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EDITORIAL

Robotics Research Growth in Latin America: Topical Collection on LARS 2020

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This editorial draws a small note on the importance of robotics research growth worldwide and more specifically in Latin America (LA), with its main studied topics, coming up with research results that have been published in the Topical Collection on LARS 2020. The topical collection is dedicated to publishing the best articles that were presented at the scientific robotics events that happened in the region, named the Latin America Robotics Symposium (LARS), the Brazilian Robotics Symposium (SBR), and the Workshop of Robotics in Education (WRE). The main goal of these events is to foster robotics in all countries of Latin America and to extend it worldwide. The main contributions introduced here corroborate with the community goal of making Robotics a top 10 research area. Robotics research in Latin America is mostly dedicated to driving academic studies to solve industry and other applications such as agriculture, mostly using drones and ground vehicles. Besides, basic research on robotics design and construction is also found in Latin American universities and research centers, aiming construction of robots and the development of algorithms devised for applications in the civil and military fields, as for monitoring applications of the environment, frontiers, and the sea. As well, onboard intelligence is also researched, including swarm intelligence, and robotics contests, with several teams from LA participating and winning world competitions.

We notice that the event was held online due to the Covid-19 pandemic, being the first time realized in this way. It was a challenge to keep all activities. In the end, the community got it running and published roughly 70 papers, overall. The 2020 Latin America Robotics Symposium was a worldwide event that completed 17 years of existence in 2020, being the largest robotics event in the LA region and it happened together with the Brazilian Robotics Symposium and the Workshop of Robotics in Education. Coined as LARS-SBR-WRE 2020, they were forums dedicated to disseminating new discoveries in Robotics, bringing together researchers from all over Latin America, and worldwide. In the 2020 edition, the event was jointly promoted by the Brazilian Computer Society - SBC and IEEE CS-RA Chapter – Northeast Brazil. It was organized by the team of the Natalnet Associate Labs (http://www.natalnet.br/) of Federal University of Rio Grande do Norte (Natal, Brazil) with proceedings published online by IEEE Xplore (https://ieeexplore.ieee.\discretionary-org/xpl/conhome/9306854/proceeding).

Regarding the process followed on this topical collection, a set of the best conference papers was initially selected based on its reviewing process. Conference authors of these papers were invited to extend and/or modify their manuscripts in relation to the published versions of the conference and to further submit them to the Journal of Intelligent & Robotic Systems. An in-depth peer review was then provided under the coordination of Guest Editors. Each submission was treated as a new one, using the journal rules that are different from those of the original Symposium. To this end, we believe that we have high-quality papers that push up the state of the art in their robotics topics, worldwide. Papers with new, added content are prioritized and it is not allowed for any accepted paper to present more than 30% of overlap to the original conference published version. The final manuscripts are high-quality articles that comprise the best results, covering a broad range of robotics research fields.

Therefore, this topical collection of JINT presents state of the art on works from theory to methodologies and applications in Robotics. The eight published papers cover

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several research topics. The first four topics include the matching of cross-Domain data with cooperative training of networks, trajectory planning for hybrid unmanned aerial underwater vehicles, visual predictive control for navigation, and social robot embodiment for child musical education. Interestingly, the remaining four papers' topic covers the use of deep reinforcement learning as a useful tool for tasks such as the learning of humanoid robot behaviors, learning the push recovery behaviors in humanoid walking, mapless 3D navigation, and visual semantic navigation. Particularities of these works are presented in the following.

An application of deep convolutional neural networks is the studied topic in the first paper, in which a triplet network has been successfully applied to underwater robotics. Authors enhance the advantages of siamese and triplet networks that have obtained great traction in intra-domain matching, but it is not trivial to directly use in cross-domain problems. Thus, a new method is proposed using a set of triplet networks focused on underwater robotics in order to perform cross-domain matching and ranking. Based on this new approach, matching on acoustic and segmented aerial images is performed with the goal of supporting an AUV localization algorithm. Results are presented in the paper showing accuracy and recall in comparison to the state-of-the-art.

The next topic is trajectory planning for a hybrid unmanned aerial underwater vehicle (UAUV) based on smooth media transition. Hybrid UAUV are known as robots that can fly and dive into the water and they need different levels of mechanical adaptation. Authors initially show that most of the literature is yet concentrated on the physical design aspects, with practical problems still appearing in the construction. Just recently, some low-level control strategies have started to be developed and implemented, with just a little research done in the context of high-level intelligence for real-world interaction. Thus, in the paper, the authors deal with a high-level approach to trajectory planning that allows collision avoidance. Results on algorithms for smooth transitions from aerial to aquatic media are also shown. The classic rapidly-exploring random tree is one of the proposed algorithms to be used. It is able to deal with obstacles, complex nonlinear dynamics, uncertainties modeling, and disturbances caused by external factors. The authors tested with a particular model named HyDrone, which is a hybrid vehicle with high underwater performance. In simulated experiments, the robot is commanded to perform different media movements.

In the next paper, deep reinforcement learning (DRL) is used for visual semantic navigation with memory for mobile robots in indoor ambient. Actually, this is the most studied topic in this TC. It has been observed in four of the published articles, showing that this topic is of great interest to the Latin American robotics community. In this particular work, navigation is mainly explored in the context of social robotic agents in complex and uncertain indoor environments (home and office). The search for specific target objects is usually a required activity in this kind of application. So, the work aims to propose an architectural model for visual semantic navigation, with memory. The model is based on recent advances observed in convolutional neural networks and in graph neural networks. The visual semantic navigation architectural model named GCN-MLP is extended with memory mechanisms (GCN-GRU and GCN-LSTM), that are recurrent neural networks. At the same time, the model exposes the robotic agent to navigation experiences in order to learn navigation policies. Quantitatively and qualitatively evaluations of the model were done showing that the models enhanced with memory converged earlier and had a better performance. They successfully terminated episodes and have had more efficient path trajectories, with a lower decrease in performance when exposed to challenges, presenting a more exploratory behavior. The work demonstrates that, from analyzed differences between GRU and LSTM, the GRU performed similarly to LSTM in most cases.

Another worked problem in this TC is autonomous navigation among static obstacles. However, at this time, with the proposal of a classical visual predictive control (VPC) scheme adapted to it. The authors of this paper discuss several issues that still limit the use of VPC in this kind of problem, and then they focus on some of them. The need for precise prediction models to improve task realization and the need for a long prediction horizon are discussed. The second is required to perform long-range displacements and guarantee stability, however, resulting in high computational cost and difficulty of implementation. Another issue is the possibility of evolution due to unexpected events (e.g., detection of new obstacles), leading to an iterative optimization approach, which brings the formulation of non-convex problems and therefore makes difficult the resolution. The VPC proposed in the article deals with the above issues, based on a more accurate prediction model that relies on an exact method for integration. Constraints are defined and the problems are modeled and solved for dealing with actuator saturation, avoidance of obstacles during the trajectory following, and keeping stability. They extend the classical VPC approach using two methods. One that allows the relaxation of constraints on the input data to reduce the computational burden of the control cycle. Another method adequately refines the optimized trajectory avoiding local minima whereas the optimization problem evolves. They

evaluate and compare their approach to the traditional VPC configurations and the results show that it runs much faster than classical configurations.

In the next paper, DRL appears again. A double critic deep reinforcement learning algorithm is devised for mapless 3D navigation, applied to UAV. Basically, the article proposes this novel DRL-based algorithm for 3D mapless navigation of the UAV. The authors use a very simple learning system approach that is based only upon a few sparse range data from a distance sensor to train a learning agent, instead of using image-based sensing approaches. They try two state-of-art double critics DRL models. The first is the twin delayed deep deterministic policy gradient (TD3) and the second is the soft actor-critic (SAC). Both approaches are managed to outperform the approach based on the deep deterministic policy gradient (DDPG) technique and also the BUG2 algorithm. In the end, the authors conclude that a new DRL structure has been devised, which is based on recurrent neural networks (RNN). It has better performance than the current structures used to perform mapless navigation of mobile robots. Thus, the DRL approaches based on double-critic with Recurrent Neural Networks (RNNs) are better suited to perform mapless navigation and obstacle avoidance for UAV.

In the field of robotics in education, a comparison of social robot embodiment for child musical education is presented next in the topical collection. The research focus is the comparison of two social robot models running the same human-robot interaction (HRI) applications. The targeted public is children aged 9-11, and the objective is to study the underlying design choices that are favored by the target audience on planned and executed tasks. The guitar tuner basically has two main functionalities, one for the tuning process and another for performance evaluation. The NAO and Zenbo robots were used for both tasks, and the work included 20 children that were assessed by their perceived robot embodiment preferences. These preferences are in relation to robot shape, robot motion, displays, and emotional expressions. The perceived usability aspects were also annotated. Due to the pandemic, evaluation has been done using an experimental remote protocol that collected feedback from the users online. The results supported the performing of quantitative and qualitative evaluations of the HRI application. The perceived differences among the robot embodiment features are highlighted and a recommendation is provided for robot embodiment design for children. Also, a discussion on the aspects related to the social distancing context and the learning based on this case study with the protocol limitations is presented at the end.

Finally and back to the last (DRL) approach, deep reinforcement learning is used once again, for learning humanoid robot behaviors. The RoboCup 3D soccer simulation league is the scenario for this work. This league is a robot soccer competition that uses a realistic simulator with implemented autonomous robotic agents in the humanoid shape. This kind of simulator constitutes a pretty interesting test bed for robotics and AI. Nowadays, many teams in this league have been motivated for using DRL, mainly after that it has been proven to be effective in continuous control tasks. Thus, the focus is the application of DRL for learning basic motion skills and coming up with more complex humanoid robot behaviors. Tasks such as completing a racing as fast as possible and dribbling against a single opponent are demonstrated. The approach basically uses a kind of hierarchical controller with a model-free policy that learns to interact with a model-based walking algorithm. DRL algorithms are used next by the humanoid agent in order to learn how to perform those behaviors. The learned dribble policy is evaluated in the article, using the Soccer 3D environment, which is simulated. A comparison of the simulated results in comparison with a hand-coded behavior used by a real robotic team shows that the DRL agent wins.

As guest editors, we wish to emphasize the support of the IEEE Latin American Robotics Council (https://ewh.ieee.org/reg/9/robotica/), which has as its main goal to organize annual regional and national Latin American robotics competitions and symposia with the support of national groups in LA. The council promotes the programming of these events, defines the basis for the competitions, and interacts with local volunteers who finally develop the activities themselves. The Latin American Robotics Council is sponsored by the Robotics and Automation Society RAS belonging to IEEE through national professional and student chapters in the region. We would like to express our best feelings to the reviewers that have used their precious time for reading the several articles and giving their valuable suggestions to improve the paper's quality. Not less important, our many thanks to the several authors mainly for their own efforts in submitting a greatly improved version of their conference paper and also for addressing all of the changes that were suggested by the reviewers. This has moved up, for sure, their paper quality to fit the standards of JINT. Actually, we came up with a topical collection that ranges from traditional to AI techniques, mainly the ones using DRL, which we expect will be of general interest to the readers of the journal. For sure, the Latin American robotics community is proud of the results achieved by their researchers. We wish to offer special thanks to Marie Veth Chua, our Journal's Editorial Office assistant in the name of all the Springer staff, which have worked hard for making the publication of this topical collection a reality. Finally, special thanks to Prof. Kimon Valavanis, our outstanding Editor in Chief, for the support given on this topical collection.

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