Marcelo Contreras Cabrera

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Education

University of Alberta — Edmonton, Canada
M.Sc. Mechanical Engineering — *May 2024 - Present*

- Research topic: "Reliable autonomous navigation"
- NODE Lab graduate research assistant, advised by Prof. Ehsan Hashemi

University of Alberta — Edmonton, Canada
Visiting undergraduate student — *Jan. 2023 - Apr. 2023*

- Research centered-program in dynamic visual odometry with an annexed paper, published in IEEE ITSC 2023
- Funded by Canadian government through the ELAP Scholarship

Universidad de Ingenieria y Tecnologia — Lima, Peru
B.Sc. Mechatronics Engineering — *Mar. 2019 - Dec. 2023*

- Bachelor's Thesis: "Fuzzy-SSVEPformer: Classification of visual evoked potentials with Neuro-Fuzzy transformer"
- Graduated among the Top 10% of the Program
- Coursework: Robotics, computer vision, non-linear control

Colegio Champagnat — Lima, Peru
High school — *Mar. 2017 - Dec. 2018*

- International Baccalaureate Diploma: Score 38/45

Experience

Research assistant — Lima, Peru
Universidad de Ingenieria y Tecnologia, BCI Group — *Aug. 2022 – present*

- Investigated the noise robustness of Neuro-Fuzzy Type 2 block integrated into a Transformer Neural Network for EEG SSVEP classification. Achieved an accuracy improvement of 4% across different datasets
- Designed an efficient learning scheme with Point-process sampling which can reduce up to 50% training time in neural networks for EEG classification without accuracy drop.

Intern — Edmonton, Canada
Networked Optimization, Diagnosis, and Estimation (NODE) Lab — *Jan. 2023 – Apr. 2024*

- Implemented the robust visual odometry algorithm's front end (OpenCV for feature extraction, PyTorch for dynamic instance filtering) and back end (g2o for graph optimization).
- Trained and tested a cooperative deep learning solution of instance segmentation (YOLACT) and object detection (YOLOv5) to filter dynamic instances with driving data collected from the surroundings of UofA.
- Led a team of 6 CS undergrad students to design a 3D object detector as part of their Deep Learning course

Control engineer — Lima, Peru
Vultur Robotics — *Feb. 2022 – Apr. 2023*

- Worked on a control algorithm for a 6 DoF robotic arm in Arduino Portenta H6 (ARM Cortex M7 & M5) board.
- Implemented a PID control algorithm for DC motors with I2C command sending for the STM32 platform.
- Designed a payload publisher via TCP/Ethernet from a Linux terminal with ROS to a microcontroller.

Projects

Unified autonomous navigation pipeline for Turtlebot 3 [code] | *ROS 1, DL, CV* — Mar. 2023 – Jul. 2023

- Integrated perception, localization and planning in a single pipeline to get a unified navigation ROS node for Turtlebot 3 adaptable to changing environments
- Designed a twofold map generation that fuses a static map from ORB-SLAM 3 and the projection of RGB-D images with YOLOv5 to detect moving people

Efficient FPGA multiplier in low-pass FIR Filter [code] | *VHDL, Vivado* — Jun. 2021 – Jul. 2021

- Implemented Wallace and Booth algorithms (4, 8, and 16-bit multiplication) for FIR filtering in FPGA Basys 3 by VHDL and Vivado

- Analyzed the impact of optimized multiplication policies on resource use and temperature in Basys 3

CanSat challenge competition [page] | *Arduino, Perception* Apr. 2021 – Jul. 2021

- Mission: Gather photos and videos of illegal mining and tree harvesting at Peruvian rain forest by a launched CanSat with a camera on its base.
- Implemented an OV7670 camera module for taking photos with an Arduino Uno as platform
- The live transmission of images was displayed in a serial port reader at 115200 bauds with a resolution of 160 x 120 pxs.

Professional service

Reviewer for several conferences

- IEEE Intelligent Transportation Systems Conference (ITSC)

Workshop organizer in confereces

- European Conference on Computer Vision (ECCV)

Skills & Accomplishments

Languages: English (proficient), Spanish (native)
Technical: Python, C/C++, ROS 1, Git, MATLAB
Libraries: Docker, PyTorch, Eigen, g2o, GTSAM, OpenCV
Award: UofA Recruitment Scholarship May/Spring 2024 (5000 CAD)
Grant: ELAP Scholarship 2023

Publications

[1] M. Contreras, A. Jain, N. P. Bhatt, A. Banerjee, and E. Hashemi. "A survey on 3D object detection in real time for autonomous driving". In: *Frontiers in Robotics and AI* 11 (Mar. 2024). DOI: 10.3389/frobt.2024.1212070. URL: https://doi.org/10.3389/frobt.2024.1212070.

[2] M. Contreras, N. P. Bhatt, and E. Hashemi. "A Stereo Visual Odometry Framework with Augmented Perception for Dynamic Urban Environments". In: *2023 IEEE 26th International Conference on Intelligent Transportation Systems (ITSC)*. 2023, pp. 4094–4099. DOI: 10.1109/ITSC57777.2023.10421981.

[3] M. Contreras, N. P. Bhatt, and E. Hashemi. "DynaNav-SVO: Dynamic Stereo Visual Odometry With Semantic-Aware Perception for Autonomous Navigation". In: *IEEE Transactions on Intelligent Vehicles* (2024), pp. 1–12. DOI: 10.1109/TIV.2024.3414653.

[4] C. Flores, M. Contreras, I. Macedo, and J. Andreu-Perez. "Transfer Learning with Active Sampling for Rapid Training and Calibration in BCI-P300 Across Health States and Multi-centre Data". In: *IEEE Transactions on Neural Systems and Rehabilitation Engineering* (2024), pp. 1–1. DOI: 10.1109/TNSRE.2024.3420960.