UNIVERSITY OF CAPE TOWN

Department of Electrical Engineering

EEE4022F/S - Final Year Project

Graduate Attribute Tracking Form

Student name:	Kamryn Norton	DP Awarded? [Y/N]	**Y**
Student no:	NRTKAM001	Supervisor name:	Dr Paul Amayo
Date:	2 October 2023	Date:	**06/10/23**
Student signature:		Supervisor signature:	

GA 1: Problem Solving

Student Response:

The complex engineering problem which required solving was to localise a wheeled robot using LiDAR scans in unstructured environments. The problem is complex because it involves the novelty of localisation in environments that do not have many easily-identifiable features. To solve the problem, the existing methods for localisation and LiDAR data processing were assessed, adapted and implemented, while the adaptations were made with the natural environment in mind. So far, I used the open-source Point Cloud Library to pre-process the LiDAR scans and apply the Iterative closest point algorithm to localise on a correspondence map. The problem presented by this method is that the localisation took between 30-120 seconds to complete based on what order the data was processed in. To solve this problem, the open-source SegMatch algorithm implementation in C++ was investigated extensively, but the use of it was unsuccessful due to platform and compilation issues. Currently, SegMatch implementation in MATLAB is being investigated and it looks like a promising avenue to solve the localisation time issue, and have a reliable localisation in significantly less time.

Supervisor Response:

Student has identified and iterated over relevant data information and techniques that will enable meaningful exploration of the problem as stated above

GA 6: Professional and Technical Communication

Student Response:

So far, in the report, the literature review has been completed and proof-read by Dr Amayo. The feedback received was used to adapt the text, and improvements were made. I feel the literature review is an accurate representation of my ability to communicate technically and professionally and sets the scene for the rest of my report.

Supervisor Response:

Preliminary literature review has been written and reviewed

GA 4: Investigations, Experiments, and Data Analysis

Student Response:

So far, no experimentation has been done besides the investigation of the time it took for each algorithm to successfully localise. I have also implemented a verification step on the SegMatch algorithm to verify that the localisation is correct. The plan for data collection is to investigate metrics such as time to complete the localisation, the RMS Error associated with the localisation, the indication of accumulated drift error, and an analysis of the effect of drift error.

I also intend to use metrics to analyse the effectiveness of the pre-processing on the localisation algorithms - both the iterative closest point and the SegMatch, and also how, if so, the algorithms and processing pipeline could be improved.

Further investigation will also be done as to the detailed workings of each algorithm to provide insight into possible improvements.

Supervisor Response:

Experiments have been planned as stated

GA 8: Individual Working

Student Response:

I have worked effectively and timeously with this project as an individual. My ability to adapt to challenges such as the implementation of a C++ library taking too much time to debug was an indication of how I can effectively manage my time and be resourceful when it comes to challenging circumstances and having limited information. I used my own project management tools to manage the composition of my literature review, and plan to do the same to write the report on my investigation, to manage my time effectively once the implementation of my processing pipeline is complete.

Supervisor Response:

GA 9: Independent Learning Ability

Student Response:

My abilities to learn, adapt to difficult circumstances, learn in the absence of many resources and use my tenacity and learned problem-solving skills have been demonstrated by the way I have adapted the use of platforms for data processing and implementation. I am wholly satisfied with my ability to be self-motivated and time conscious when dealing with and delivering a project, the deadlines for the project, and my ability to create my own deadlines within the project to ensure my tasks are on track to completion. While I did need some support from my supervisor at times, I believe a redeeming factor for myself was in my ability to ask for help, or solve problems alternatively when help was not always available. I also completed my ethics clearance, as an indication that I am aware of the ethical implications of my project.

Supervisor Response:

Instructions:

Students must explain in this document what they **have already done** and what they **plan to do** to satisfy each Graduate Attribute. Descriptions of each GA is provided below. Supervisors may then respond to the student's plans and current progress, providing additional comments or advice as they see fit. If the student's progress is sufficient, they may indicate that DP is awarded.

GA 1: Problem Solving

Identify, formulate, analyse and solve complex engineering problems creatively and innovatively.

GA 4: Investigations, Experiments and Data Analysis

Demonstrate competence to plan and conduct investigations and experiments. The balance of investigation and experiment should be appropriate to the discipline. Research methodology to be applied in research or investigation where the student engages with selected knowledge in the research literature of the discipline. Note: An investigation differs from a design in that the objective is to produce knowledge and understanding of a phenomenon and a recommended course of action rather than specifying how an artefact could be produced.

GA 6: Professional and Technical Communication

Demonstrate competence to communicate effectively, both orally and in writing, with engineering audiences and the community at large. This course evaluates the long report component of this outcome at exit level. Material to be communicated is in an academic or simulated professional context. Audiences range from engineering peers, management and lay persons, using appropriate academic or professional discourse. Written reports (10 000 to 15 000 words plus tables, diagrams and appendices) should cover material at exit-level. Methods of providing information include the conventional methods of the discipline, for example engineering drawings, as well as subject-specific methods.

GA 8: Individual, Team and Multidisciplinary Working

Demonstrate competence to work effectively as an individual, in teams and in multidisciplinary environments. This course evaluates the **individual** working component of this learning outcome at exit level.

GA 9: Independent Learning Ability

Demonstrate competence to engage in independent learning through well developed learning skills. Operate independently in complex, ill-defined contexts requiring personal responsibility and initiative, accurately self-evaluate and take responsibility for learning requirements; be aware of social and ethical implications of applying knowledge in particular contexts.