Proposal for research topics

Topic # 1:

Autonomous unmanned surface vehicle a modular deep learning approach:

Abstract: The research of collaborative robots is diverging into the various categories such as the artificial intelligence, robot hardware development, realization of Autonomous Unmanned Surface Vessels (AUSV) and drones. As these researches make progress, many researchers have started to make their focus on the internal design of the robots context awareness, which is partially inspired by the rapid growth of technology. In the past, robots were confined to the manufacturing factories and used as welding and parts-assembly in automobiles and electronic devices. In such a well-defined context, challenges regarding the perception and the adaptation to the environment were considered as low priority challenges. Nowadays, the desired functions of robots have changed, and the trend is to use robots in hostile environments where the stability of the surrounding conditions and the connectivity is limited. AUSV has a wide field of application in both military and civil domain, they will allow to execute critical missions without endangering the human life. As one application of robotics in hostile environment, AUSV require collaborative capabilities to achieve a rescue mission in a disaster area, search survivors, or do marine border patrol. Recent literature [1-6] proposes solutions to support AUSV on missions such as: Area search, target detection and tracking, formations, rendezvous, escort. However, most of proposed AUSV was designed to operate in an already known environment and are not designed to adapt themselves to the new changes in the context. The strong coupling between the perception, strategy, action, and hardware makes the adaptability of these robots hard to achieve [7-9]. That limits the applicability of the existing approaches to support missions on hostile environment. We designed a robot brain with modular deep learning approach. Our goal was to have a robust behaviour against noise, because in environments with a high risk of degradation, making the best use of the accessible surrounding resources to replace defective ones is crucial. We proposed also a low constrained deep reinforcement strategy to allow AUSV navigate and avoid obstacles. We developed also a maritime 3D simulator, to validate our approach before prototyping. Until now we were able to validate our approach throw simulation, and ensure that our model can be generalized to an unknown environments. Further work must be done to prototype an a RC Boat, and test it in real environment, also we want build a mesh network where each AUSV serves as a network node and, to allow AUSV operate effectively over extreme connectivity conditions.

References:

[1] Manley, Justin E. "Development of the autonomous surface craft" ACES"." OCEANS'97. MTS/IEEE Conference Proceedings. Vol. 2. IEEE, 1997.

[2] Dunbabin, Matthew, Alistair Grinham, and James Udy. "An autonomous surface vehicle for water quality monitoring." Australasian Conference on Robotics and Automation (ACRA). 2009.

[3] Leedekerken, Jacques C., Maurice F. Fallon, and John J. Leonard. "Mapping complex marine environments with autonomous surface craft." Experimental Robotics. Springer Berlin Heidelberg, 2014.

[4] Nakatani, Takeshi, et al. "ASV MAINAMI for AUV monitoring and its sea trial." Autonomous Underwater Vehicles (AUV), 2016 IEEE/OES. IEEE, 2016.

[5] Hyakudome, Tadahiro, et al. "Development of prototype autonomous surface vehicle." Techno-Ocean (Techno-Ocean). IEEE, 2016.

[6] Peng, Yan, et al. "Development of the USV 'JingHai-I'and sea trials in the Southern Yellow Sea." Ocean Engineering 131 (2017): 186- 196.

[7] Pfeiffer, Mark, et al. "From perception to decision: A data-driven approach to end-to-end motion planning for autonomous ground robots." Robotics and Automation (ICRA), 2017 IEEE International Conference on. IEEE, 2017.

[8] Tai, Lei, and Ming Liu. "Deep-learning in Mobile Robotics-from Perception to Control Systems: A Survey on Why and Why not." arXiv preprint arXiv:1612.07139 (2016).

[9] Bojarski, Mariusz, et al. "End to end learning for self-driving cars." arXiv preprint arXiv:1604.07316 (2016).

Topic # 2: **Smart Data**

Building anontology for collaborative environment in Cloud Computing and big data by using Dynamic Data Sensitivity Access Control in big data environment like Hadoop Platform.

In general, this is an approach that allows data to become intelligent (Example: a Word file is generally accessible by click; but if it becomes intelligent we have to go through identity tests to be able to use it).

Topic # 3:

Use of drones and robots for territorial security:

In the case of an event in the city (football match, musical concert, festival, etc.), as well as in airports, train stations, etc., heterogeneous robots (drones, watchdog robot , etc.) collaborate with each other in order to have a common decision, and to ensure a level and an automatic security strategy able to replace the security agents.

Topic # 4: **eHealth**

Decision support system in medical specialties based on Artificial Intelligence to serve remote areas: case of cerebral vascular accidents.

Topic # 5:

Placement of virtual machines in a Cloud based on methaheuristic algorithms for energy optimization.