Diploma Topics 2021-2022, AI-MAS Laboratory

Autonomous Driving

Titlu: Detecția somnolenței șoferilor

Coordonatori /Contact: **Prof. dr. ing. Adina Magda Florea (**adina.florea@upb.ro)
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Descriere:
Tema are ca scop aplicarea metodelor de vedere computerizată pentru a detecta semne de somnolență a șoferilor la volan [1].

Opțional: Studentul care va alege tema va avea posibilitatea să lucreze în cadrul laboratorului AI-MAS (https://aimas.cs.pub.ro/). De asemenea, studentul va putea utiliza resursele de calcul puternice ale laboratorului pentru implementarea proiectului.
[1] https://arxiv.org/ftp/arxiv/papers/1811/1811.01627.pdf

Title: Autonomous driving dataset pedestrian augmentation

Coordinator/Contact: **Sl. dr. ing. Dan Novischi (dan_marius.novischi@upb.ro**)

Description:
The best way to make a machine learning model generalize better is to train it on more data. Of course, in practice the amount of data we have is limited. One way to get around this problem is to create fake data and add it to the training set. This is called dataset augmentation. The project's main objective is to create a two stage augmentation pipeline for the AIMAS Autonomous Driving dataset using Generative Adversarial Network techniques. The pipeline will first generate fake examples based on pedestrian segmentations extracted from the Cityscapes dataset. Then, in stage two the solution will leverage fake examples using in-painting to augment the AIMAS Autonomous Driving dataset.

[1] https://www.cityscapes-dataset.com/
[2] https://github.com/aimas-upb/nemodrive-sda/tree/v2
[3]https://towardsdatascience.com/demystified-wasserstein-gan-with-gradient-penalty-ba5e9b905ead
[4] https://github.com/junyanz/pytorch-CycleGAN-and-pix2pix

Opțional: Studentul va putea utiliza resursele de calcul puternice / componente disponibile ale laboratorului AI-MAS pentru implementarea proiectului.

Title: Image Stitching for Self-Driving Tasks

Coordinators/Contacts **Sl. dr. ing. Alexandru Sorici (**alexandru.sorici@upb.ro)
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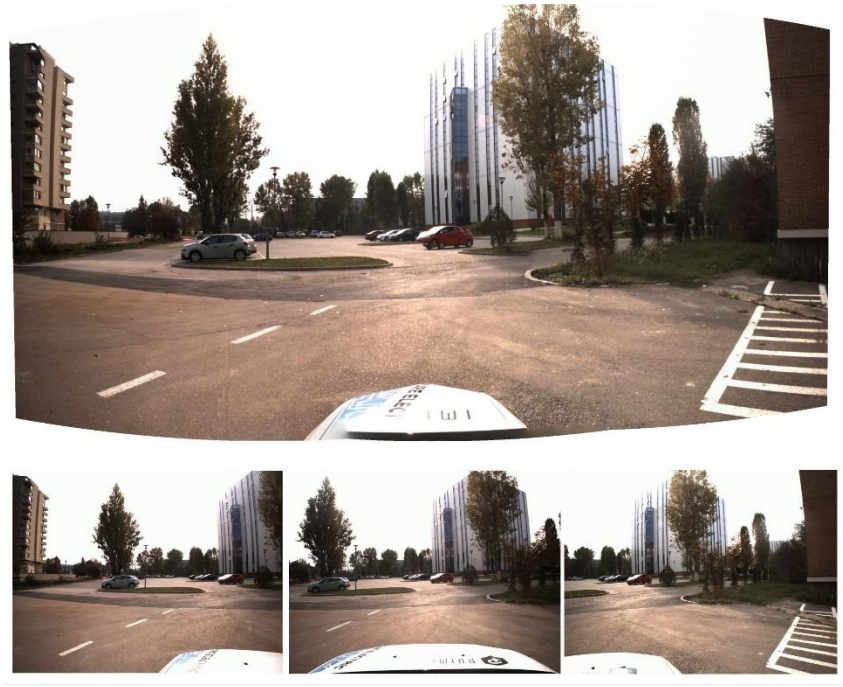
Description:

Within the Nemodrive project (nemodrive.cs.pub.ro), which has the objective of developing software solutions that enable an electric car to autonomously navigate within the UPB campus, we use input from 3 front facing RGB cameras mounted on the car roof. Cameras are oriented to the left, center and right to enable an as large as possible visual field.



However, in order to use all the available visual information within algorithms developed for traffic object detection and semantic segmentation, a preprocessing step of **image stitching is** required in order to obtain a single panoramic view that facilitates consistency of algorithm application. Furthermore, for the case of depth estimation algorithms, stitching of the resulting “point clouds” becomes possible as a post-processing step.

This research topic has the following objectives:

- Obtaining a baseline implementation using existing image stitching libraries that use classic computer vision techniques(e.g.: https://www.pyimagesearch.com/2018/12/17/image-stitching-with-opencv-and-python/)
- Experiment with using newer deep learning based image stitching techniques (e.g: https://arxiv.org/abs/1909.05983)

- Explore the use of additional features (e.g. estimated depth, visual odometry) to improve image stitching quality (e.g: https://arxiv.org/abs/2106.12859)

Requirements:
Most Machine Learning frameworks have considerable support in Python, such that an adequate knowledge of this programming language is required.

Title: Developing autonomous-driving algorithms on the DuckieTown platform

Coordinators/Contacts: **Sl. dr. ing. Alexandru Sorici (alexandru.sorici@upb.ro)**
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Description:
DuckieTown (https://www.duckietown.org/platform) is an educational platform that introduces students to the challenges of developing the stack of algorithms required for autonomous driving. It contains both a virtual simulator, as well as a real-world small scale driving track with an autonomous driving robot, traffic signs and duck-pedestrians. The latter is available in the AI-MAS laboratory.
The objective of this research topic is to apply various ML algorithms which have been developed as part of the Nemodrive project (https://nemodrive.cs.pub.ro/ - e.g. driving trajectory prediction through imitation learning, pedestrian detection, depth estimation from monocular camera setup), as well as to test the robustness of Sim2Real (domain adaptation algorithms which generalize from a simulated environment to a real one) algorithms existing in the literature.

Requirements:
Adequate experience working with the Python programming language is a plus.

Titlu: Prelucrarea si recunoasterea formelor semnalelor electroencefalografice (EEG)

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Descriere:
Tema propune analiza unor secvente temporale EEG (din seturi de date existente care) plecand de la instrumente clasice de prelucrare, ex. filtrari de semnale, care actioneaza ca modele de referinta (baseline).
Modele antrenabile (machine learning based) sunt folosite pentru a îmbunătăți capacitatea de clasificare/regresie a modelelor de referinta.
Setul de date de la care se pleaca este legat de analiza secventelor EEG inregistrate in timpul somnului (https://www.physionet.org/content/sleep-edf/1.0.0/), dar domeniul poate fi extins pe parcursul temei.
Numar studenti: 1