

---

## THESIS ASSIGNMENT

**Type of Thesis:** Diploma thesis  
**Language of Thesis:** English  
**Secondary language:** Slovak

**Title:** Neural oscillations and spatial auditory attentional control

**Title SK:** Neurálne oscilácie a riadenie priestorovej sluchovej pozornosti

**Aims:**

- learn and understand the basics of EEG data preprocessing and ERP analysis in the Fieldtrip Matlab toolbox,
- learn how to perform brain oscillation analysis on EEG data,
- analyze EEG data of Kopco et al. (2021) to test the hypothesis that oscillatory components in the alpha-band correlate with spatial attentional effects observed behaviorally
- optional: perform source analysis and connection analysis on the data

**References:** Kopco, N., Sebens, R., Ahveninen, J., Best, V., Shinn-Cunningham, B. (2021), "Electrophysiological correlates of auditory and visual attentional cueing in fine-grained auditory spatial discrimination task", DAGA conference 2021, 15.-18.08.2021 in Wien (abstract, video presentation). [https://pcl.upjs.sk/wp-content/uploads/2021/08/Norbert\\_DAGA\\_2021.mp4](https://pcl.upjs.sk/wp-content/uploads/2021/08/Norbert_DAGA_2021.mp4)  
Kopco, N., Sebens, R. (2020). "Evoked responses to auditory vs. visual attentional cues in auditory spatial discrimination" (Abstract, poster) Poster D1, presented at the Cognitive Neuroscience Society 2020 Annual Meeting, Virtual Conference, Boston, MA, May 2-5, 2020. [https://pcl.upjs.sk/wp-content/uploads/2020/06/Noro\\_cns\\_2020\\_final.pdf](https://pcl.upjs.sk/wp-content/uploads/2020/06/Noro_cns_2020_final.pdf)

**Supervisor:** doc. Ing. Norbert Kopčo, PhD.  
**Institutes :** ÚINF - Institute of Computer Science  
**Head of Institute:** doc. RNDr. Ondrej Krídlo, PhD.

**Approved:**

riaditeľ ústavu

---

## THESIS ASSIGNMENT

**Type of Thesis:** Diploma thesis  
**Language of Thesis:** English  
**Secondary language:** Slovak

**Title:** Neural correlates of auditory distance perception

**Title SK:** Neurálne koreláty sluchového vnímania vzdialenosti

**Aims:**

- learn and understand the basics of fMRI data preprocessing and standard GLM analysis,
- learn how to do MVPA in CosmoMVPA, with focus on split-half correlation and searchlight+SVM
- perform split-half correlation analysis on auditory distance perception data split in various ways
- perform searchlight+SVM analysis on the same data
- compare the results of these two MVPA approaches to standard GLM based univariate approach.

(- optional: compare the MVPA classifier performance to PointMAP classifier, - analyze and collect behavioral distance perception data)

**References:** Kopčo N, Doreswamy KK, Huang S, Rossi S, Ahveninen J (2020). Cortical auditory distance representation based on direct-to-reverberant energy ratio. *NeuroImage*, Volume 208, 116436 doi.org/10.1016.  
Doreswamy KK, Ahveninen J, Huang S, Rossi S, Kopco N (2021). “Neural Correlates of Auditory Distance Perception with Congruent and Incongruent Cues”, Abstract M7, submitted at the VIRTUAL 44th Annual MidWinter Meeting of the Association for Research in Otolaryngology, February 20-24, 2021. (abstract , poster, audio presentation)

**Keywords:** spatial auditory perception, plasticity

**Supervisor:** doc. Ing. Norbert Kopčo, PhD.  
**Consultant:** RNDr. Keerthi Kumar Doreswamy  
**Institutes :** ÚINF - Institute of Computer Science  
**Head of Institute:** doc. RNDr. Ondrej Krídlo, PhD.  
**Electronic version available:** unlimited

**Approved:**

riaditeľ ústavu

---

## THESIS ASSIGNMENT

**Type of Thesis:** Bachelor thesis  
**Language of Thesis:** English  
**Secondary language:** Slovak

**Title:** Neural encoding of auditory distance information in the human brain

**Title SK:** Neurálne kódovanie informácií o sluchovej vzdialenosti v ľudskom mozgu

**Aims:**

- learn and understand the basics of fMRI data preprocessing and standard GLM analysis,
- learn how to do MVPA in CosmoMVPA, with focus on split-half correlation and searchlight+SVM
- perform split-half correlation analysis on auditory distance perception data split in various ways
- perform searchlight+SVM analysis on the same data
- compare the results of these two MVPA approaches to standard GLM based univariate approach.

(- optional: compare the MVPA classifier performance to PointMAP classifier, - perform within-subject analysis of data with symmetrical stimuli)

**References:** Kopčo N, Doreswamy KK, Huang S, Rossi S, Ahveninen J (2020). Cortical auditory distance representation based on direct-to-reverberant energy ratio. *NeuroImage*, Volume 208, 116436 doi.org/10.1016.  
Doreswamy KK, Ahveninen J, Huang S, Rossi S, Kopco N (2021). "Neural Correlates of Auditory Distance Perception with Congruent and Incongruent Cues", Abstract M7, submitted at the VIRTUAL 44th Annual MidWinter Meeting of the Association for Research in Otolaryngology, February 20-24, 2021. (abstract , poster, audio presentation)

**Keywords:** spatial auditory perception

**Supervisor:** doc. Ing. Norbert Kopčo, PhD.  
**Consultant:** RNDr. Keerthi Kumar Doreswamy  
**Institutes :** ÚINF - Institute of Computer Science  
**Head of Institute:** doc. RNDr. Ondrej Krídlo, PhD.  
**Electronic version available:** unlimited

**Approved:** doc. RNDr. Ondrej Krídlo, PhD.  
riaditeľ ústavu

---

## THESIS ASSIGNMENT

**Type of Thesis:** Bachelor thesis  
**Language of Thesis:** English  
**Secondary language:** Slovak

**Title:** Cortical oscillations and auditory spatial attention

**Title SK:** Kortikálne oscilácie a sluchová priestorová pozornosť

**Aims:**

- learn and understand the basics of EEG data preprocessing and ERP analysis in the Fieldtrip Matlab toolbox,
- learn how to perform brain oscillation analysis on EEG data,
- analyze EEG data of Kopco et al. (2021) to test the hypothesis that oscillatory components in the alpha-band correlate with spatial attentional effects observed behaviorally
- optional: perform source analysis and connection analysis on the data

**References:** Kopco, N., Sebens, R. (2020). “Evoked responses to auditory vs. visual attentional cues in auditory spatial discrimination” Poster D1, presented at the Cognitive Neuroscience Society 2020 Annual Meeting, Virtual Conference, Boston, MA, May 2-5, 2020.  
Kopco, N., Sebens, R., Ahveninen, J., Best, V., Shinn-Cunningham, B. (2021), “Electrophysiological correlates of auditory and visual attentional cueing in fine-grained auditory spatial discrimination task”, DAGA conference 2021, 15.-18.08.2021 in Wien

**Keywords:** spatial auditory perception, EEG

**Supervisor:** doc. Ing. Norbert Kopčo, PhD.

**Consultant:** Ing. Udbhav Singhal

**Institutes :** ÚINF - Institute of Computer Science

**Head of Institute:** doc. RNDr. Ondrej Krídlo, PhD.

**Electronic version available:** unlimited

**Approved:** doc. RNDr. Ondrej Krídlo, PhD.  
riaditeľ ústavu

---

## THESIS ASSIGNMENT

**Type of Thesis:** Bachelor thesis  
**Language of Thesis:** English  
**Secondary language:** Slovak

**Title:** Auditory distance perception in fixed and varying simulated acoustic environments

**Title SK:** Sluchové vnímanie vzdialenosti vo fixnom a meniacom sa simulovanom akustickom prostredí

**Aims:**

- prepare experiment on auditory distance perception using an existing script in Matlab
- collect new data and analyze them together with available data to evaluate:
  - whether listeners are able to maintain multiple models of auditory environments in their brains in parallel,
  - whether learning distance perception in different rooms is affected by consistency of room simulation

**References:** Schoolmaster, M, N Kopčo, and BG Shinn-Cunningham (2004). "Auditory distance perception in fixed and varying simulated acoustic environments," J. Acoust. Soc. Am., (Presented at th 147th meeting of the Acoustical Society of America, New York, NY).  
Schoolmaster, M, N Kopčo, and BG Shinn-Cunningham (2003). "Effects of reverberation and experience on distance perception in simulated environments," J. Acoust. Soc. Am., (Presented at the 145th meeting of the Acoustical Society of America, Nashville, TN).  
Kopčo N, M Schoolmaster, and BG Shinn-Cunningham (2004) Learning to Judge Distance of Nearby Sounds in Reverberant and Anechoic Environments. (Invited presentation) In: Proc. Joint congress CFA/DAGA '04 22.-25.03.2004 in Strasbourg, France

**Keywords:** spatial auditory perception

**Supervisor:** doc. Ing. Norbert Kopčo, PhD.  
**Consultant:** Myroslav Fedorenko  
**Institutes :** ÚINF - Institute of Computer Science  
**Head of Institute:** doc. RNDr. Ondrej Krídlo, PhD.  
**Electronic version available:** unlimited

**Approved:** doc. RNDr. Ondrej Krídlo, PhD.  
riaditeľ ústavu

---

## THESIS ASSIGNMENT

**Type of Thesis:** Ph. D. thesis  
**Language of Thesis:** Slovak  
**Secondary language:** English

**Title:** Plasticity and attention in spatial hearing

**Title SK:** Plasticita a pozornosť v priestorovom počúvaní

**Aims:** In everyday situations, humans are exposed to multiple concurrent stimuli in complex, continuously changing environments. To correctly extract relevant information, they adapt their processing to reflect the specifics of the current scene, and they learn from previous experience to improve the perceptual strategies used. The current project proposes to perform a series of behavioral experiments, brain imaging studies, and computational modeling to study how attention and mechanisms of implicit and explicit learning are used to cope with complex listening environments for speech processing, sound localization, and learning of new phonetic categories.

### References:

**Tutor:** doc. Ing. Norbert Kopčo, PhD.  
**Institutes :** ÚINF - Institute of Computer Science  
**Head of Institute:** doc. RNDr. Ondrej Krídlo, PhD.

**Approved:** Prof. RNDr. Stanislav Krajčí, PhD.  
head of common field commission

---

## THESIS ASSIGNMENT

**Type of Thesis:** Ph. D. thesis  
**Language of Thesis:** Slovak  
**Secondary language:** English

**Title:** Cross-modal interactions and spatial auditory processing

**Title SK:** Krosmodálne interakcie v priestorovom sluchu

**Aims:** Vision influences how we perceive space by hearing. Ventriloquism effect and after-effect are phenomena illustrating short-term plasticity in spatial hearing induced by visual signals. Visual attentional cuing also influences spatial auditory processing both in terms of sound localization and spatial benefit in speech perception. The current project will examine the effect of visual information on spatial auditory perception by performing behavioral experiments, neuroimaging studies, and computational modeling.

### References:

**Tutor:** doc. Ing. Norbert Kopčo, PhD.  
**Institutes :** ÚINF - Institute of Computer Science  
**Head of Institute:** doc. RNDr. Ondrej Krídlo, PhD.

**Approved:** Prof. RNDr. Stanislav Krajčí, PhD.  
head of common field commission

---

## THESIS ASSIGNMENT

**Type of Thesis:** Ph. D. thesis  
**Language of Thesis:** Slovak  
**Secondary language:** English

**Title:** Brain-training games for spatial hearing

**Title SK:** Brain-training hry a priestorové počutie

**Aims:** Solutions designed to enhance auditory processing when hearing thresholds are within normal limits are very limited and none are as recognized or as widely available as are hearing aids and cochlear implants. The project aims to contribute to the development of novel procedures to rehabilitate auditory processing deficits (APD) by developing a brain training game based on modern auditory neuroscience and the results of the EU Horizon 2020 ALT grant. The development of auditory brain training game will be in collaboration with University of California, Riverside Brain Game Center and Oregon Health State University. The main goal of the games is to develop and test rehabilitative techniques that restore auditory function for those who perform poorly on tests of APD by training various aspects of auditory processing.

### References:

**Tutor:** doc. Ing. Norbert Kopčo, PhD.  
**Institutes :** ÚINF - Institute of Computer Science  
**Head of Institute:** doc. RNDr. Ondrej Krídlo, PhD.

**Approved:** Prof. RNDr. Stanislav Krajčí, PhD.  
head of common field commission



---

## THESIS ASSIGNMENT

**Type of Thesis:** Bachelor thesis

**Language of Thesis:** English

**Secondary language:** Slovak

**Title:** Plasticity in audio-visual spatial perception

**Title SK:** Plasticita v audio-vizuálnom priestorovom vnímaní

**Aims:**

- Prepare a review in the field of plasticity in audio-visual spatial perception.
- Set up a system for real-time simultaneous recording head orientation, eye-gaze direction and hand pointing direction.
- Design an experiment based on Kopco, Loksa et al. (2019) to test how saccade adaptation contributes to the ventriloquism effect and its reference frame as observed in that study.
- Analyze the experimental data to determine whether adaptation induced by congruent stimuli was caused by eye saccades in Kopco, Loksa et al. (2019),
- Analyze the experimental data to determine whether reference frame of the ventriloquism aftereffect is location-independent when eye saccades are not used for responding.

**References:** Kopčo, N, I-F Lin, BG Shinn-Cunningham, and JM Groh (2009). Reference frame of the ventriloquism aftereffect. *Journal of Neuroscience*, 29(44):13809-13814; doi:10.1523/JNEUROSCI.2783-09.( supplementary material, link to journal).

Kopčo N, Lokša P, Lin I-F, Groh J, Shinn-Cunningham B (2019). Hemisphere-Specific Properties of the Ventriloquism Aftereffect. *Journal of the Acoustical Society of America*, 146, EL177 doi.org/10.1121/1.5123176 (a preprint including monkey data is available here).

Loksa P, Kopco N (2021) A model of the reference frame of the ventriloquism aftereffect. doi.org/10.1101/2021.03.31.437664.

**Keywords:** spatial auditory perception, plasticity

**Supervisor:** doc. Ing. Norbert Kopčo, PhD.

**Consultant:** Ing. Peter Lokša, PhD.

**Institutes :** ÚINF - Institute of Computer Science

**Head of Institute:** doc. RNDr. Ondrej Krídlo, PhD.

**Electronic version available:** unlimited

**Approved:**

doc. RNDr. Ondrej Krídlo, PhD.

riaditeľ ústavu

---

## THESIS ASSIGNMENT

**Type of Thesis:** Bachelor thesis  
**Language of Thesis:** English  
**Secondary language:** Slovak

**Title:** Rapid adaptation in audio-visual spatial perception

**Title SK:** Rýchla adaptácia v audio-vizuálnom priestorovom vnímaní

**Aims:**

- Prepare a review in the field of plasticity in audio-visual spatial perception.
- Set up a system for real-time simultaneous recording head orientation, eye-gaze direction and hand pointing direction.
- Studz the experiment of Kopco et al (2009) and Kopco, Loksa et al. (2019) to test how saccade adaptation contributes to the ventriloquism effect.
- Analyze human and monkey experimental data to determine whether trial-to-trial adaptation is observed in the data and what is its reference frame.

**References:** Kopčo, N, I-F Lin, BG Shinn-Cunningham, and JM Groh (2009). Reference frame of the ventriloquism aftereffect. *Journal of Neuroscience*, 29(44):13809-13814; doi:10.1523/JNEUROSCI.2783-09.( supplementary material, link to journal).

Kopčo N, Lokša P, Lin I-F, Groh J, Shinn-Cunningham B (2019). Hemisphere-Specific Properties of the Ventriloquism Aftereffect. *Journal of the Acoustical Society of America*, 146, EL177 doi.org/10.1121/1.5123176 (a preprint including monkey data is available here).

Loksa P, Kopco N (2021) A model of the reference frame of the ventriloquism aftereffect. doi.org/10.1101/2021.03.31.437664.

**Keywords:** spatial auditory perception, plasticity

**Supervisor:** doc. Ing. Norbert Kopčo, PhD.

**Consultant:** Ing. Peter Lokša, PhD.

**Institutes :** ÚINF - Institute of Computer Science

**Head of Institute:** doc. RNDr. Ondrej Krídlo, PhD.

**Electronic version available:** unlimited

**Approved:**

doc. RNDr. Ondrej Krídlo, PhD.  
riaditeľ ústavu

---

## THESIS ASSIGNMENT

**Type of Thesis:** Bachelor thesis  
**Language of Thesis:** Slovak  
**Secondary language:** English

**Title:** Contextual plasticity and scaling in virtual environment

**Title SK:** Kontextuálna plasticita a škálovanie vo virtuálnom prostredí

**Aims:**

**References:**

**Keywords:** spatial auditory perception, contextual plasticity

**Supervisor:** doc. Ing. Norbert Kopčo, PhD.

**Consultant:** doc. RNDr. Gabriela Andrejková, CSc.

**Institutes :** ÚINF - Institute of Computer Science

**Head of Institute:** doc. RNDr. Ondrej Krídlo, PhD.

**Electronic version available:** unlimited

**Approved:**

Prof. RNDr. Viliam Geffert, DrSc.  
riaditeľ ústavu