

## AEGEUS

### A Novel EEG Ultrasound Device for Functional Brain Imaging and Neurostimulation

The overall goal of AEGEUS is to develop a radically new diagnostic and therapeutic device for neurological applications which combines a highly innovative ultrasound component for brain imaging and focused stimulation of brain regions with advanced electrophysiological measurements of neural activity.

First goal of the project is the development of a novel ultrasound (US)-based functional imaging method that, in conjunction with electroencephalography (EEG), allows for high spatiotemporal resolution examination of brain activity. While EEG itself yields best data from neural tissue close to the skull, the US component is designed to deliver images from deeper brain regions. The second pillar of the device's function is focused US brain stimulation. Based on the possibility to localize abnormal activity, the neuromodulation component of the novel device can be guided to focal stimulation of selected brain regions, which can be further developed into a closed-loop design. The full envisioned system is a versatile tool that combines EEG-sensors and US transceivers in a wearable headset. The project foresees the development of hard- and software as well as algorithms to integrate the information from both modalities into functional neuroimaging with unprecedented spatiotemporal resolution. Beyond the technical realization, this project includes a proof of concept study to evaluate and demonstrate practical applicability in healthy participants and in patients with epilepsy, during clinical routine examination, cognitive, and sensory stimulation, including test-retest validation. The new device will reduce the time to examine and treat neurological patients and the cost thereof. The ability to perform better diagnosis via accurate imaging, targeted neurostimulation, and neuromodulation with a cost-effective, noninvasive device will have transformative effects on treatment options for neurological diseases and stimulate new lines of research in cognitive neuroscience

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