IVAN ERIC DÍAZ ARENAS

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Date of birth: 25.02.1999
Place of birth: Monterrey, Nuevo Leon, Mexico

SUMMARY Mechatronics engineer with a strong interest on the mathematical foundations behind machine learning algorithms within the robotics field. International working experience at a german robotics startup and research experience on an autonomous vehicles team.

WORK EXPERIENCE

Evocortex GmbH - Machine Learning Department - Nuremberg, Germany - April 2022 to April 2024

Undergraduate thesis (score 1,3 in European Credit Transfer):
- Title: *Object Detection System Implementation for an Autonomous Mobile Robot using a Synthetic 2D-RGB Data Generation Approach.*
- Problem (dataset shift): training with purely synthetic data (computer rendered images) significantly reduces the object detection rate in real world industrial scenarios (initial tests obtained a mean average precision lower than 50%).
- Contribution: following the domain randomization approach, the performance of neural networks during the detection task achieved an mAP slightly over 60% on real world scenarios.

Working student (thesis work continuation):
- Problem: object detection contained key undesirable False Positives and False Negatives that could not be reduced via hyperparameters manual tuning.
- Task 1: internal structure analysis of a YOLOv5-based and Detection Transformers (DeTr) based neural networks to implement saliency maps that could explain the network's focus point on the image during the detection task, following both a gradient-based-method algorithm and a non invasive one.
- Task 2: pipeline implementation for synthetic data generation using deep diffuse models based on Stable Diffusion (SD) v1.5 and ControlNet neural network (NN) structure.

RESEARCH EXPERIENCE (AT THE UNIVERSITY)

VantTec - Unmanned Underwater Vehicle (UUV) project - Monterrey, Mexico - July 2021 to present day

Computer vision department [work in progress]:
- Problem: diffuse models do not consider the mathematical underwater image formation model (attenuation coefficients) when rendering images in underwater applications.
  - Contribution: ControlNet-based NN structure specialized in underwater applications for controlling diffuse models during the image renderization.
- Review of novel view synthesis using 3D Gaussian Splats and Neural Radiance Fields for underwater applications.

Control engineering department [work in progress]:
- Review of the control systems implemented on an outdated version of the UUV and update of the dynamic model aiming a proposal for a model predictive control.
- Underwater gazebo robotics simulation for the UUV aimed for testing the control systems. It runs the UUV's ROS application and contains plugins for thrusters, sonar simulation, camera's visual distortions, among others.

Published papers - Education field - Monterrey, Mexico - 2022 and 2024
- [Conference paper] 2022 IEEE Global Engineering Education Conference (EDUCON): *A Digital Twin implementation for Mobile and collaborative robot scenarios for teaching robotics based on Robot Operating System.*
- [Article paper] 2024 Education Sciences: *Disciplinary Competencies Overview of the First Cohorts of Undergraduate Students in the Biotechnology Engineering Program under the Tec 21 Model*

EDUCATION (DOUBLE DEGREE PROGRAM)

University - Tecnológico de Monterrey - Monterrey, Mexico - 2018 to June 2024
B.S. Mechatronics Engineering with tuition scholarship *Mario J. Montemayor*

University - Hochschule für Technik und Wirtschaft des Saarlandes - Saarbrücken, Germany - 2021 to 2024
B.S. Mechatronik/Automatisierungstechnik

- **Language skills:** Spanish (mother tongue), English (TOEFL PBT 583, CEFR B2), German (Goethe B2), French B2 studies
- **Software skills:** Python, Pytorch, Robotic Operating System, Docker, Blender, Solidworks, Ubuntu, TIA Portal, Gazebo Robotics Simulator, Isaac Sim, OpenCV, Git, GIMP, Windows.