

Miért **nem** működnek a mai beszéd alapú agy-számítógép interfészek? (artikulációs és deep learning aspektusok)

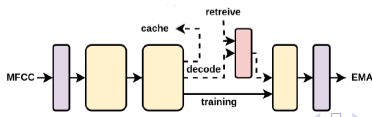
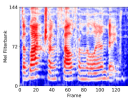
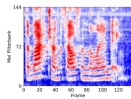
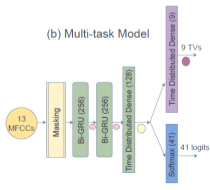


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2023. március 13.

(Agykutatás hete, Vastagbélszűrés hónapja, stb.)



- 1 Intro: brain-to-speech
- 2 Methods: brain-to-articulation-to-speech
- 3 Future plans

Intro: brain-to-speech

nature

Article | [Published: 24 April 2019](#)

Speech synthesis from neural decoding of spoken sentences

[Gopala K. Anumanchipalli](#), [Josh Chartier](#) & [Edward F. Chang](#) 

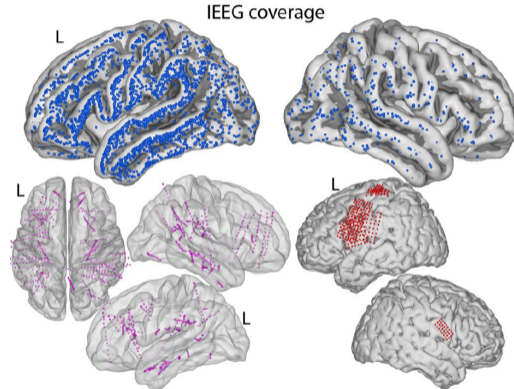
[Nature](#) **568**, 493–498 (2019) | [Cite this article](#)

Speech BCI I

- agy-számítógép interfész / **Brain-Computer Interface**, BCI
- beszéd BCI célja: hang kimenet, azaz egyfajta némabeszéd-interfész / **Silent Speech Interface**, SSI

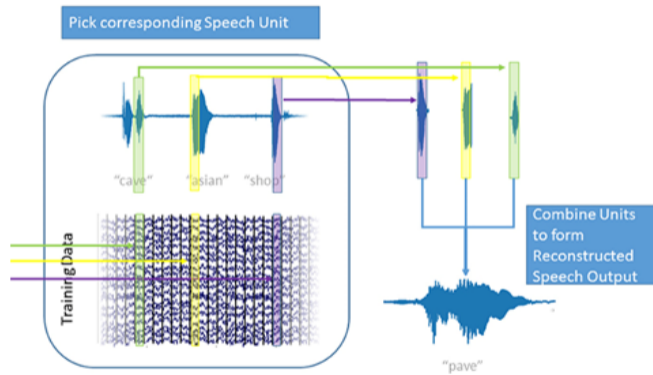
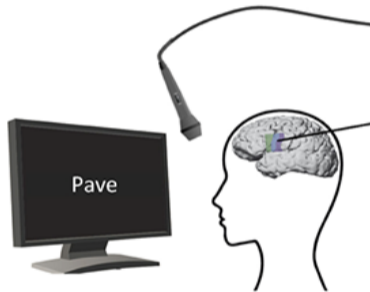
- [Anumanchipalli et al., 2019]

Speech BCI II



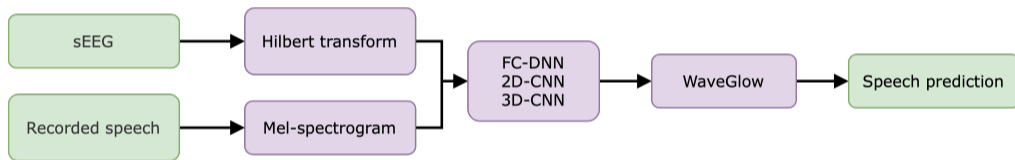
[Berezutskaya et al., 2022]

Speech BCI III



[Herff et al., 2019]

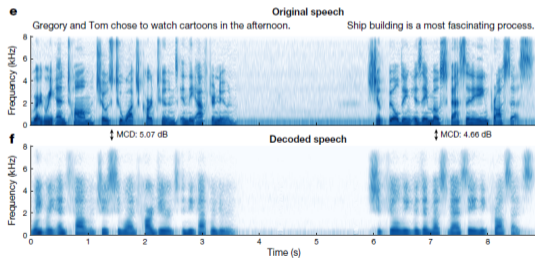
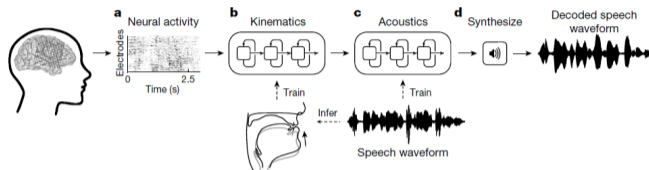
Speech BCI IV



[Arthur and Csapó, 2023]

http://smartlab.tmit.bme.hu/is2023_sEEG

Speech BCI V



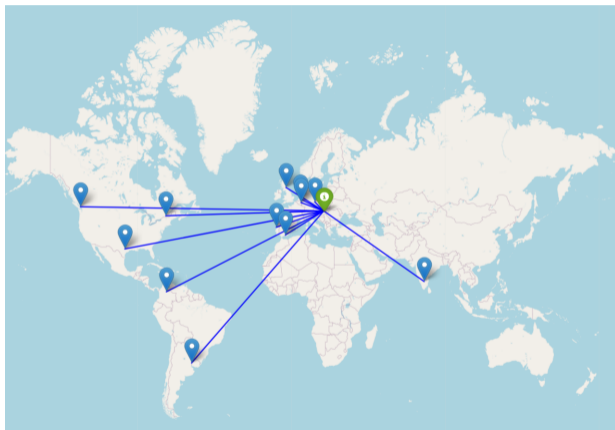
[Anumanchipalli et al., 2019]

<https://www.nature.com/articles/s41586-019-1119-1>

Speech BCI VI

- előzmények
 - Speech synthesis from neural decoding of spoken sentences
 - Generating Natural, Intelligible Speech From Brain Activity ...
 - Magnetometers vs Gradiometers for Neural Speech Decoding
 - Decoding speech from brain activity using linear methods
 - Towards Naturalistic Speech Decoding from Intracranial Brain Data
 - Decoding spoken phonemes from sensorimotor cortex with ECoG
 - Speech synthesis from intracranial ssEEG using a neural vocoder
 - ...

Speech BCI VII

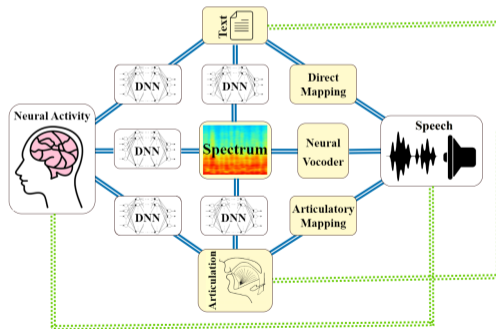


Speech BCI VIII

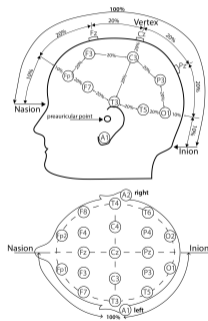
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 - Speech synthesis from intracranial ssEEG using a neural vocoder

- mitől működhetne mégis?
 - agy ... **artikuláció** ... beszéd
 - agy → artikuláció → beszéd

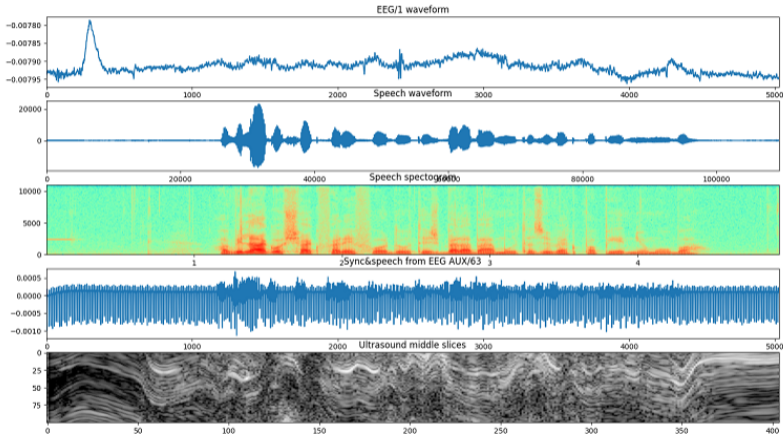
Methods: brain-to-articulation-to-speech



Electroencephalograph (EEG)

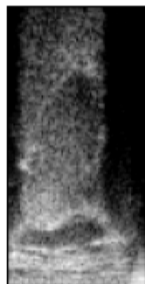
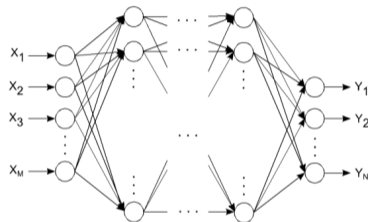
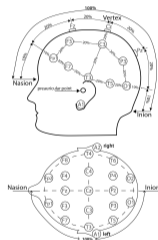


EEG, ultrasound and speech



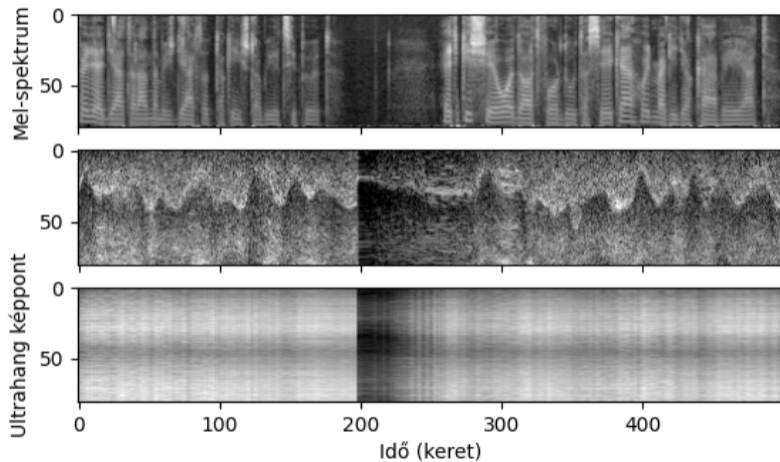
Idő (12ms blokkok)

EEG-to-ultrasound I

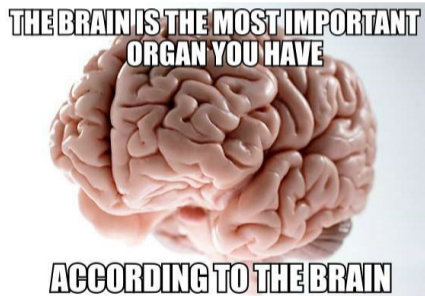


Forráskód

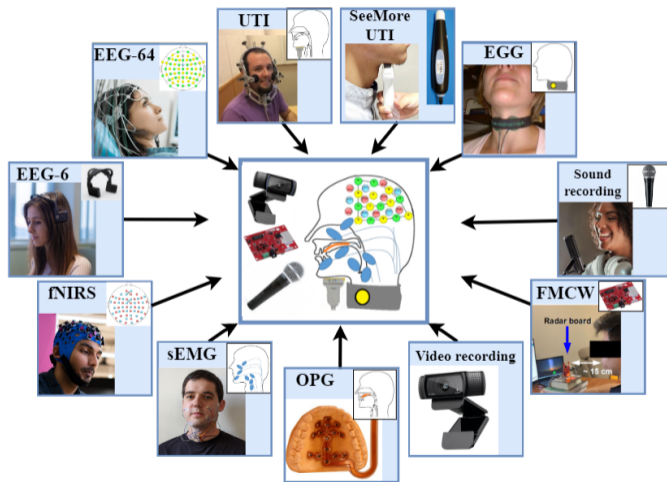
EEG-to-ultrasound II



Future plans



Lendület Neurális Artikuláció Kutatócsoport



MOONSHINE-2023 (Kimle, 2023. július 24-27)

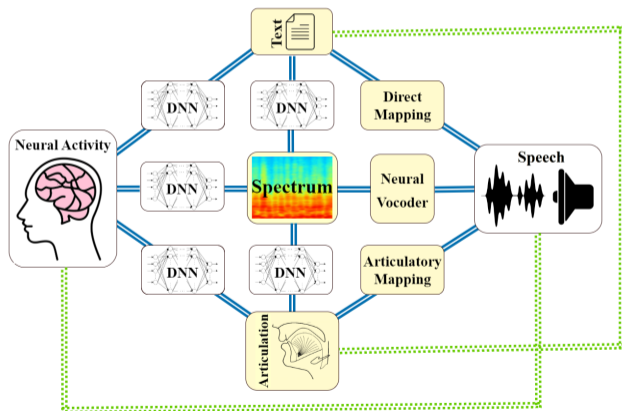
neurart suMmer wOrkshop ON SpeechH-based brain-computer INterfaces kimIE, hungary, 2023

<https://neurart.tmit.bme.hu/moonshine-2023>



Q?

- szívesen megvitatjuk & meghallgatjuk a gondolataidat!



References I



Anumanchipalli, G. K., Chartier, J., and Chang, E. F. (2019).
Speech synthesis from neural decoding of spoken sentences.
Nature, 568(7753):493–498.



Arthur, F. V. and Csapó, T. G. (2023).
Speech synthesis from intracranial stereotactic Electroencephalography using a neural vocoder.
In submitted.



Berezutskaya, J., Vansteensel, M. J., Aarnoutse, E. J., Freudenburg, Z. V., Piantoni, G., Branco, M. P., and Ramsey, N. F. (2022).
Open multimodal iEEG-fMRI dataset from naturalistic stimulation with a short audiovisual film.
Scientific Data 2022 9:1, 9(1):1–13.



Herff, C., Diener, L., Angrick, M., Mugler, E., Tate, M. C., Goldrick, M. A., Krusienski, D. J., Slutzky, M. W., and Schultz, T. (2019).
Generating Natural, Intelligible Speech From Brain Activity in Motor, Premotor, and Inferior Frontal Cortices.
Frontiers in Neuroscience, 13:1267.