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[APPLIED RESEARCH INTERESTS]

- Interactive learning: imitation/feedback/reward shaping, curriculum/transfer learning, affect feedback *
- Mobile robotics: reinforcement learning for control, sim2real, structural & controller design optimization *
- * Vision: target tracking, visual localization, augmented reality

[SELECTED WORK EXPERIENCE]

Facebook: research engineer

February 2021 present

World-Lock Quality: developing a scalable modular infrastructure for collecting data and computing metrics to quantify the effectiveness of World-Lock Rendering, and the accuracy of various sensor calibrations, for the Orion family of Augmented Reality glasses.

Element AI: research scientist; Robotics Program lead

March 2017 December 2020

- RL for industrial process simulations: developed a Python RL interface extending the Alpyne API for AnyLogic simulations, supporting learner-centric control and multiple agents; demonstrated significant gains from learned policy using Multi-Agent Reinforcement Learning (MARL) over heuristic for dispatching trucks within an open pit-mine simulation
- RL-assisted design: implemented and enhanced the sample efficiency for a vehicle design method, which jointly optimizes behavior and design, by leveraging the Soft Actor-Critic deep reinforcement learning algorithm
- Learning to "drive" with applied RL: worked on confidential collaborative client project: co-developed gym environment for a black-box dynamics vehicle simulator, and applied the open-source library Ray+Tune+RLLib, on AWS SageMaker cluster, to learn efficient & robust "driving" policies, so as to quantify performance on various tasks
- * 3D active mesh anomaly detection: co-developed system for collecting RGBD frames using a robot arm to cover a manufactured target object, and performing 3D reconstruction and detection of visual+structural anomalies with respect to reference CAD
- * Unsupervised visual anomaly detection: co-developed system for localizing anomalies on natural objects (e.g. apples), by integrating pre-trained instance segmentation, object pose regression, visual embedding, and density estimation components
- * Physical adversarial textures for fooling visual tracking: supervised a research intern and co-developed a method to robustly fool visual trackers into losing track of their target and locking onto inconspicuous-looking textured posters

McGill University: lead engineer - software and systems at the Mobile Robotics Lab

February 2016 - May 2017

- * Ported & enhanced Aqua swimming robot's real-time control software/OS/hardware
- Expanded driver support for new devices (IMU, uOLED display, USB3 camera, ...) into Aqua swimming robot's real-time control software and high-level ROS infrastructures
- Led teams of roboticists during multiple robot pool trials for research and evaluation purposes, under roles of primary developer, deployment specialist, and general manager

[SELECTED (REFEREED) CONFERENCE PUBLICATIONS]

- R. Wiyatno and A. Xu. Physical Adversarial Textures that Fool VIsual Object Tracking, in CVF/IEEE International Conference on Computer Vision (ICCV '19), Seoul, South Korea, 2019.
- A. Xu and G. Dudek. Maintaining Efficient Collaboration with Trust-Seeking Robots, in Proc. of the IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS'16) (finalist for the IROS KROS Best Paper Award on Cognitive Robotics), pp. 3312-3319, Daejeon, South Korea, 2016.

- D. Meger, J. Gamboa, A. Xu, P. Giguère, and G. Dudek. <u>Learning Legged Swimming Gaits from Experience</u>, in *Proc. of the IEEE International Conference on Robotics and Automation (ICRA'15)* (finalist for the Best Conference Paper Award), pp. 2332-2338, Seattle, USA, 2015.
- ♦ A. Xu and G. Dudek. <u>OPTIMo: Online Probabilistic Trust Inference Model for Asymmetric Human-Robot Collaborations</u>, in *Proc. of the ACM/IEEE International Conference on Human-Robot Interaction (HRI'15)*, pp. 221-228, Portland, USA, 2015.
- M. Doniec, A. Xu, and D. Rus. Robust Real-Time High Definition Underwater Video Streaming with AquaOptical II, in *Proc. of the IEEE International Conference on Robotics and Automation (ICRA '13)*, pp. 5117-5124, Karlsruhe, Germany, 2013.
- F. Shkurti, A. Xu, M. Meghjani, J. Gamboa, Y. Girdhar, P. Giguère, B. Dey, J. Li, A. Kalmbach, C. Prahacs, K. Turgeon, I. Rekleitis, and G. Dudek. <u>Multi-Domain Monitoring of Marine Environments using a Heterogeneous Robot Team</u>, in *Proc. of the IEEE/RSJ International Conference on Intelligent Robots and System (IROS '12*), pp. 1747-1753, Vilamoura, Portugal, 2012.
- G. Dudek, J. Sattar, and A. Xu. <u>A Visual Language for Robot Control and Programming: A Human-Interface Study</u>, in *Proc. of the IEEE International Conference on Robotics and Automation (ICRA '07)*, pp. 2507-2513, Roma, Italy, 2007.

[EDUCATION]

McGill University, Montréal, Québec, Canada. Ph.D. in School of Computer Science Thesis: Efficient Collaboration with Trust-Seeking Robots

Supervisor: Professor Gregory Dudek

CGPA: 4.00 (out of 4.00)

McGill University, Montréal, Québec, Canada. Bachelor of Computer Engineering Minor in Software Engineering CGPA: **4.00** (out of 4.00) Great Distinction 2004 – 2008 (degree granted in May 2008)

(degree granted in

February 2017)

2008 - 2017

[RESEARCH COMMUNITY INVOLVEMENT]

- Program co-chair for CRV 2018 and CRV 2019
- Reviewer for ICRA, IROS, RSS, RA-L, HRI, CoRL, CRV, ICCV, IJRR, AURO, ...
- Developer of the ueye cam ROS package for IDS uEye cameras

[COMMUNICATION]

- Fluent in spoken and written English
- Adequate spoken French
- Adequate spoken Chinese Mandarin

[ROBOTICS AND SYSTEM DESIGN KNOWLEDGE]

- Proficient with Bayesian and statistical machine learning techniques, including Probabilistic Graphical Modeling, supervised regression, unsupervised clustering, and reinforcement learning methods
- Extensive knowledge of classical vision and robot perception algorithms, including color & edge processing, Hough transform, Iterative Closest Point, 2D image features (SIFT/SURF/...), etc.
- Extensive hands-on experience in designing, conducting, and managing robotics field experiments as well as controlled studies with human participants
- Familiar with core robotics algorithms for localization, SLAM, planning, and control
- Familiar with optimization-based algorithm design, such as using linear programming, mixed-integer programming, and gradient-based / gradient-free optimization methods
- Familiar with control-theoretic methods, including proportional-integral-derivative feedback design & tuning, trajectory optimization, etc.

[SOFTWARE DEVELOPMENT SKILLS]

- Fluent in Python, C++, C, MATLAB, HTML & JavaScript & CSS
- Extensive programming experience in 16+ years of academic and industrial research, producing 200,000+ lines of (Linux/cross-platform) code in 50+ projects
- Extensive experience with development toolchains/environments such as CMake, GNU/Linux build tools, Jupyter Notebook & Lab, VS Code
- Extensive experience with middlewares, frameworks, and libraries, including PyTorch, Tensorflow/Keras, ROS, Gazebo, OpenCV, Open3D, Ray+Tune+RLLib, Boost, Qt
- Experience with virtualization and remote control tools, including Docker, VNC, screen

[HARDWARE AND EMBEDDED SYSTEMS EXPERIENCE]

- Extensive working experience (software development, field deployment, electronics integration, platform maintenance) with:
- Jaco2 and Gen3 manipulators by Kinova (www.kinovarobotics.com)
- the Aqua family of amphibious robots by McGill University & Independent Robotics (www.aquarobot.net)
- the Marine Autonomous Robotic Explorer (MARE) robotic surface vessel by McGill University
- the Kingfisher unmanned surface vessel by Clearpath Robotics (www.clearpathrobotics.com/kingfisher)
- o the Unicorn UAV by Lockheed Martin Procerus Technologies (www.lockheedmartin.com/procerus)
- o the Pelican quadrotor by Ascending Technologies (<u>www.asctec.de</u>)
- the AR.Drone and Bebop lines of quadrotors by Parrot Technologies (<u>ardrone.parrot.com</u>)
- o the Tello quadrotor by DJI / Ryze Robotics (www.ryzerobotics.com/tello)
- the Husky wheeled robot by Clearpath Robotics (www.clearpathrobotics.com/husky)
- the SL-Commander planetary rover, instrumented by MDA (www.mdacorporation.com)
- the Kubota RTV rugged truck, instrumented by Clearpath Robotics (www.clearpathrobotics.com)
- Extensive operational and programming experience with Arduino-compatible microprocessor boards: Arduino Uno/Due/Yun; PJRC Teensy, ESP8266 & ESP32, etc.
- ♦ Programming, configuration, and signal debugging experience with communication protocols, including UART/USART, SPI, I2C
- Extensive experience with electronics prototyping, including through-hole soldering, and breadboard & wire-wrap circuit designs