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Sound of **Vision**



INTERACTIVE SONIFICATION
OF THE U-DISPARITY MAPS OF 3D SCENES

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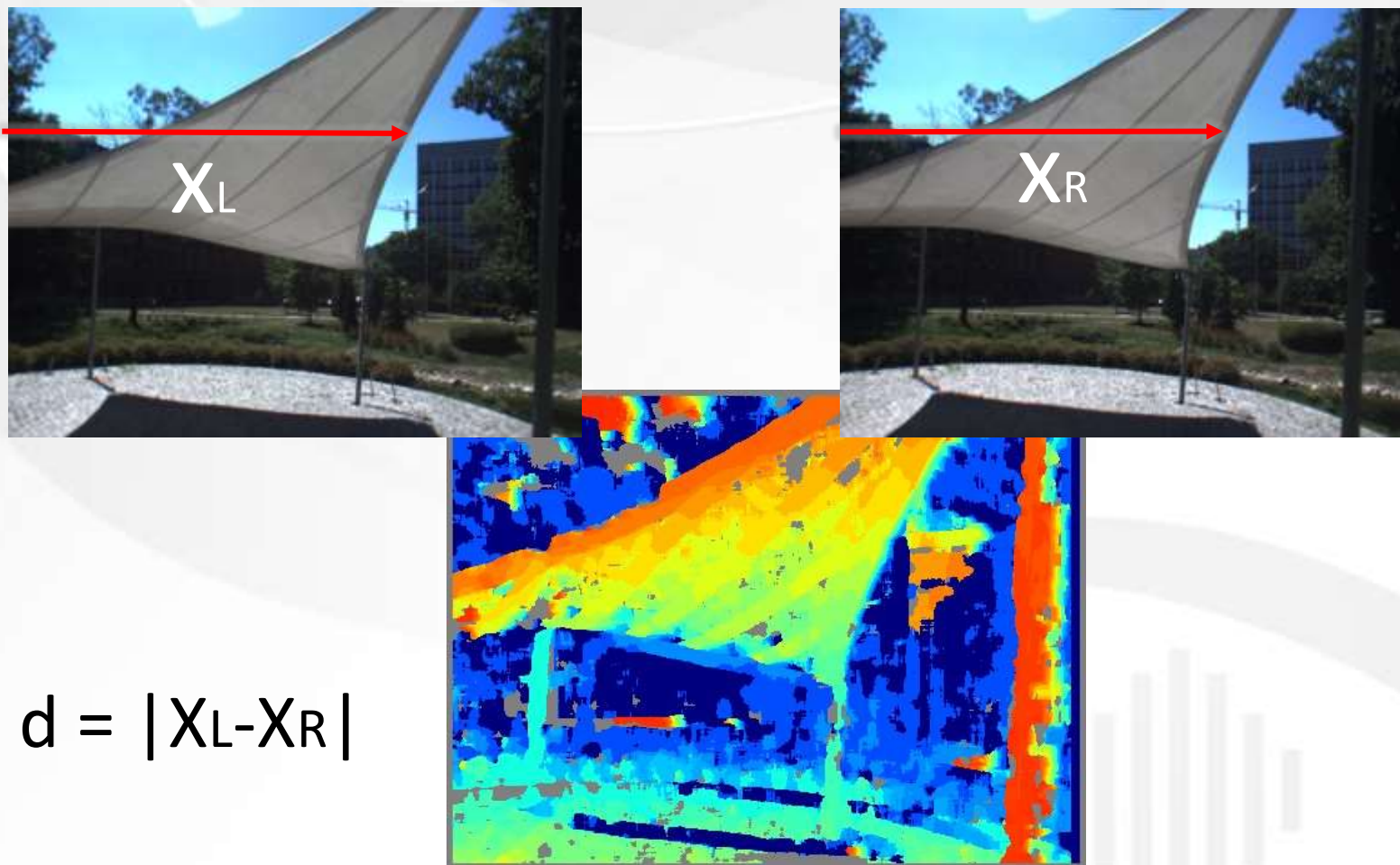
Sound of Vision project

EU Horizon 2020 - prototype wearable electronic travel aid

- Aim of the project: a wearable ETA for assisting blind persons by rendering the image of the environment through an auditory display
- The prototype device captures a 3D image of the environment, processes it in realtime, and presents the relevant information to a blind user
- New approaches to 3D scene reconstruction and segmentation



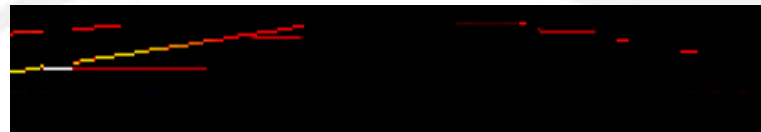
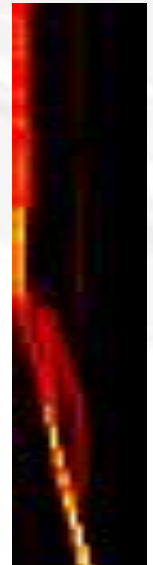
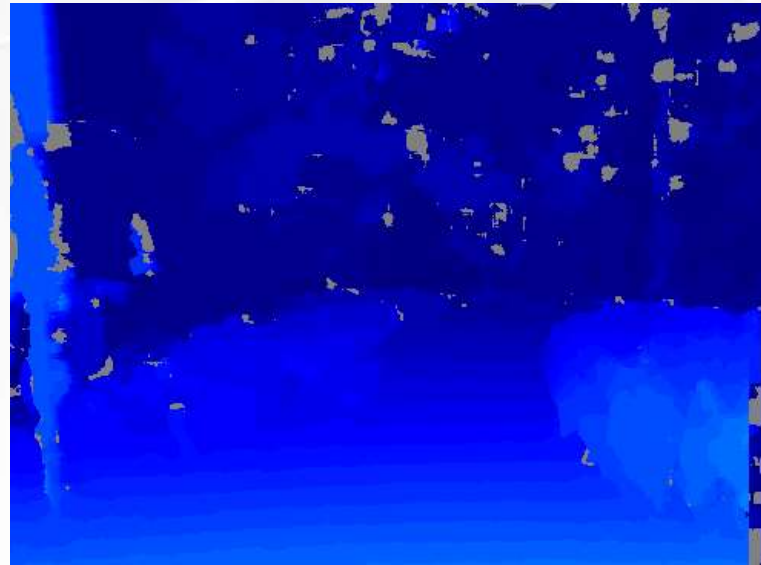
Stereovision -> Disparity map



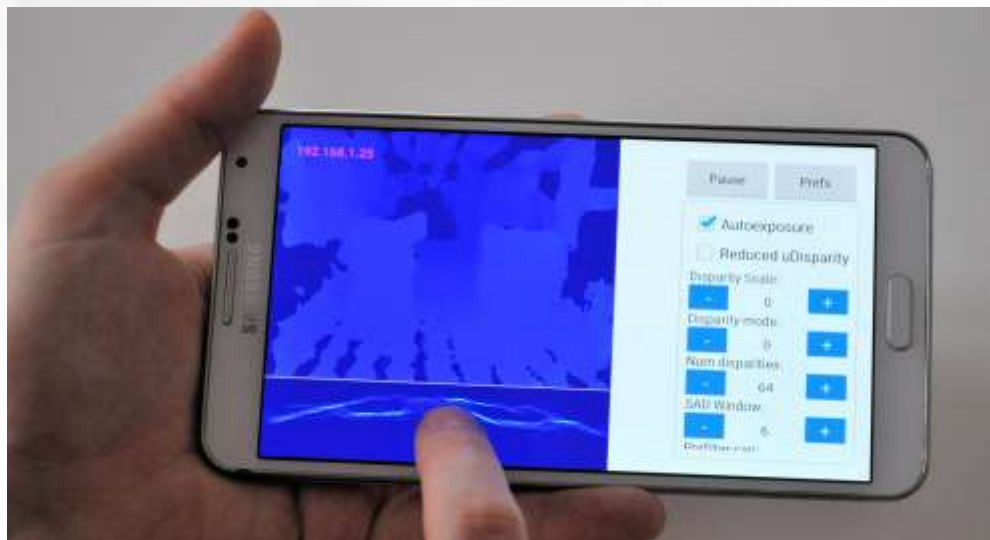
$$d = |X_L - X_R|$$



UV-disparity representation of disparity map



The architecture of an electronic system for interactive sonification of 3D scenes

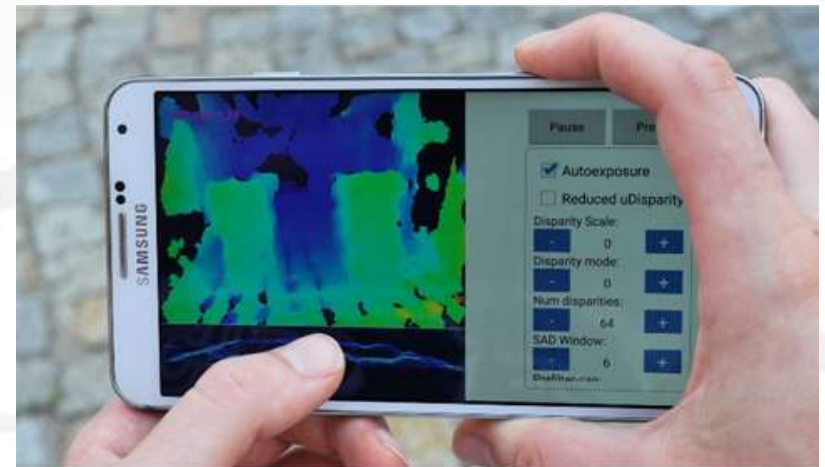


Interactive sonification of the disparity map

- The indicated column of the map controls left-right panning of the generated sound
- The row in the U-disparity map (i.e the disparity value) in the sonified range determines the sound frequency that codes the depth information (the higher the pitch the closer the sonified object).
- The sound signal generated by the system is a sum of sinusoids – each sinusoid frequency represents the selected distance range

$$s(t) = \sum_{i=0}^{i=N-1} a_i \sin\left(2\pi\left(f_{\min} + i \frac{f_{\max} - f_{\min}}{N-1}\right)t\right)$$

- N - number of sound frequencies
- f_{\min} - frequency of sound with index 0
- f_{\max} - frequency of sound N-1 which corresponds to the closest objects

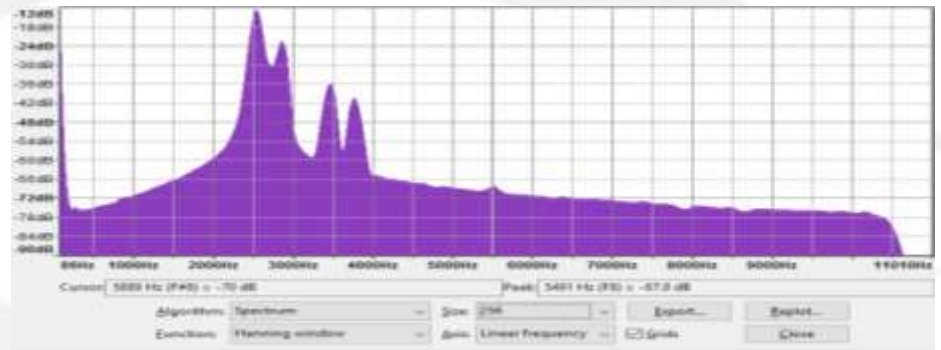
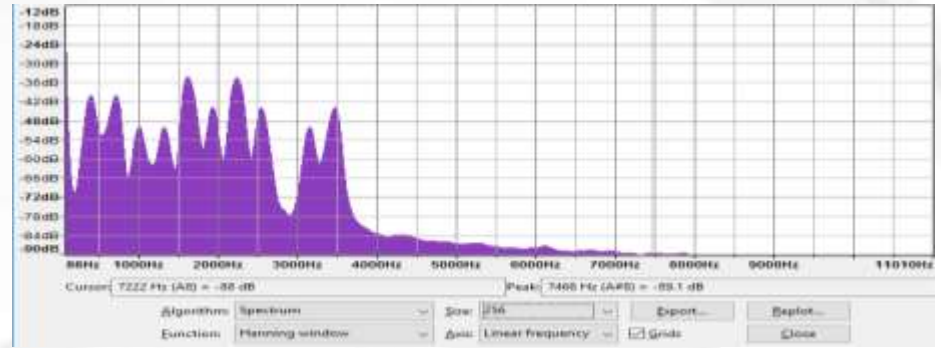
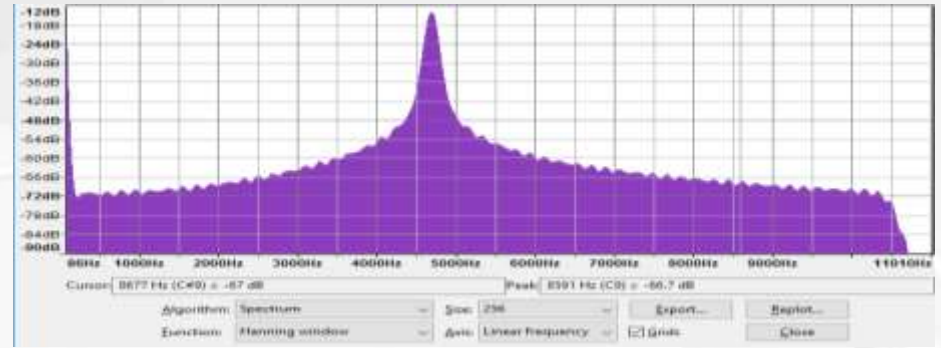
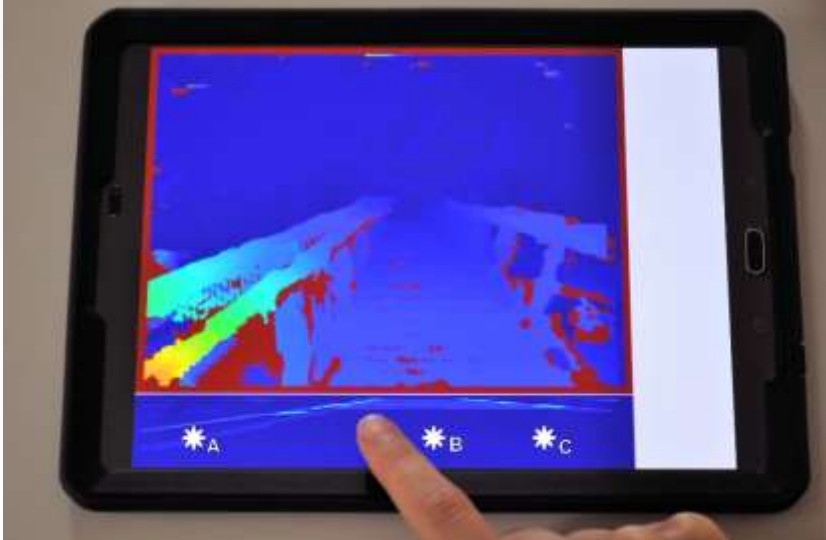


Offline tests with the blind users

- 3 blind and 2 sighted persons
- Testers familiar with the mobile phones and instructed how the U-disparity map is generated
- The users asked to verbally describe the scene based on the sound generated by the mobile device.
- All users correctly found the obstacles and were able to state, which object is closer to the camera. They were also able to find and indicate directions corresponding to scene spaces devoid of obstacles



Sonification results



Summary

- An original interactive sonification technique for the purpose of 3D scene representation for the visually impaired people
- Sonification of the processed depth images termed the U-disparity maps
- First trials of such an interactive sonification scheme with three blind volunteers shows a potential use of the system as a spatial orientation aid for the visually impaired.

<http://eletele.p.lodz.pl/pskul/ison2016>

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