Marthinus Johannes Nel

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EDUCATION

Northwestern University   **Evanston, IL, USA**
MSc in Robotics   *Expected Graduation: December 2023*
Stellenbosch University   **Stellenbosch, South Africa**
BEng in Mechatronics and Automation Engineering   *Class of 2021*

PROFESSIONAL EXPERIENCE

Intuitive, Inc.   **Sunnyvale, CA, USA**
Systems Analyst (Robotics and Controls Engineer) Intern   *June-September 2023*
- Engineered algorithms to register 3D medical datasets used for navigation in surgical robotics applications
- Developed a modular evaluation pipeline for assessment of registration algorithm performance which included automated report generation to aid in results interpretation
- Designed a detailed synthetic data framework ensuring the generation of high fidelity data for use in the registration pipeline
- Developed an interactive Unity simulation environment for 3D registration with C++/C# data marshaling (.dll) for efficient algorithm performance
- Implemented a stereo depth estimation algorithm for use with endoscopic medical video
- Designed a Python-based evaluation pipeline to assess the performance of disparity algorithms using benchmark datasets

(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 single blade wind turbine for remote environments to improve electricity security
- Conducted wind-tunnel experiments to ensure correct PID controller response

PROJECTS

Guide dog - Unitree Go1 Quadruped (C++, Python, ROS 2)   *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 for autonomous navigation with NAV2 and Rtabmap

Simultaneous Localization and Mapping (EKF SLAM) from Scratch (C++, ROS 2)   *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 (C)   *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 timing-critical nested PID control loops for improved quadrotor performance and stability

7-DOF Robot Arm for Autonomous Air-hockey opponent (Python, ROS 2)   *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 (Git) for the project repository

Thrust vector controlled scaled rocket (C++)   *Feb - Dec 2021*
- Invented, built, and tested a thrust vector controlled scaled rocket with a custom flight controller PCB
- Implemented a PID controller and a state machine in C++ for autonomous active orientation control in-flight and recovery
- Designed the rocket body, thrust vector control mount and parachute deploy system in Inventor/Fusion360

SKILLS

- **Programming:** C++, C, Python, C#, Bash, R, Assembly Language, Ladder Logic, Structured text
- **Robotics:** ROS 2/ROS, Robot kinematics, Control systems design, Machine Learning, SLAM, Computer Vision, MoveIt, OpenCV, Embedded systems, PIC, ARM, NVIDIA single-board computers, PLC, Gazebo
- **Manufacturing:** Inventor/Fusion360/SolidWorks/OnShape, PCB Design, EAGLE/KiCAD, Machining
- **Software:** Linux, Git, CMake, Unit/Integration tests, Visual Studio, PX4/Ardupilot, MAVLink, MATLAB, Unity, Atlassian