

Marthinus Johannes Nel

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EDUCATION

Northwestern University

M.S. in Robotics

Stellenbosch University

B.S. in Mechatronic Engineering

Evanston, IL, USA

Expected Graduation: December 2023

Stellenbosch, South Africa

Class of 2021

PROJECTS

Guide dog - Unitree Go1 Quadruped (ROS 2, C++, Python)

Winter 2022

- Developed voice recognition and control for Go1 in C++ and Python using picovoice with custom commands and a wake word
- Trained YOLOv7 on a custom dataset and deployed it on a Jetson Nano for object detection: mAP.0.5 80% mAP.0.5-0.95 60%
- Implemented Lidar graph-based SLAM and ICP odometry with RS-Helios-16P robosense lidar using Rtabmap package for autonomous navigation and dynamic obstacle avoidance in NAV2

Simultaneous Localization and Mapping (EKF SLAM) from Scratch

Winter 2022

- Programmed a feature-based EKF SLAM pipeline using C++ and ROS 2 for both simulation and real turtlebot3 robot
- Created a kinematics control and odometry library for differential drive robots
- Implemented a landmark detection algorithm using supervised learning and data association

Autonomous Quadrotor Design and Control

Winter 2022

- Implemented 3D spatial tracking using a Vive sensor for autonomous hovering with joystick control
- Developed a C-based software stack to interact with low-level code and achieve desired high-level behavior
- Programmed and fine-tuned a timing-critical PID control loop for improved quadrotor performance and stability.

7-DOF Robot Arm for Autonomous Air-hockey opponent

Fall 2022

- Led a team of 4 to develop a Python ROS 2 package for a Franka 7-DOF robot arm to autonomously play air-hockey
- Developed a puck trajectory prediction Python script to enable the robot arm to hit the puck
- Created a Python ROS 2 API wrapper to plan and execute trajectories through MoveIt2 with post plan processing
- Head of version control for the project repository

Computer Vision Pen grab challenge

Fall 2022

- Performed background subtraction and color thresholding with a RGBD camera to determine the 3D location of pen
- Coded a Pincher X100 4-DOF robot arm in Python to grab the pen through inverse kinematics

Thrust vector controlled scaled rocket

Feb - Dec 2021

- Invented, built, and tested a thrust vector controlled scaled rocket
- Implemented a PID controller and a state machine in C++ for autonomous active orientation control in-flight and recovery
- Formulated and constructed a custom flight controller PCB
- Designed the rocket body, thrust vector control mount and parachute deploy system in Inventor/Fusion360

PROFESSIONAL EXPERIENCE

CranioTech, Inc.

Stellenbosch, South Africa

Biomedical Engineering Intern

Dec 2020

- Executed viability tests on a 3D orthodontic surgery software for implant design
- Created 3D patient specific implants and preformed titanium 3D printing

(DOT) Seedmaster, Inc., (OMNiPOWER), Raven, Inc.

Regina, Canada

Test Engineering Intern

Jun 2019

- Collaborated with the assembly team to assemble an autonomous robotic farming platform
- Coordinated with a team of 6 to conduct uphill seeding field testing on the autonomous platform for data collection
- Resolved problems with regards to power loss to the wheels by locating faulty pressure relieve valves

Bronberg Dynamics (Pty), Ltd.

Pretoria, South Africa

Mechatronics Engineering Intern

Dec 2018

- Programmed a PID controller in C++ for turbine blade orientation at different wind speeds for rotation speed control
- Devised, constructed, and tested a low cost functional prototype single blade wind turbine for remote environments to improve electricity security
- Coordinated wind-tunnel experiments to ensure correct PID controller response

SKILLS

- **Programming:** Python, C++, C, Bash, R, Assembly Language
- **Robotics:** ROS 2/(ROS), Gazebo, MoveIt, Machine Learning, OpenCV, SLAM, Computer Vision, Control systems design, Embedded systems, PIC, ARM
- **Manufacturing:** Inventor, Fusion360, SolidWorks, Rapid Manufacturing, Machining, EAGLE, PCB Design, KiCAD, OnShape
- **Software:** Linux, Git, CMake, Unit Testing, Ardupilot, MATLAB