Simon GEIRNAERT

PhD in Electrical Engineering

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May 2022	PhD in Electrical Engineering	KU Leuven
July 2018	MSc in Mathematical Engineering	KU Leuven

Research

KU Leuven

2022-present
As a postdoctoral researcher at the Dept. of Electrical Engineering and Dept. of Neurosciences, I develop EEG signal processing algorithms for attention decoding in various brain-computer interface applications. I also co-supervise two PhD students.

Feb. - April 2023
During a three-month research visit at Aarhus University, I collaborated with Prof. Kidmose around the topic of ear-EEG and auditory attention decoding.

2018-2022
As a PhD researcher under the supervision of Prof. Bertrand (Dept. of Electrical Engineering) and Prof. Francart (Dept. of Neurosciences), I developed EEG signal processing algorithms for auditory attention decoding in neuro-steered hearing devices. I obtained my PhD degree Summa cum laude and with congratulations from the examination committee.

Scientific contributions

[refereed journal publications]

S. Geirnaert, T. Francart, A. Bertrand, "An Interpretable Performance Metric for Auditory Attention Decoding Algorithms in a Context of Neuro-Steered Gain Control", *IEEE Transactions on Neural Systems and Rehabilitation Engineering*, vol. 28, no. 1, pp. 307-317, 2020. Software packages available.

S. Geirnaert, T. Francart, A. Bertrand, "Fast EEG-based decoding of the directional focus of auditory attention using common spatial patterns", *IEEE Transactions on Biomedical Engineering*, vol. 68, no. 5, pp. 1557-1568, 2021. Code available.

S. Geirnaert, S. Vandecappelle, E. Alickovic, A. de Cheveigné, E. Lalor, B. Meyer, S. Miran, T. Francart, A. Bertrand, "Electroencephalography-Based Auditory Attention Decoding: Toward Neurosteered Hearing Devices", *IEEE Signal Processing Magazine*, vol. 38, no. 4, pp. 89-102, 2021.

S. Geirnaert, T. Francart, A. Bertrand, "Unsupervised Self-Adaptive Auditory Attention Decoding", *IEEE Journal of Biomedical and Health Informatics*, vol. 25, no. 10, pp. 3955-3966, 2021.

J. Dan*, **S. Geirnaert***, A. Bertrand, "Grouped variable selection for generalized eigenvalue problems," *Signal Processing*, vol. 195, 108476, 2022. *joint first author. Software package and experiment code available.

S. Geirnaert, T. Francart, A. Bertrand, "Time-adaptive Unsupervised Auditory Attention Decoding Using EEG-based Stimulus Reconstruction," *IEEE Journal of Biomedical and Health Informatics*, vol. 26, no. 8, pp. 3767-3778, 2022.

[refereed conference publications]

S. Geirnaert, G. Goovaerts, S. Padhy, M. Boussé, L. De Lathauwer, S. Van Huffel, "Tensor-based ECG Signal Processing Applied to Atrial Fibrillation Detection," in *Proceedings of the 2018 52nd Asilomar Conference on Signals, Systems, and Computers (ACSSC),* Pacific Grove, CA, USA, pp. 799-805, Oct. 2018.

S. Geirnaert, T. Francart, A. Bertrand, "A New Metric to Evaluate Auditory Attention Detection Performance Based on a Markov Chain," in *Proceedings of the 2019 27th European Signal Processing Conference (EUSIPCO),* A Coruña, Spain, pp. 1-5, Sept. 2019.

S. Geirnaert, T. Francart, A. Bertrand, "Riemannian Geometry-Based Decoding of the Directional Focus of Auditory Attention Using EEG," in *Proceedings of the 2021 IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP),* Toronto, ON, Canada, pp. 1115-1119, June 2021. Code available.

N. Heintz, **S. Geirnaert**, T. Francart, A. Bertrand, "Unbiased Unsupervised Stimulus Reconstruction for EEG-Based Auditory Attention Decoding," in *Proceedings of the 2023 IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP),* Rhodes Island, Greece, June 2023.

S. Geirnaert, T. Francart, A. Bertrand, "Stimulus-Informed Generalized Canonical Correlation Analysis of Stimulus-Following Brain Responses," in *Proceedings of the 2023 31st European Signal Processing Conference (EUSIPCO),* Helsinki, Finland, September 2023. Code available.

[abstracts in proceedings of conferences]

S. Geirnaert, G. Goovaerts, S. Padhy, M. Boussé, L. De Lathauwer, S. Van Huffel, "Tensor-based ECG Signal Processing Applied to Atrial Fibrillation Detection", *17th National Day on Biomedical Engineering*, Brussels, Belgium, 30 Nov. 2019. Poster presentation.

S. Geirnaert, S. Vandecappelle, N. Das, T. Francart, A. Bertrand, "Towards Neuro-Steered Hearing Prostheses", *f-TALES: Neuro Sense & Sense-ability*, Leuven, Belgium, 1-2 April 2019. Poster presentation.

S. Geirnaert, T. Francart, and A. Bertrand, "Expected Switching Time: a Markov Chain Based Performance Metric to Evaluate Auditory Attention Decoding Algorithms," *SITB2019: 40th WIC Symposium on Information Theory in the Benelux/9th joint WIC IEEE SP Symposium on Information Theory and Signal Processing in the Benelux*, Ghent, Belgium, 28-29 May 2019. Oral presentation.

S. Geirnaert, S. Vandecappelle, T. Francart, and A. Bertrand, "A Comparative Study of Auditory Attention Decoding Algorithms," *Auditory EEG Signal Processing (AESoP) Symposium*, Leuven, Belgium, 16-18 Sept. 2019. Oral presentation.

S. Geirnaert, T. Francart, and A. Bertrand, "An Interpretable Performance Metric for Evaluating Neural Decoders in the Context of Auditory Attention-Based Gain Control," *Auditory EEG Signal Processing (AESoP) Symposium*, Leuven, Belgium, 16-18 Sept. 2019. Poster presentation.

[invited talks]   "Assessing Auditory Attention Decoding Algorithms for Gain Control in Neuro-Steered Hearing Aids," *International Hearing Instruments Developer Forum 2019*, Oldenburg, Germany, 13-14 June 2019.

"A Comparative Study of Auditory Attention Decoding Algorithms," *Auditory EEG Signal Processing (AESoP) Symposium*, Leuven, Belgium, 16-18 Sept. 2019.

"An interpretable performance metric for evaluating neural decoders in the context of auditory attention-based gain control," *Workshop in Cognitive Hearing*, online, 23 April 2020.

"Decoding auditory attention from EEG: where are we and what's next?," *Workshop in Cognitive Hearing,* University of Maryland, College Park, MD, USA, 6-10 June 2022. Jointly with A. Bertrand.

"Fast and accurate, and unsupervised and time-adaptive EEG-based auditory attention decoding for neuro-steered hearing devices," *BCI award ceremony*, online, 11 Oct. 2022.

"Data-driven Signal Processing Algorithms for EEG-based Auditory Attention Decoding," *EEG Seminar*, Ghent, 25 Nov. 2022.

[PhD thesis]   **S. Geirnaert**, "Signal Processing Algorithms for EEG-based Auditory Attention Decoding," KU Leuven, May 2022. Supervisors: A. Bertrand, T. Francart. Jury: J.-P. Celis, A. Bertrand, T. Francart, S. Van Huffel, H. Van hamme, M. Slaney, B. Babadi.

Awards

October 2022   Nominee for the International BCI Award 2022, awarded by the BCI Award Foundation. For this prestigious award, there were 12 nominees out of 103 submission. We were nominated for our recent advances in neuro-steered hearing devices.

20-05-2022   I received my PhD degree summa cum laude with congratulations from the board of examiners, which is awarded to less than 5% of the PhD candidates.

29-05-2019   Best presentation and paper award at the 40th 2019 IEEE Symposium on Information Theory and Signal Processing in the Benelux, awarded by the Stitching Gauss.

30-10-2018   Finalist Agoriaprijs 2018 for my master thesis about the development of a tensor-based method to detect atrial fibrillation.

Grants

2018-2022	*Multi-modal signal processing algorithms for extract of coupled sources in combined audio and EEG recordings* FWO PhD Fellowship fundamental research (acceptance rate 21%)
2023-2026	*Signal processing algorithms for attention decoding of brain responses to natural stimuli in brain-computer interfaces* Junior postdoctoral fellowship (acceptance rate 21%)
2023-2027	*Listen very carefully! Online tracking of auditory attention via electroencephalography (EEG) in individuals and groups of learners* ID-N project (€467 381). Role: co-PI, PI: A. Bertrand (KU Leuven), other co-PIs: B. De Smedt (KU Leuven), E. Bellon (KU Leuven)

Education

June 2022-…	Co-supervision of PhD project of Iustina Rotaru (jointly with Alexander Bertrand and Tom Francart).
September 2022-…	Co-supervision of PhD project of Yuanyuan Yao (jointly with Alexander Bertrand and Tinne Tuytelaars).
2019-2020, 2020-2021, 2021-2022	Mentor for four master theses in the Master of Biomedical Engineering (3) and Master of Mathematical Engineering (1) @KU Leuven. One master student is now a PhD researcher in our team.
Fall 2019, 2020, 2021, 2022	Teaching assistant for the course Biomedical Data Processing (B-KUL-H03I2A) @KU Leuven, guiding exercise sessions and doing oral evaluations of the final projects. For two years, I was the responsible for the team of TA's, planning the exercise sessions and designing the final project.
Summer 2021, 2022-2023	Mentor for two honors students, doing an extra curriculum research project.
2019-, 2020-, 2021-, 2022-, 2023	Mentor of various design courses in the bachelor and master of Biomedical Engineering (B-KUL-H03I7A and B-KUL-H09O0B) @KU Leuven.
2021-2022	Mentor for the course Research Training in Biomedical Technology (B-KUL-H0N46A).

Outreach

November 2020	My research was covered on national television (news report on VTM Nieuws) and radio (interview on Radio 1) and in various (inter)national written media (e.g., [Het Nieuwsblad](#)) following a press release about one of my papers.
September 2021	3-minute [pitch](#) (in Dutch) about my research in the context of SciComm-initiative 'Wetenschap Uitgedokterd'.
November 2021	Science blog about neuro-steered hearing devices in [EOS](#) (popularizing science magazine Flandres), [BioVox](#) (Belgian life sciences community), and [Leuven.AI Stories](#).
2020, 2021	Play a game with your eyes: workshop for children on controlling a video game with EOG for the 'Kinderuniversiteit'.
2019, 2022	Presentation and demonstration on the National Day of Science ('Dag van de Wetenschap') about auditory attention decoding.
01-09-2022	Signal processing algorithms for EEG-based auditory attention decoding: a 2-min [video overview](#) of my PhD.
2022-...	Various video explainers and demo's on [Youtube](#).