Προτεινόμενα Θέματα Διπλωματικής Εργασίας

Από

Θεόδωρος Γιαννακόπουλος

A. An empirical study on end-to-end multimodal sentiment systems

Συνοπτική περιγραφή:

Multimodal learning is a Machine Learning area that is associated with including different types of signals, which are caused by the same phenomenon, in the learning process. A typical example is Multimodal Language where it is crucial to combine three types of information: (i) audio waveform of speech, (ii) speech content (text), and (iii) visual cues (e.g., gestures). Multimodal Sentiment Analysis is a basic task in this area where the scope is to infer the sentiment level of a multimodal language signal, for instance, positive or negative sentiment. Despite their great applicability in real-world applications, such systems are currently limited to research. That is mostly due to (i) the high model complexity (in terms of the number of parameters), (ii) the absence of end-to-end systems that are applied to actual input signals, since most systems use pre-extracted and pre-aligned feature vectors, and (iii) underperforming under missing or noisy modalities.
The scope of this thesis is to perform an empirical study on current models of the literature in order to evaluate their performance and complexity in an end-to-end setting.
For an introduction to Multimodal Learning, see
https://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=8269806

B. Examination of cross-dataset generalization abilities for Speech Emotion Recognition systems

Συνοπτική περιγραφή:

Speech Emotion Recognition is associated with predicting the underlying emotion levels that are contained in an input speech signal. There is a range of datasets for this task that are based on different design choices. More speciffícaly, datasets differ, along with other aspects, with respect to (i) the type of speech (acted, improvised, etc), (ii) the definitions of emotional levels, (iii) the context (e.g., theater actors are more expressive compared to everyday situations), (iv) the spoken language, and (v) the recording setup. The scope of this thesis is to empirically examine the cross-dataset generalization ability of models trained under different dataset types and investigate parameters that affect the transfer of knowledge among speech emotion recognition datasets.

Προτεινόμενα ΘέματαΔιπλωματικής Εργασίας

Από

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Α. **Προτεινόμενος Τίτλος:** automated image analysis in brain/ spinal cord microscope images

Επιβλέπων:

Μέλη Συμβουλευτικής / Εξεταστικής Επιτροπής:

Συνοπτική περιγραφή:

Recent advances of microscopy (e.g. light-sheet microscope, multi-fluorescence techniques) or even established techniques such as the confocal and epifluorescent microscopy, produce and provide huge amount of data that cannot be -in their complexity- fully analyzed alone by humans (Fig. 1). The understanding of neural function and diseases requires such 2D/3D spatial and (under conditions) temporal information by microscopy, followed by complex and detailed analysis of its various cells and structures. Thereby, image analysis of microscopy data is driving the field of Neuroscience.

More specifically, in the case of brain stroke, the tissue lesion produces local and remote effects in other areas of the brain or spinal cord, which are not entirely understood. Due to the high neuroanatomical hierarchy of the CNS, any lesion or change in these areas has to identified, quantified and mapped to its corresponding neuroanatomy to gain a meaning. Here, an automated algorithm for such an analysis can speed-up the process, remove human bias or imprecision of detection and even add features not available so far.

Thus, this thesis aims to develop such an "question-adaptable" algorithm for spinal cord microscopy-images using AI-based methods. It will utilize and/or combine already available tools such as the AIDA-Histo (Pallast et al., 2019) or ImageJ, adapt automated image-registration methodologies from the StrokeAnalyst (Damigos et al., 2022) and incorporate neuroanatomical data from the Allen Brain Atlas databases. It should be a stand-alone, user-friendly interface that will be able to detect cells or structures based on user-defined "needs and instructions" and return data on different neuroanatomical areas.

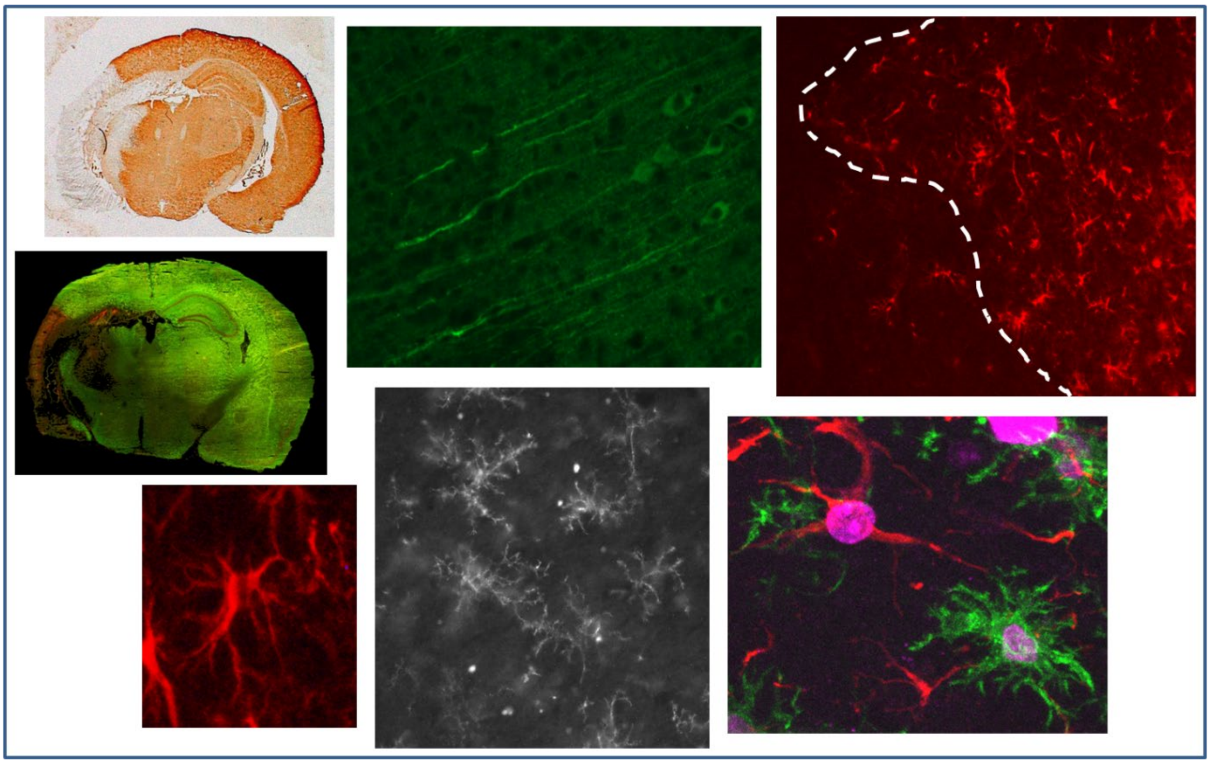

Fig. 1: examples of microscope-acquired "image-data" for analysis in Neurosciences (data from our Laboratory), and specifically brain stroke.

B. **Προτεινόμενος Τίτλος:** Adaptation of DeepLabCut on stroke-specific behavioral tests.

Επιβλέπων:

Μέλη Συμβουλευτικής / Εξεταστικής Επιτροπής:

Συνοπτική περιγραφή:

Clinically "translational", sensitive and focal neurological or behavioral assessment of stroked mice is important for the evaluation of novel therapeutical interventions in experimental stroke. Up to date, the usual stroke behavioral assessment of mice (by the majority of the relevant laboratories worldwide) is mainly based in crude, nominal, scales with no clinical or neuroanatomical "translationality" to humans (Lourbopoulos et al., 2021). On the other hand, the existing and sensitive tests for evaluating fine motor deficits after a treatment (examples of such tests are shown in Fig. 2) are too laborious for humans and bare significant bias, thus being utilized only by few laboratories.
A successful AI-based approach to address such problems could be the "DeepLabCut" AI algorithm (Mathis et al., 2018;Lauer et al., 2022). This is an open-source algorithm, developed in 2018 by the Mathis et al, with currently expanding utilization in the field of behavioral analysis.

As such, this thesis aims to utilize, adapt and possibly further develop on the "DeepLabCut", using already established behavioral tests in mice in our Laboratory. The output should be the adaptation and validation of the algorithm on mice after stroke, in order to build a reliable and automated analysis of the complex fine motor deficits after stroke.

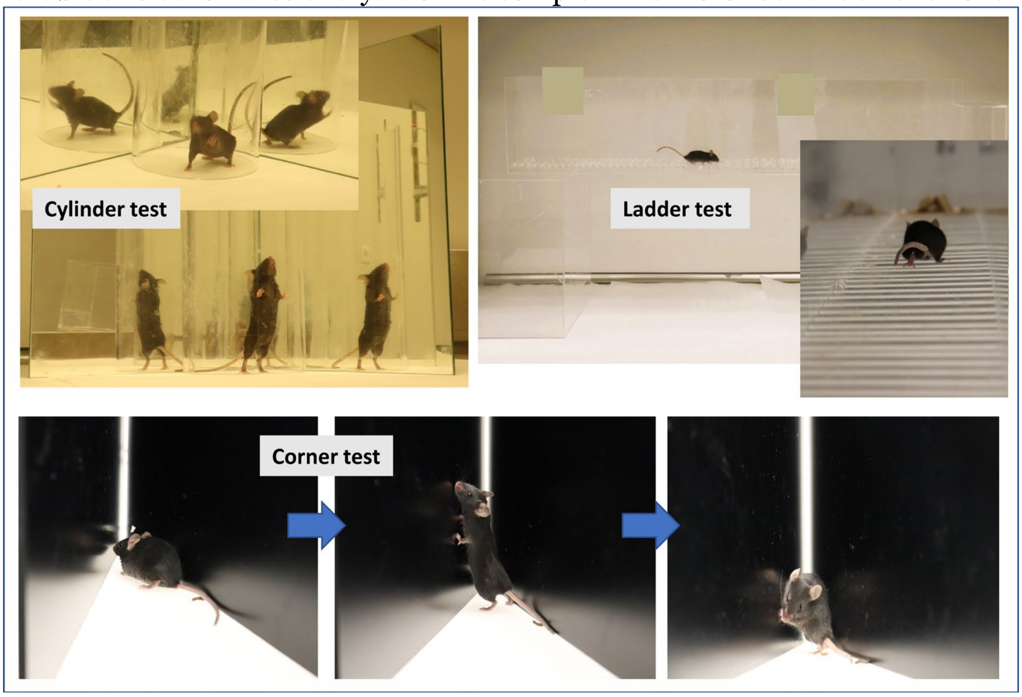

Fig. 2: examples of video-acquired, behavioral tests (Cylinder test, Ladder test and Corner test, run in our Laboratory) that evaluate fine motor deficits after brain stroke.

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