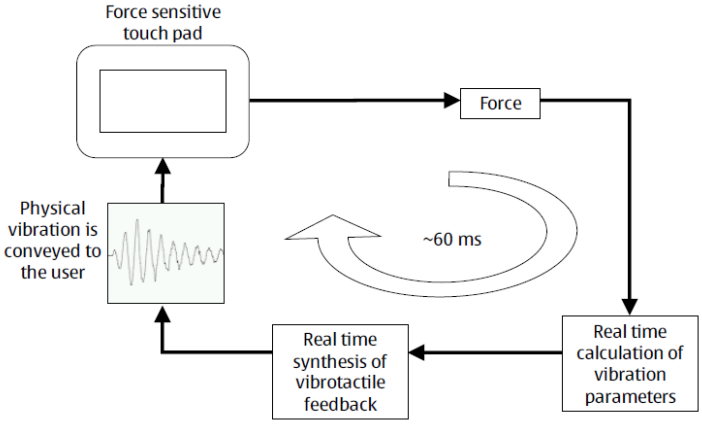
Creating Haptic Illusions --- *Kooboh*



- Kildal, J. Kooboh: Variable Tangible Properties in a Handheld Haptic-Illusion Box. *Proc. EuroHaptics'12* Springer, (2012), 191-194.
- Kildal, J. 3D-Press: Haptic Illusion of Compliance when Pressing on a Rigid Surface. *Proc. ICMI'10* ACM, (2010), 8pp.

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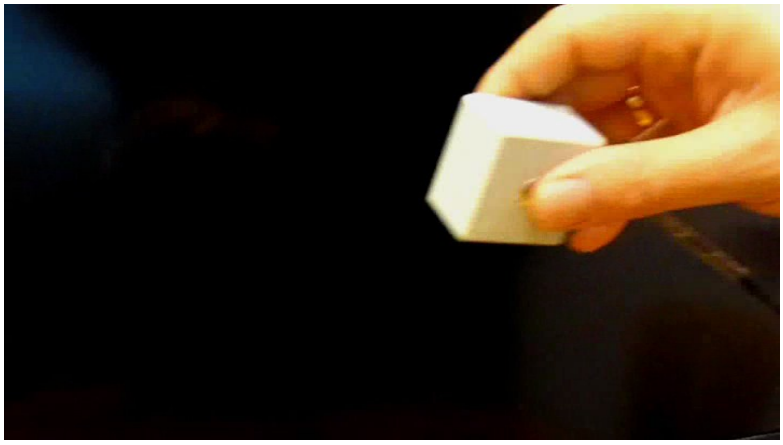
Creating Haptic Illusions --- *Kooboh*



http://www.youtube.com/watch?v=57_hRI3ILfM
http://www.youtube.com/watch?v=RTkr9ISjDAA

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Force Input

$$\varphi = \varphi_{Haptic} + \varphi_{Audio} + \varphi_{Visual}$$

Lai, C.-H., Niinimaki, M., Tahiroğlu, K., Kildal, J. and Ahmaniemi, T. Perceived Physicality in Audio-Enhanced Force Input. *Proc. ICMI'11* ACM, (2011), 287-294.

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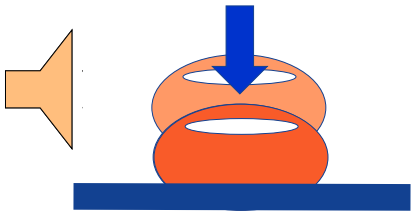
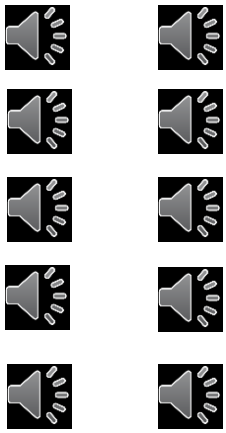
Conclusions





$$\varphi = \varphi_{Haptic} + \varphi_{Audio} + \varphi_{Visual}$$

Lai, C.-H., Niinimaki, M., Tahiroğlu, K., Kildal, J. and Ahmaniemi, T. Perceived Physicality in Audio-Enhanced Force Input. *Proc. ICMI'11* ACM, (2011), 287-294.

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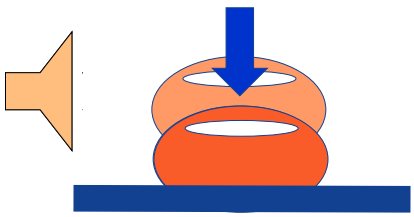
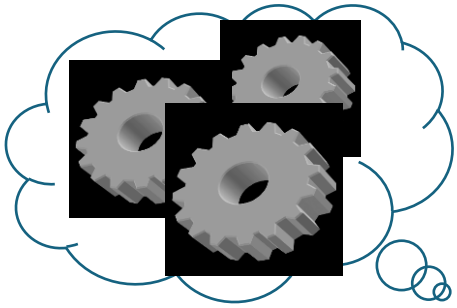
Conclusions

Metaphors, Emotions, (Illusions)





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Lai, C.-H., Niinimaki, M., Tahiroğlu, K., Kildal, J. and Ahmaniemi, T. Perceived Physicality in Audio-Enhanced Force Input. *Proc. ICMI'11* ACM, (2011), 287-294.

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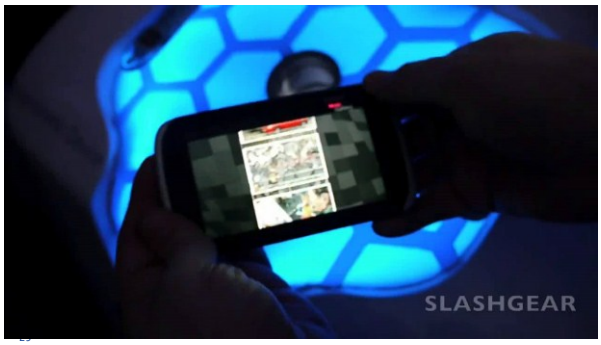
Flexible Devices at Nokia Research

From vision to Implementation



http://www.youtube.com/results?search_query=nokia+kinetic+device&oq=nokia+kinetic+device&gs_l=youtube.3..0.99239.101950.0.102169.14.6.0.8.8.0.235.877.0j4j2.6.0...0.0...1ac.1.11.youtube.wucjADqKLdw

Kinetic Device (2011)

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Bend

Twist

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Research Publications

- Kildal, J., Paasovaara, S. and Aaltonen, V. ***Kinetic Device: Designing Interactions with a Deformable Mobile Interface***. Proc. CHI EA'12 ACM, (2012), 1871-1876.
- Kildal, J. ***Interacting with Deformable User Interfaces: Effect of Material Stiffness and Type of Deformation Gesture***. Proc. HAID'12 Springer, (2012), 71-80.
- Kildal, J. and Wilson, G. ***Feeling It: The Roles of Stiffness, Deformation Range and Feedback in the Control of Deformable UI***. Proc. ICMI'12, (2012), 393-400 .
- Kildal, J. and Boberg, M. Feel the Action: ***Dynamic Tactile Cues in the Interaction with Deformable UIs***. Proc. CHI EA'13 ACM, (2013), 1563-1568.
- Kildal, J., Lucero, A. and Boberg, M. ***Twisting Touch: Combining Deformation and Touch as Input within the Same Interaction Cycle on Handheld Devices***. Proc. MobileHCI '13 ACM, (2013), 237-246. --- BEST PAPER AWARD

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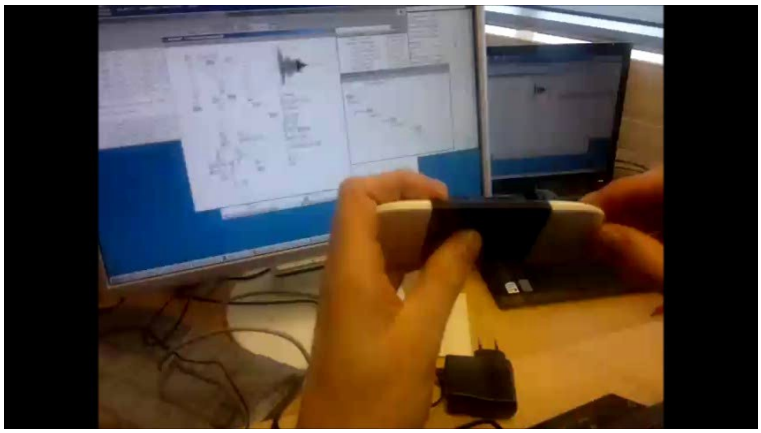
Towards tangible interfaces



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Augmenting input with tactile textures

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http://vimeo.com/28447850

Väänänen-Vainio-Mattila, K., Suhonen, K., Kildal, J., Tahiroğlu, K., Laaksonen, J. and Ahmaniemi, T. User Experience and Usage Scenarios of Audio-Tactile Interaction with Virtual Objects in a Physical Environment. *Proc. DPPI'13*, (2013)

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