

MICHAEL STRAEBIG

MARIE CURIE FELLOW, PLYMOUTH UNIVERSITY

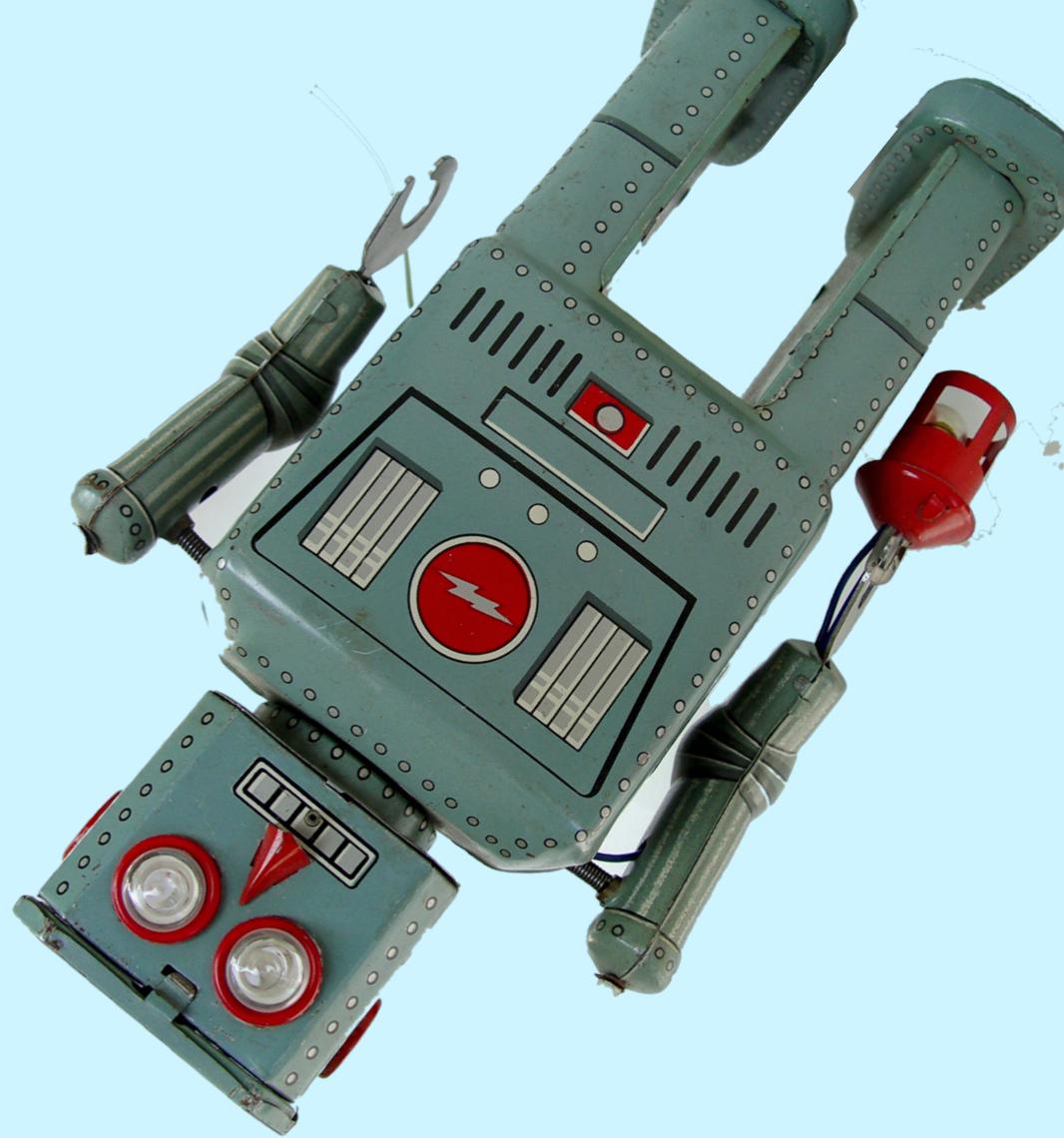
MICHAEL.STRAEBIG@PLYMOUTH.AC.UK

@CRCDNG

COGNOVO.EU/PROJECT-9/

SENSORY CON-FUSION

MULTISENSORY AESTHETICS, PLYMOUTH UNIVERSITY, 16/05/2017

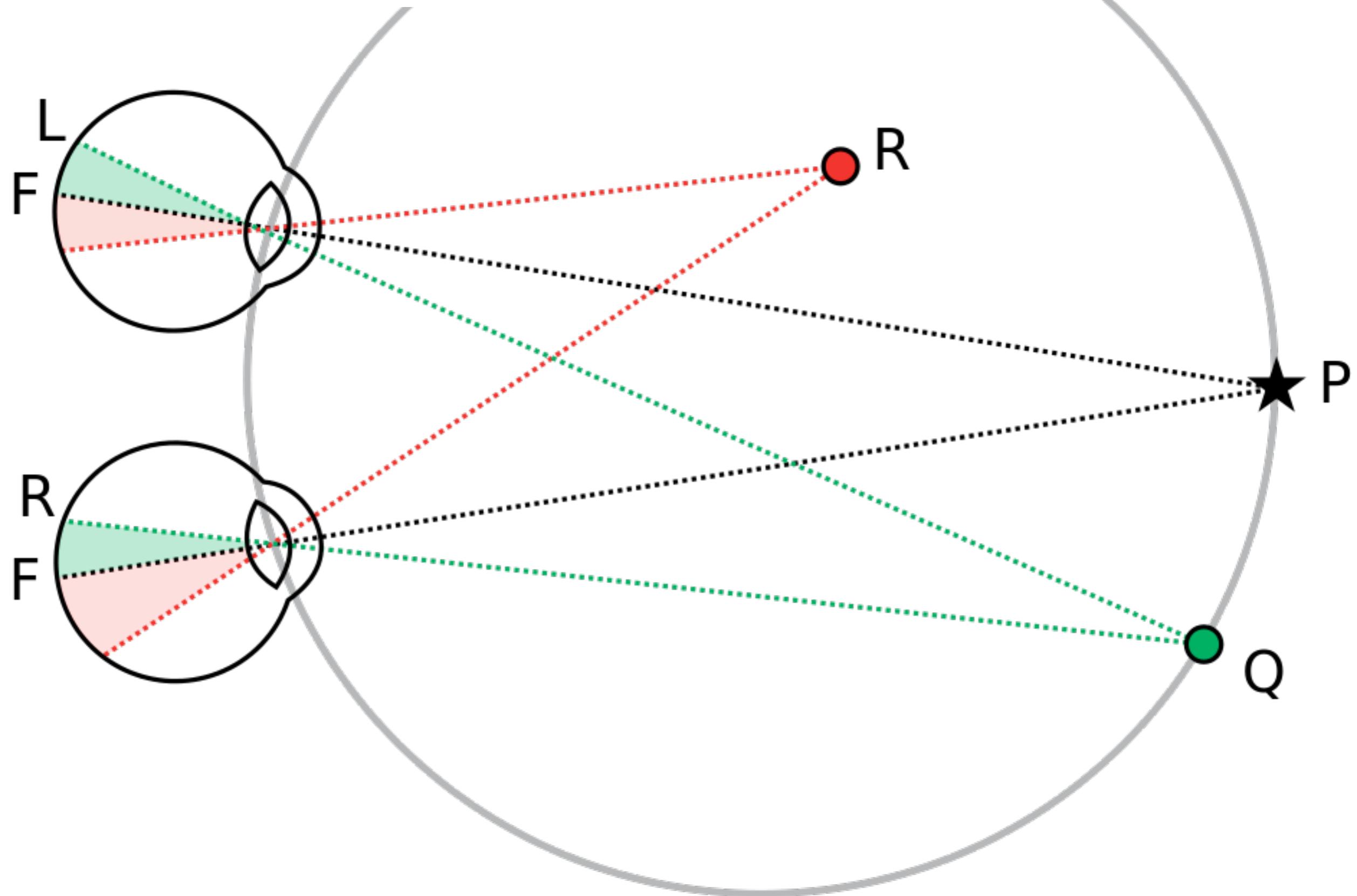


1. HUMAN | MACHINE

HUMAN \ MACHINE SENSORY FUSION

(Calvert, Spence and Stein, 2004; Spence, 2011)

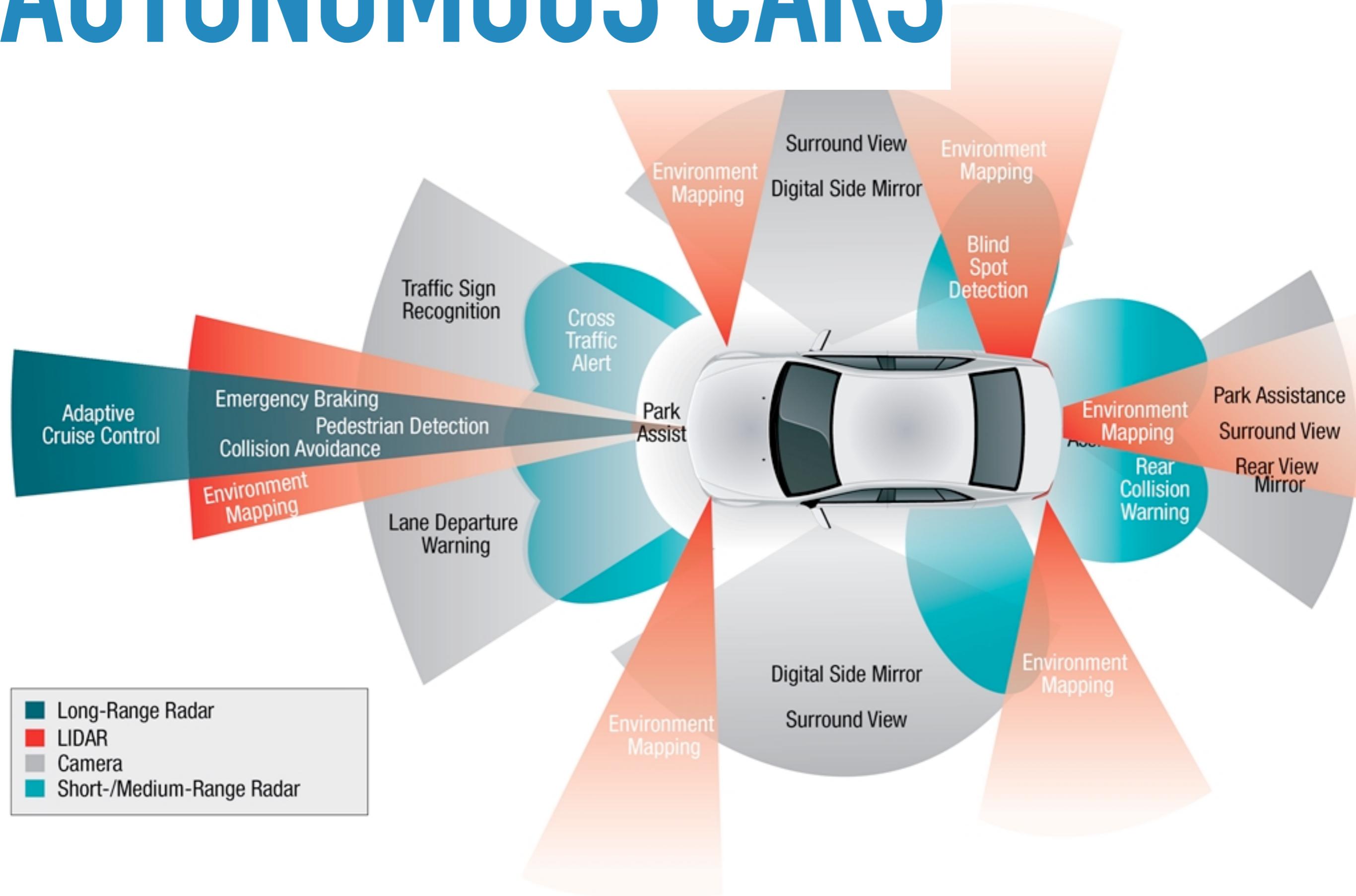
STEREOPSIS



HUMAN / MACHINE SENSOR FUSION

(Khaleghi et al., 2013)

AUTONOMOUS CARS



TECHNICAL PURPOSE

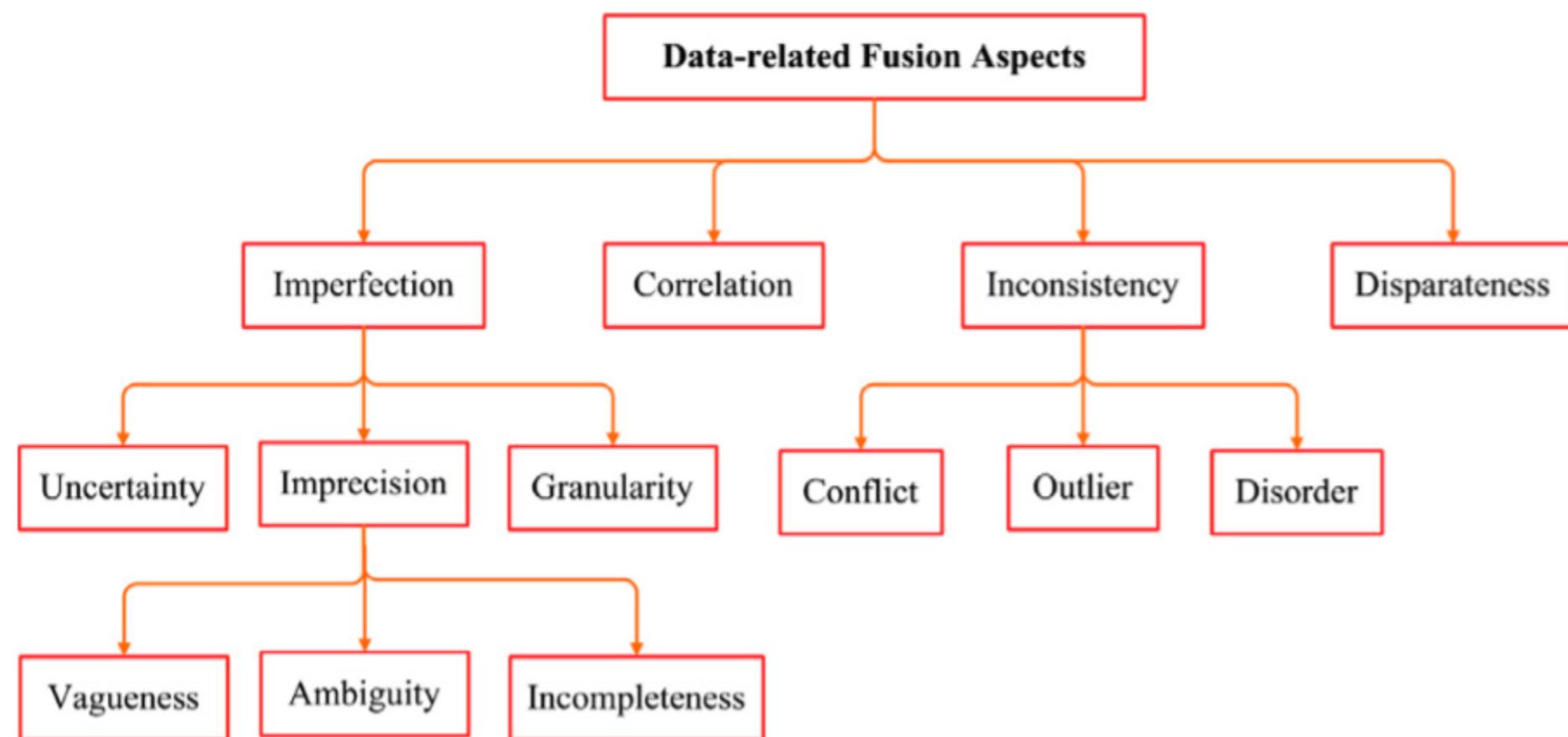


Fig. 1. Taxonomy of data fusion methodologies: different data fusion algorithms can be roughly categorized based on one of the four challenging problems of input data that are mainly tackled: namely, data imperfection, data correlation, data inconsistency, and disprateness of data form.

(Khaleghi et al., 2013)

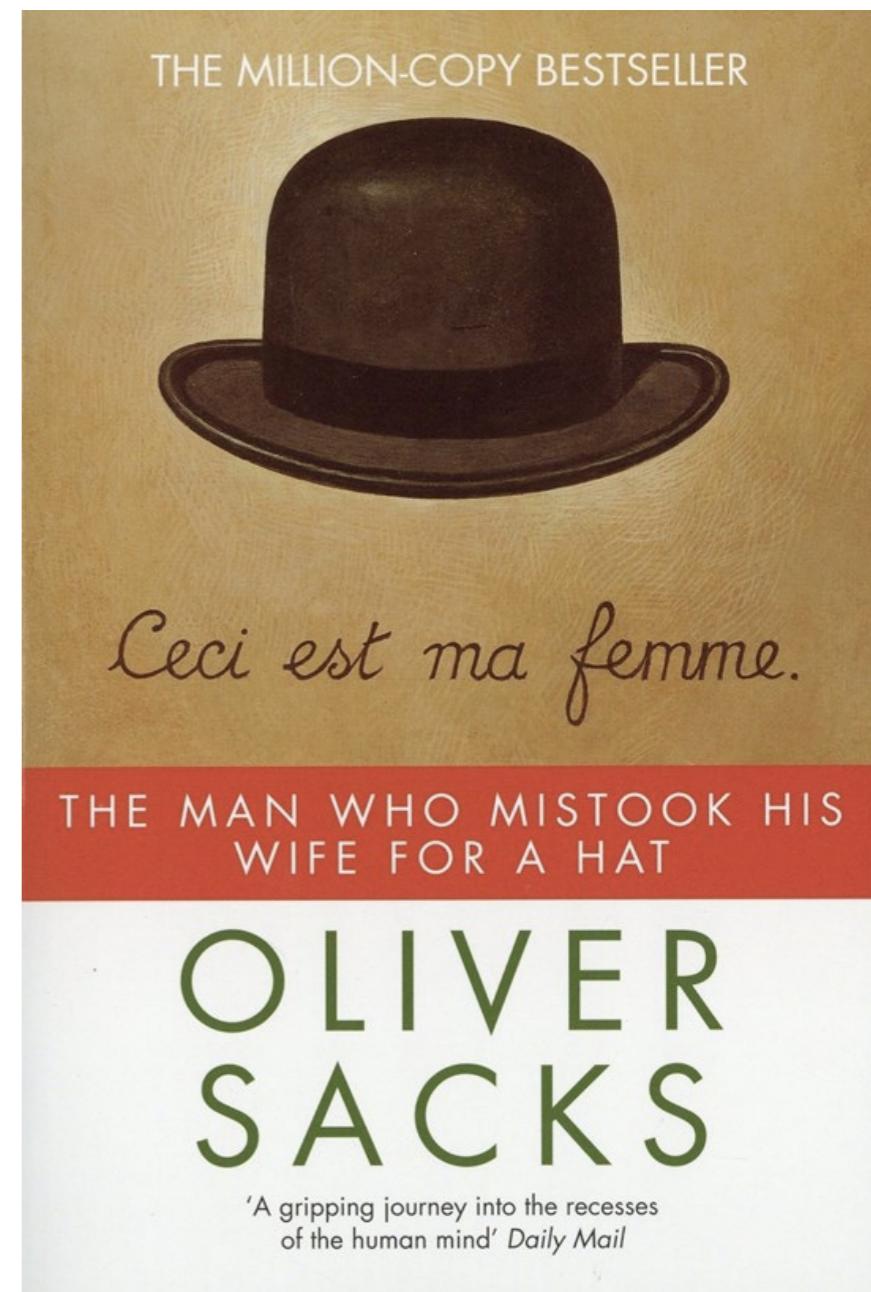
HUMAN | MACHINE: ANTHROPO-NEUTRAL STANCE



(Latour, 2002), (Straschnoy et al., 2008)

2. FUSION / CON-FUSION

(Sacks, 2011), (McGurk and MacDonald, 1976),
(Hubbard and Ramachandran, 2005)



EXPERIENCING THE OTHER



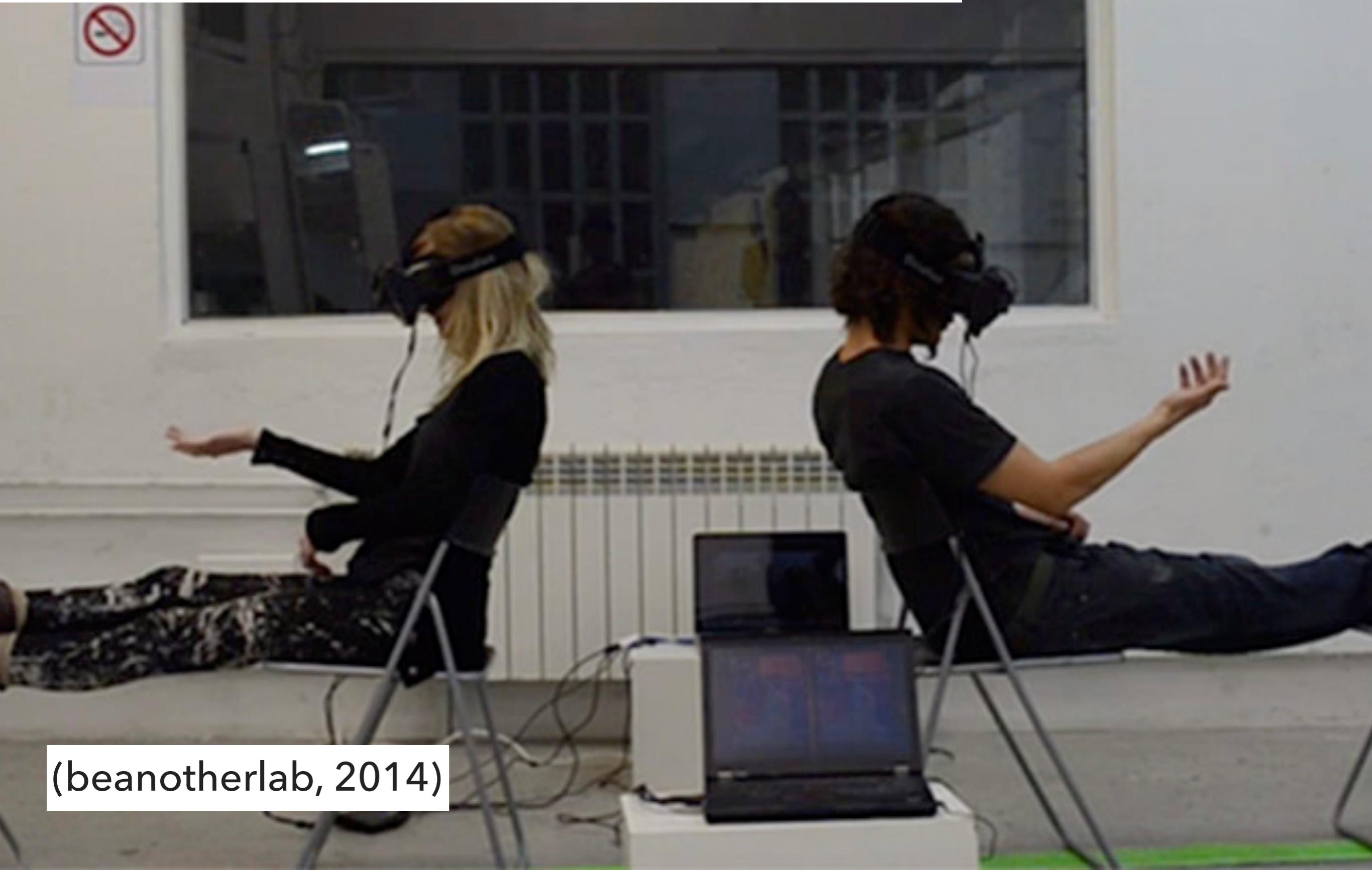
(Piatza, Zöllner and Adenauer, 2012)

SENSORY HACKING



(Matsumoto et al., 2016)

PERCEPTION SWAPPING

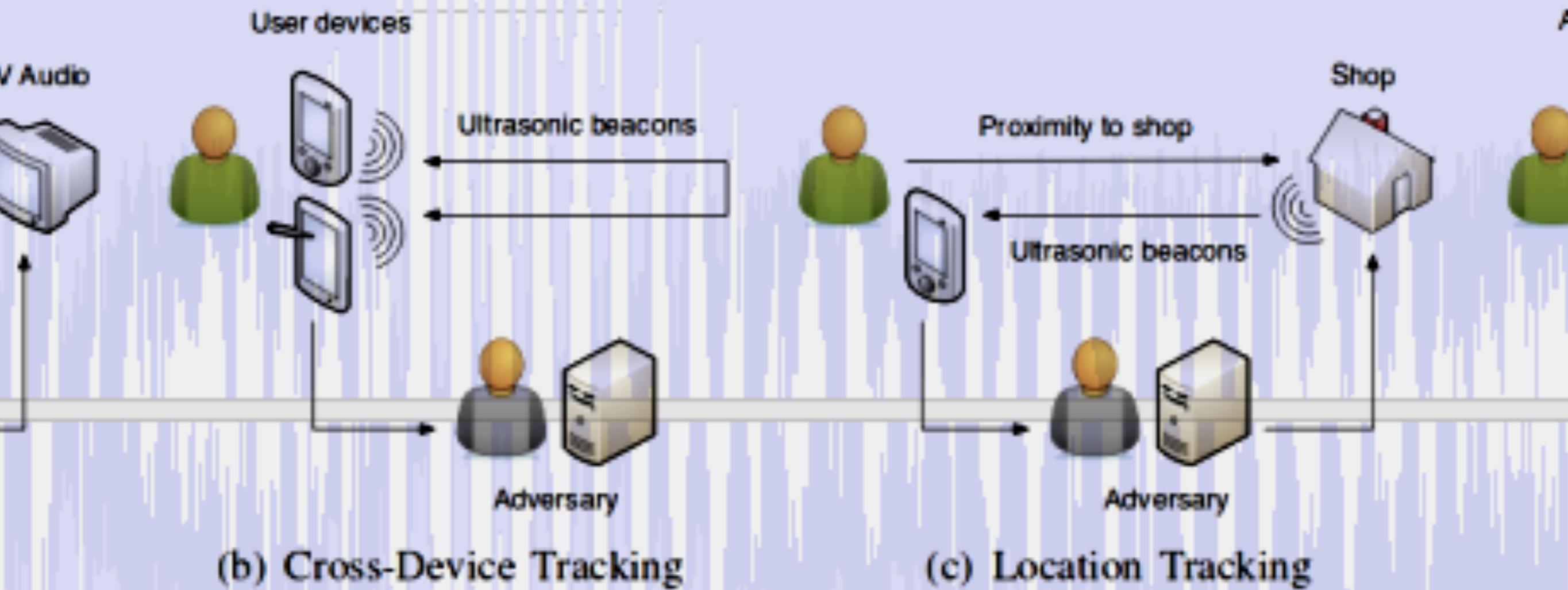


(beanotherlab, 2014)

CROSSTALK



DIGITAL | ANALOG



(Arp et al., 2017), (Yan, Wenyuan and Liu, 2016), (Genkin, Shamir and Tromer, 2016)

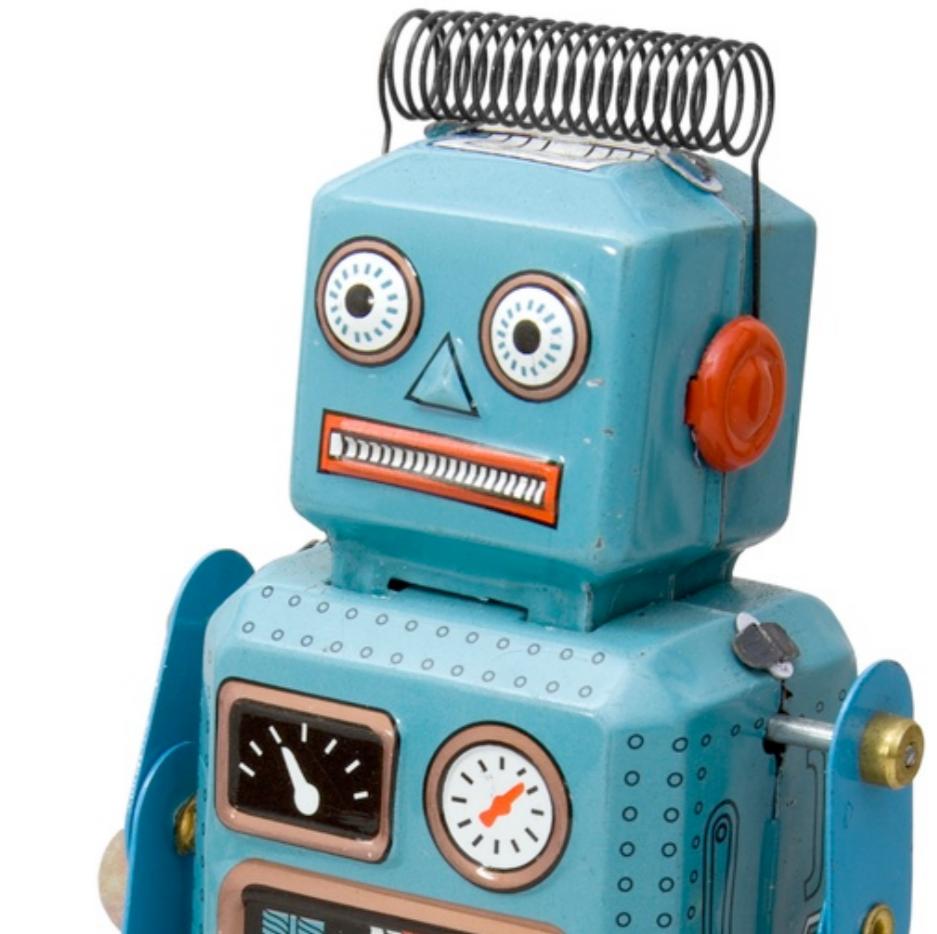
SYSTEM | ENVIRONMENT



(Smith and Zeller, 2016)

CONSTRUCT \ PERCEIVE

(Bateson 1972), (Foerster 1973),
(Glanville 2008)



3. AESTHETICS / CONCEPT

(Goldie and Schellekens, 2009)

2. SENSORY CON-FUSION

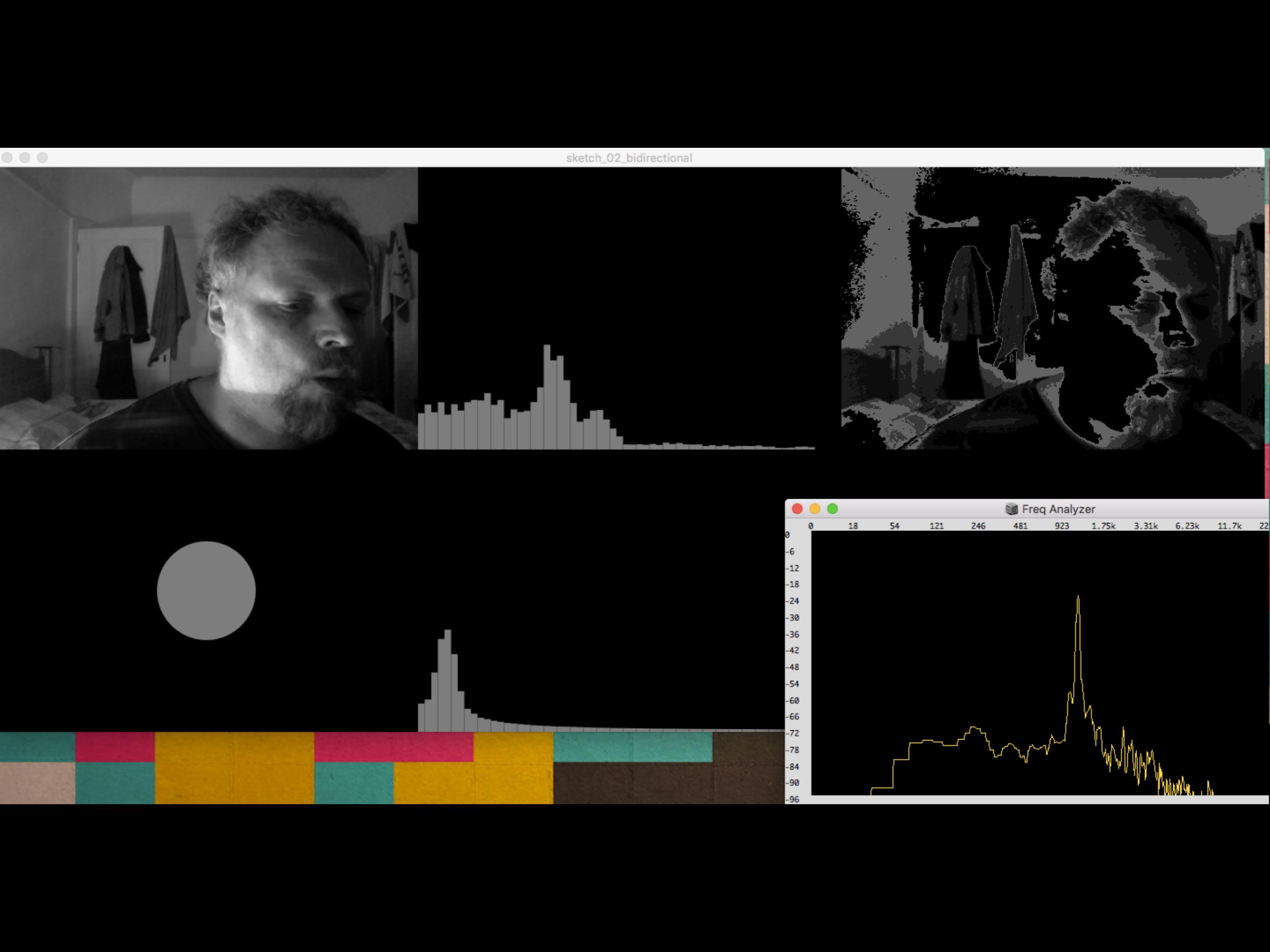
EXPERIMENT 1

AUDIO → VIDEO

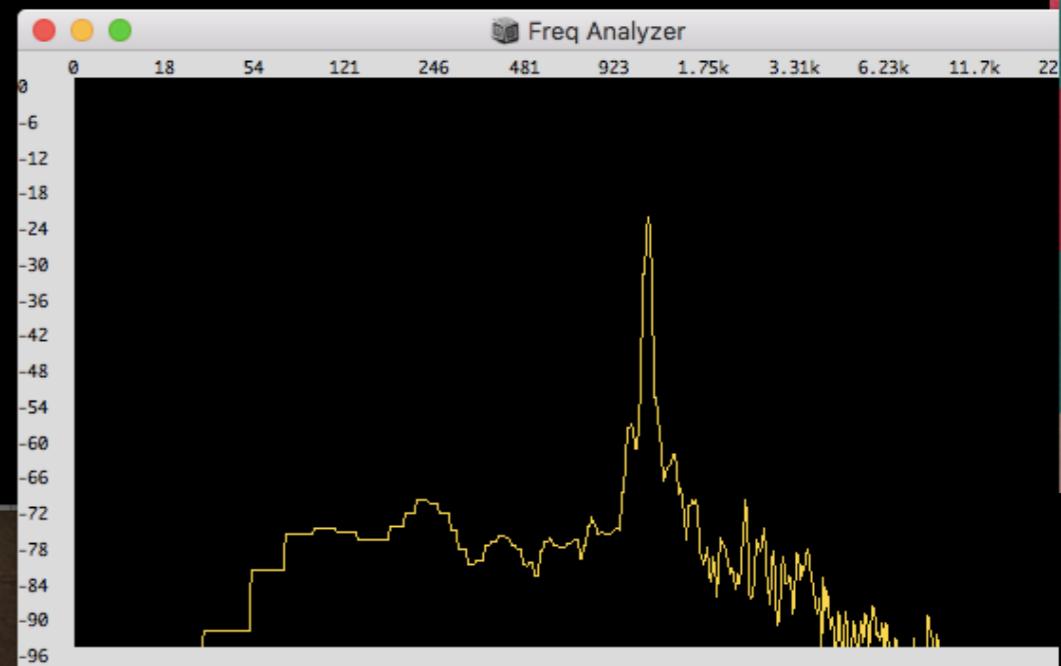


EXPERIMENT 2

AUDIO  **VIDEO**



sketch_02_bidirectional



(EXPERIMENT 3 TBD)

MULTIPLE SENSORS



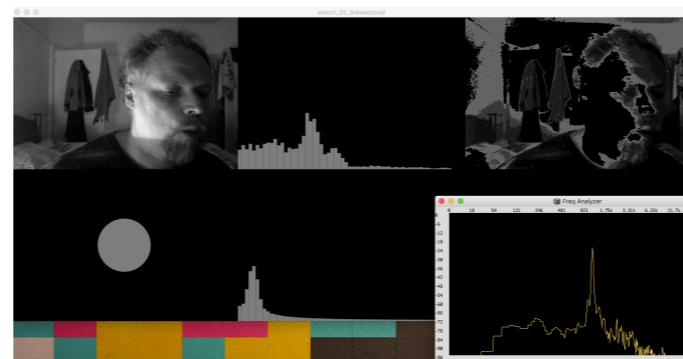
HUMAN | MACHINE

CONSTRUCT \ PERCEIVE

FUSION / CON-FUSION

DIGITAL | ANALOG

AESTHETICS / CONCEPT



LITERATURE

- ▶ Arp, D., Quiring, E., Wressnegger, C. and Rieck, K. (2017) 'Privacy Threats through Ultrasonic Side Channels on Mobile Devices'. Available at: <http://christian.wressnegger.info/content/projects/sidechannels/2017-eurosp.pdf> (Accessed: 15 May 2017).
- ▶ Ashley, S. (2016) Centimeter-accurate GPS for self-driving vehicles - SAE International. Available at: <http://articles.sae.org/15067/> (Accessed: 10 May 2017).
- ▶ BeAnotherLab (2014) BeAnotherLab, The Machine to be Another. Available at: http://www.themachinetobeanother.org/?page_id=820 (Accessed: 15 May 2017).
- ▶ Calvert, G., Spence, C. and Stein, B. E. (eds) (2004) *The handbook of multisensory processes*. Cambridge, Mass: MIT Press.
- ▶ Deroy, O. and Spence, C. (2016) 'Crossmodal Correspondences: Four Challenges', *Multisensory Research*, 29(1-3), pp. 29-48. doi: 10.1163/22134808-00002488.
- ▶ Genkin, D., Shamir, A. and Tromer, E. (2016) 'Acoustic cryptanalysis', *Journal of Cryptology*, pp. 1-52.
- ▶ Goldie, P. and Schellekens, E. (eds) (2009) *Philosophy and conceptual art*. Oxford: Clarendon Press [u.a.].
- ▶ Hubbard, E. M. and Ramachandran, V. S. (2005) 'Neurocognitive Mechanisms of Synesthesia', *Neuron*, 48(3), pp. 509-520. doi: 10.1016/j.neuron.2005.10.012.
- ▶ Johnson, H. (1997) 'The Real Truth About Crosstalk', *Electronic Design*, August. Available at: <http://www.sigcon.com/Pubs/straight/crosstalk.htm> (Accessed: 15 May 2017).
- ▶ Khaleghi, B., Khamis, A., Karray, F. O. and Razavi, S. N. (2013) 'Multisensor data fusion: A review of the state-of-the-art', *Information Fusion*, 14(1), pp. 28-44. doi: 10.1016/j.inffus.2011.08.001.
- ▶ Klingbeil, M. K. (2009) Spectral analysis, editing, and resynthesis: Methods and applications. Citeseer. Available at: <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.459.3226&rep=rep1&type=pdf> (Accessed: 15 May 2017).
- ▶ Kokar, M. M., Tomasik, J. A. and Weyman, J. (2004) 'Formalizing classes of information fusion systems', *Information Fusion*, 5(3), pp. 189-202. doi: 10.1016/j.inffus.2003.11.001.

LITERATURE (2)

- ▶ Mateas, M. (2001) 'Expressive AI - A hybrid art and science practice', *Leonardo: Journal of the International Society for Arts, Sciences, and Technology*, 34(2), pp. 147-153.
- ▶ Matsumoto, K., Ban, Y., Narumi, T., Yanase, Y., Tanikawa, T. and Hirose, M. (2016) 'Unlimited corridor: redirected walking techniques using visuo haptic interaction', in *Proceedings of the SIGGRAPH '16 ACM SIGGRAPH 2016 Emerging Technologies*. Anaheim, California: ACM Press, pp. 1-2. doi: 10.1145/2929464.2929482.
- ▶ McGurk, H. and MacDonald, J. (1976) 'Hearing lips and seeing voices', *Nature*, 264(5588), pp. 746-748.
- ▶ Piatza, S., Zöllner, C. and Adenauer, J. (2012) Eyesect / The Constitute. Available at: <http://theconstitute.org/eyesect/> (Accessed: 15 May 2017).
- ▶ Pickering, A. (2011) *The cybernetic brain: sketches of another future*. Paperback Ed. Chicago, Ill: University of Chicago Press.
- ▶ Rough, B. (2014) 'Aesthetics vs. Art', *1000-Word Philosophy*, 13 February. Available at: <https://1000wordphilosophy.wordpress.com/2014/02/13/aesthetics-vs-art/> (Accessed: 12 May 2017).
- ▶ Sacks, O. W. (2011) The man who mistook his wife for a hat. *Pikador*. Available at: <https://www.overdrive.com/search?q=561A60EF-D9CD-4DD2-98C4-6D0AF1F5569B> (Accessed: 15 May 2017).
- ▶ Smith, D. H. and Zeller, F. (2016) 'The Death and Lives of hitchBOT: The Design and Implementation of a Hitchhiking Robot', *Leonardo*. doi: 10.1162/LEON_a_01354.
- ▶ Spence, C. (2011) 'Crossmodal correspondences: A tutorial review', *Attention, Perception, & Psychophysics*, 73(4), pp. 971-995. doi: 10.3758/s13414-010-0073-7.
- ▶ Yan, C., Wenyuan, X. and Liu, J. (2016) 'Can you trust autonomous vehicles: Contactless attacks against sensors of self-driving vehicle', DEF CON. Available at: <http://dc.org/files/defcon24/Speaker%20Materials/DEFCON-24-Liu-Yan-Xu-Can-You-Trust-Autonomous-Vehicles-WP.pdf> (Accessed: 15 May 2017).

IMAGE CREDITS

- ▶ Autonomous car sensors: Centimeter-accurate GPS for self-driving vehicles, <http://articles.sae.org/15067/>
- ▶ Hitchbot, <https://www.instagram.com/p/zNZRnpPimQ/?taken-by=hitchbot>.
- ▶ Multiple Sensors, <http://redhunter.com/blog/2016/04/28/sonari2c-multiple-hc-sr04-sensors-on-arduino-i2c/>
- ▶ Principle of binocular vision, Wikipedia user Vlcekmi3, (CC BY-SA 3.0)
- ▶ The New Artist, <http://the-new-artist.info/>.
- ▶ The man who mistook his wife for a hat, Picador
- ▶ Toy Robot (CC BY 2.0), Azul Barrientos, <http://cdn3.volusion.com/fnhzx.zhzta/v/vspfiles/photos/RSTRD1-2.jpg?1423793847>
- ▶ Toy Robot (CC BY 2.0) , Amal FM, <https://www.flickr.com/photos/amal-fm/7769628700>
- ▶ TV crosstalk, DXer1986, <https://www.youtube.com/watch?v=DmwFda51SqA>
- ▶ Ultrasonic tracking, Pedro Umbelino, <http://hackaday.com/2017/05/04/ultrasonic-tracking-beacons/>

THANK YOU

michael.straeubig@plymouth.ac.uk

i3games.de

[@crcdng](#)

cognovo.eu/project-9

Special Thanks: John Matthias, Jane Grant, Mike Phillips, James Brocklehurst, Emma Whittaker, Sue Denham, Matt Wade

This work is funded as part of Marie Curie Initial Training Network FP7-PEOPLE-2013-ITN, CogNovo, grant number 604764

