

Brain TLS Project

- Using brain activity and eye movement analysis of a person to represent the perceived space
- **Project Partners:** Institute of Engineering Geodesy (IIGS), Visualization Research Center (VISUS) - University of Stuttgart and Cognitive Neuroscience Lab - Eberhard Karls University of Tübingen.
- Successful application as part of the Research Seed Capital (RiSC) program line, in which young scientists conduct research using completely new approaches or on unusual questions.
- Project duration: 03.2020 - 03.2022

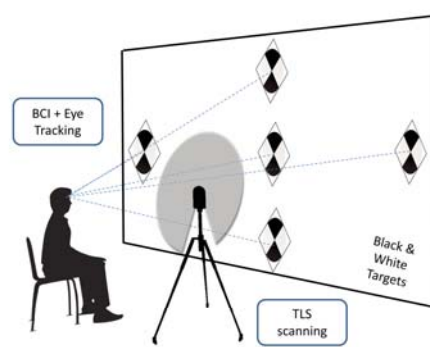
Geodesy meets Neuroscience

- Parallels between human perception and geodetic instruments

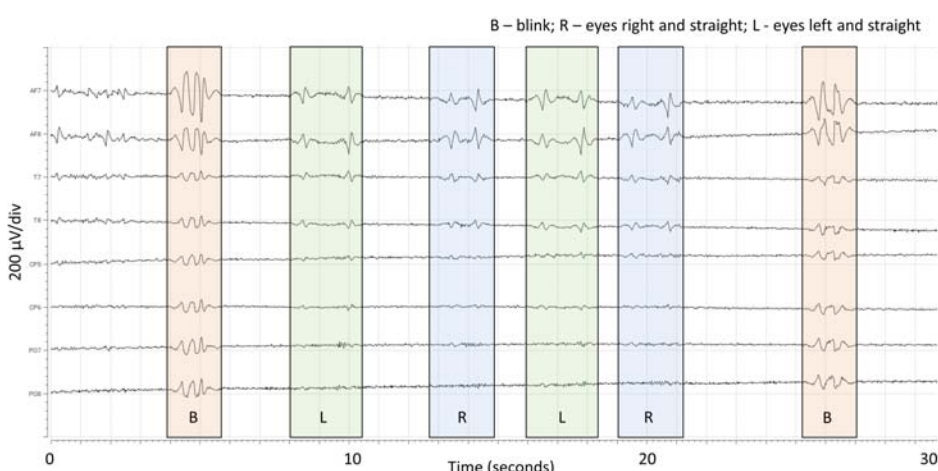
Instrument in geodesy	Human in neuroscience
Measures angles and distances	Sensorial perception and interpretation
Mostly sight dependent	Mostly based on vision
Uses gravity to relate to a coordinate system	Uses gravity to balance and aid at orientation
Represents space through coordinates	Represents space through grid & place cells

Methods

- Recording brain signals with non-invasive Brain Computer Interface (BCI) combined with eye-tracking while a subject observes targets as in the experiment shown below
- 3D laser scan of the entire scene for ground truth geometry



- Searching for geometric correlations
- Analysing of BCI Electroencephalography (EEG) signal form and pattern



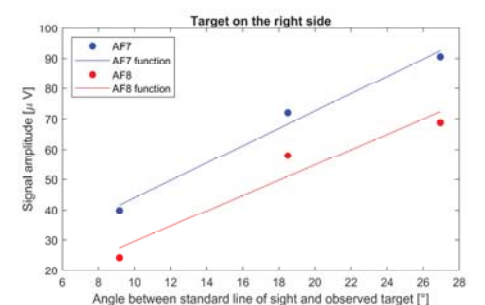
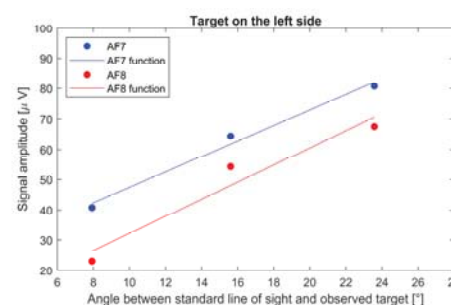
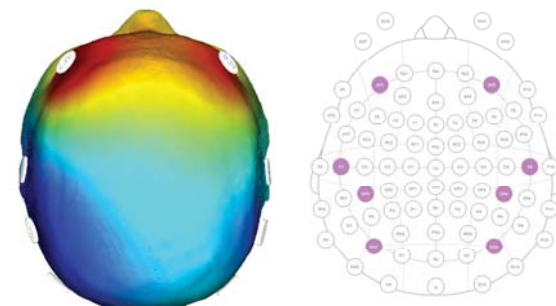
Brain TLS –
 Perceived Space
 Representation using
 Brain Activity
 Analysis, Eye-
 Tracking and
 Terrestrial Laser
 Scanning



Are humans
 measurement
 instruments?

Results

- Target positions on a plane can be obtained from fixations determined with eye-tracking within less than 20 cm to ground truth
- Signal patterns that differentiate the observed target relative to egocentric coordinate system (e.g. left from right)
- Signal amplitude (μV - level) is proportional to the angle between the standard line of sight and the current line of sight
- Maybe a new measurement method will arise ...



Selected Publications and Speeches

Kerekes, G.; Schwieger, V. (2021) Towards Perceived Space Representation using Brain Activity, Eye-Tracking and Terrestrial Laser Scanning. In A. Basiri, G. Gartner, & H. Huang (Eds.), LBS 2021: Proceedings of the 16th International Conference on Location Based Services. doi.org/10.34726/1788

Kerekes (2021) Brain TLS - Perceived Space Representation using Brain Activity Analysis, Eye-Tracking and Terrestrial Laser Scanning, Strategiedialog 2021 - Bold Research (virtual event) 20.04./03.05.2021.

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