47th IAA SYMPOSIUM ON THE SEARCH FOR EXTRATERRESTRIAL INTELLIGENCE (SETI) – The Next Steps (A4)
Interactive Presentations - 47th IAA SYMPOSIUM ON THE SEARCH FOR EXTRATERRESTRIAL INTELLIGENCE (SETI) – The Next Steps (IP)

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NEUROSCIENCE IN SETI : A CONTEMPORARY CASE STUDY FROM THE ARTS AND HUMANITIES.

Abstract

The first brain activity was purposefully sent into space in 1977, etched as sound in the Golden Record by Carl Sagan and his team. In 2014, media artist Daniela de Paulis, artist in residence at the Dwingeloo radio telescope in The Netherlands, first presented at ASTRON the possibility of radio-transmission of brain activity as part of her project 'COGITO in Space' (www.cogitoinspace.org). The project links brain-activity transmission to SETI through an ongoing interdisciplinary collaboration that includes a team of neuroscientists, engineers, astrophysicists and radio operators, among other specialists. In COGITO, laboratory-grade EEG recordings are analyzed and converted to sound in real-time, using an open-source interstellar EEG-transmission protocol designed for the project (www.EEGsynth.org). The antenna of the Dwingeloo radio telescope in The Netherlands instantly transmits this audio-stream into space i.e. while the participant's brain activity is recorded. The antenna uses amateur radio equipment, with a limited power transmission, thus not increasing chances of possible detection by an alien civilization. One of the challenges of the project was the real-time conversion of 32-channel EEG into a mono 44.1kHz audio signal for radio transmission, including the 3D electrode positions that would allow the reconstruction of the cortical activity and topography by a hypothetical receiver. The interstellar EEG-transmission protocol converts the EEG into a single audio channel as follows: First all the 32 channels of EEG are converted into the frequency domain. Since most human EEG signals obtained in frequencies under 45Hz (higher frequencies are dampened by electrical resistance of the skull and skin), only this frequency-range was retained. All the 32 channels are subsequently concatenated in the frequency domain, with each channel encoded into a 75Hz bandwidth. Each 75Hz part starts with a pure (identifier) tone at 1Hz, followed by the 1-45Hz spectrum of the EEG channel. The X, Y and Z-positions of the electrode are then encoded through frequency-modulation (FM) of additional peaks in three successive 10 Hz bands.

The frequency representation is then converted back to a single audio channel with a sample rate of 44.1kHz. This process occurs in real-time with a minimal time-lag (¡1 second) between recorded EEG and transmitted radio signal. The conversion also includes a method for compensating the effect of the hardware of the radio-telescope on the frequency-distribution. The objective of this paper is to provide other SETI researchers with a case study to stimulate further work on reception of intelligently designed interstellar bio-signals.