ΠΑΝΕΠΙΣΤΗΜΙΟ ΠΕΙΡΑΙΩΣ
UNIVERSITY OF PIRAEUS

DEMOKRITOS

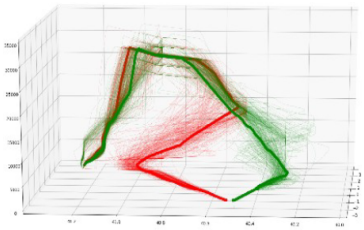
Προτεινόμενα Θέματα Διπλωματικής Εργασίας

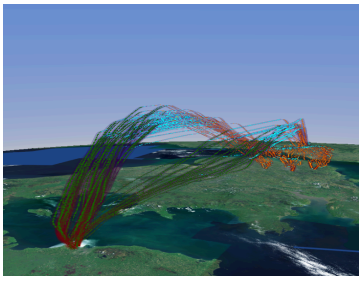
Από

Καθηγητή Γεώργιο Βούρο

A. Visual Mobility Analytics

Συνοπτική περιγραφή:





(Bottom Figure: provided by VA group in IAIS Fraunhofer)

Visual analytics is a research discipline that is based on acknowledging the power and the necessity of the human vision, understanding, and reasoning in data analysis and problem solving. It develops a methodology of analysis that facilitates human activities by means of interactive visual representations of information.[1] A substantial body of research in VA has been focusing on data and problems related to mobility and transportation[2] [3].

This thesis aims at developing visual methods for interactive clustering of trajectories in the aviation domain. Specifically, it aims at
- developing state of the art trajectory clustering methods,
- providing a highly interactive environment for inspecting the clustering results provided by different methods and fine-tuning clustering results by adjusting algorithms' parameters.

The result should be demonstrated with large number of real-world trajectories in the aviation domain.

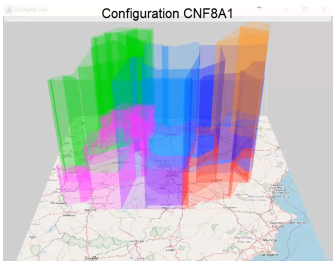
[1] Thomas, J., Cook, K.: Illuminating the Path: The Research and Development Agenda for Visual Analytics. IEEE (2005).

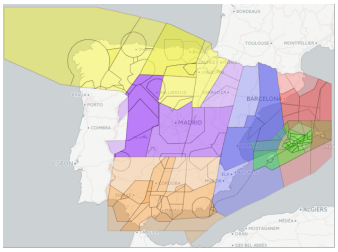
[2] Andrienko, N., Andrienko, G.: Visual analytics of movement: An overview of methods, tools and procedures. Information Visualization 12(1), 3–24 (2013). DOI 10.1177/ 1473871612457601

[3] Andrienko, G., Andrienko, N., Chen, W., Maciejewski, R., Zhao, Y.: Visual analytics of mobility and transportation: State of the art and further research directions. IEEE Transactions on Intelligent Transportation Systems 18(8), 2232–2249 (2017). DOI 10.1109/TITS.2017.
2683539

Β. Airspace Configuration Prediction

Συνοπτική περιγραφή:





(Figures provided by VA group in IAIS Fraunhofer)

This thesis aims at developing imitation learning methods for learning the course of active airspace configurations using predicted traffic conditions. Airspace configurations, as the figures in the left side show for the Spanish airspace, are specific segregations of the airspace, in sectors. Each sector is controlled by two humans (Air Traffic Controllers). This segregation is done for effective air traffic control and safety reasons. However, the segregation active at each time point depends on the traffic conditions (while 9 or 10 sectors may be active for Spain during the day, only one active sector may suffice during the night). The prediction of these active configurations is a major problem in the aviation domain, mainly for airlines' interest[4]. In this thesis we will explore solving this prediction problem using deep reinforcement learning -imitation learning techniques, which are highly promising in making predictions in high-dimensional state-action spaces. We aim at high-innovation which, in case that accurate experimental results are provided, may result in an article publication. (Bottom Figure:

Γ. Directed Info-GAIL in Predicting Trajectories

Συνοπτική περιγραφή:

As noted in the Directed Info-GAIL paper[5] "the use of imitation learning to learn a single policy for a complex task that has multiple modes or hierarchical structure can be challenging". This thesis will explore the use of directed info-GAIL algorithm, which is based on the generative adversarial imitation learning framework to automatically learn sub-task policies from unsegmented demonstrations of aircraft trajectories, given that flights have indeed different modes of behaviour in different segments of trajectories, depending on many trajectories' contextual features.

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[4] Y. Xu, X. Prats and D. Delahaye, "Synchronization of Traffic Flow and Sector Opening for Collaborative Demand and Capacity Balancing," 2018 IEEE/AIAA 37th Digital Avionics Systems Conference (DASC), London, 2018, pp. 1-10.

[5] Arjun Sharma∗ , Mohit Sharma∗ , Nicholas Rhinehart, Kris M. Kitani, "DIRECTED-INFO GAIL: LEARNING HIERARCHICAL POLICIES FROM UNSEGMENTED DEMONSTRATIONS USING DIRECTED INFORMATION", arXiv:1810.01266v2 [cs.LG] 12 Mar 2019

Δ. Hierarchical Planning using Parameterized Actions

Συνοπτική περιγραφή:

Parameterised actions in reinforcement learning are composed of discrete actions with continuous action-parameters. This provides a framework for solving complex domains that require combining high-level actions with flexible control. Recent efforts include the P-DQN algorithm and multi-pass deep Q-networks, or MP-DQN[6],[7]. This thesis aims to develop such methods and empirically compare them in the context of conflicts resolution in the aviation domain, mainly for demand and capacity balancing using multiple alternative flight plans.

[6] Ermo Wei and Drew Wicke and Sean Luke, «Hierarchical Approaches for Reinforcement Learning in Parameterized Action Space», arXiv:1810.09656v1 [cs.LG] 23 Oct 2018

[7] https://www.researchgate.net/publication/333077832_Multi-Pass_Q-Networks_for_Deep_Reinforcement_Learning_with_Parameterised_Action_Spaces