Victor Sebastian Martinez Perez

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EDUCATION

Instituto Tecnologico y de Estudios Superiores de Monterrey *August 2017 – June 2023* **Monterrey, NL**
Bachelor of Science in Digital Systems and Robotics Engineering (Research and Innovation Modality) ***Academic Excellence***
Space Robotics Summer Program *July 2019 – August 2019* **Berlin, DE**

WORK EXPERIENCE

ZF Group Intern (VantTec Self-Driving Car Project) *July 2022 – September 2023* **Monterrey, NL**

Steering and Braking System: designed steering and braking system boards, programmed FreeRTOS tasks for stepper motor control, CAN communications and CAN encoder frame parsing. Enabled control via Xbox controller or desired angle inputs. Simple HIL tests done to ensure correct functioning of the modules: in-lab encoder-stepper testing and then manually steering the wheel to debug firmware.

***Vehicle Mathematical Modelling*:** research-oriented development and characterization of vehicle dynamics based on a bicycle model. Conducted experiments in a parking lot to determine the rolling resistance and the propulsion forces of the car induced by a 255-step digital potentiometer embedded in a PCB module connected to the vehicle motor controller. A VectorNav VN-300 was employed to measure vehicle speed and acceleration profiles against different step inputs on straight-line tests. Initial validation was done in simulations, with Rviz.

***Longitudinal and Lateral Control*:** implemented lateral and longitudinal control schemes in real life for the golf-cart shuttle. The lateral control employs the Stanley guidance law, while longitudinal (velocity) control utilizes PID, ASMC, or AITSMC designed controllers. These controllers were initially developed in ROS2 simulations and later fine-tuned in real-world scenarios. Used custom-built controller library. Model characterization and controllers' design required fast implementation and were completed during August 2023 in a span of four weeks.

Navigation: performed waypoint navigation in a parking lot based on NED-reference frame goal positions obtained from VectorNav VN-300 GPS measurements and started integration with an AMCL-based localization system for in-Campus navigation.

RESEARCH EXPERIENCE

Undergraduate Robotics Researcher *January 2021 – September 2023* **Monterrey, NL**
Research assistant at Robotics Laboratory at Tecnologico de Monterrey with Dr. Herman Castañeda Cuevas (hermancc@tec.mx).

Robust Control Design: designed 6-DOF sliding-mode-based controllers in Simulink, for an Unmanned Underwater Vehicle (UUV).

Controller Library: developed a C++ controller library for use in various vehicles. This library offers PID and SMC-based control laws, which can be used independently or as supplementary control signals for feedback linearization controllers. It also includes base class definitions for marine and car-like vehicles, used to create specific controllers for real-world vehicles. Also, the library provides definitions for Line-Of-Sight and Stanley controllers, employed as guidance laws. This library has undergone real-world testing in a car and in simulations for a boat and submarine.

***Trajectory Generation*:** developed a simple C++ motion planning library with RRT* sample-based planner (from OMPL) used for trajectory generation based on sigmoid-curve jerk profiles to obtain smooth references for an UUV (tested in simulations) on 2D maps.

Conference Publications

Adaptive Non-Singular Terminal Sliding Mode Tracking Control of an UUV Against Disturbances
2022 – IFAC Conference on Control Applications in Marine Systems, Robotics and Vehicles – V. Sebastian Martinez-Perez – Andres E. Sanchez-Calvo – Alejandro Gonzalez-Garcia – Herman Castañeda

Adaptive Integral Terminal Sliding Mode Guidance and Control for an UUV Under Perturbations
2022 – AMCA Congreso Nacional de Control Automatico – Andres E. Sanchez-Calvo – V. Sebastian Martinez-Perez – Alejandro Gonzalez-Garcia – Herman Castañeda

LEADERSHIP AND PROJECTS

VantTec: *Student group from ITESM focused on research and development of Autonomous Vehicles.* **Monterrey, NL**
President, Vicepresident *August 2020 – July 2022*
Self-Driving Car Project Leader *May 2022 – September 2023*
Led a 25-person team in equipping an electric golf cart shuttle for Tec de Monterrey's 80th anniversary with autonomous features, including control, localization on-campus, and collaborated with ZF Group. Managed mechanics, electronics/embedded, and localization teams.
Software developer *August 2019 – September 2023*

Collision Avoidance for a Boat: developed a collision avoidance method based on Velocity Obstacles in ROS simulations, with RViz. The Velocity Obstacle method computes a safe set of velocities that the boat can choose to avoid collisions with static obstacles. The Computational Geometry Algorithms Library played a vital role in creating geometric representations and operations for polygons, facilitating collision avoidance calculations and visualization in RViz.

3D Object Position Estimation using LiDAR + ZED for a Boat: employed a previously developed LiDAR-based buoy detection method, classifying them based on their shape. However, this method had limitations in real life, misidentifying objects with similar dimensions as buoys. To enhance accuracy, these detections were verified against a Yolo-ZED method, which uses a pre-trained YoloV3 network with GPU support through a ROS package that estimates distances using the ZED's depth map, which was used to calculate the 3D position of objects.

***Simulation Environment for RoboSub and RoboBoat competitions*:** created a Gazebo simulator for RoboNation online competitions during the pandemic, to validate challenge solutions and simplifying future development. It employs dynamic models for USV and UUV, simulating their state (pose and velocity), features 3D models for both, includes simulated sensors (LiDAR and stereo camera for the boat, two cameras for the submarine), offers a basic lake scenario, and integrates custom props for each competition.

AWARDS AND HONORS

Academic Excellence *Students with grades greater than 95/100 and within the top 5% of their career.* *June 2023*
Premio Romulo Garza 2020 *National award for the best undergraduate research project at Tecnologico de Monterrey between 2018-2020.*
RoboBoat / RoboSub *First and third place overall respectively (2020). 6 awards granted (RoboBoat 2021)*
Academic Talent Scholarship *70% academic excellence tuition scholarship at Tecnologico de Monterrey* *2017*