**Research proposal thesis IEM**

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**Research title: Obstacle Avoidance using Mecanum Wheeled Vehicles Using Contraction**

Background information

Obstacle avoidance is a classical problem in robotics and many approaches have been proposed [3]. These methods are usually limited to semi static environments [8]. Online replanning or elastic-band methods deform locally the path and can therefore be applied for dynamic environments. However, they lose global convergence and have to be combined together with global path planning algorithms to create hybrid algorithms. Hybrid algorithms can switch between global path planning and local deformation [12]. In order to alleviate computational cost, recent work use customized circuitry on chips for faster global sampling and evaluation of all feasible paths [9].

**Keywords:** Obstacle avoidance, Stability.

Research goal and research output (e.g. design/deliverables)

Design a Hybrid Path Planning Algorithm using Contraction Theory and apply it to a Nexus Robot formation equipped with Lidar and Ultrasonic sensors.

All techniques used will be validated in simulation and on the Nexus robot.

Throughout the thesis we will show that the DS approach is robust in dynamic environments and has high adaptability

Deliverables:

* Simulation results & Analysis of results
* MATLAB code showcasing algorithm
* Python code showcasing algorithm for easy reusability in future projects

Business context (e.g. problem/innovation)

By business context we mean the factors that create the problem and give rise to the need for innovation.

This project’s results could be useful in tasks where human and robot are cooperating. The robot has to account for human movement and not come into collision with any static or moving obstacles.

This project’s results could be useful in the following applications:

* Autonomous wheelchairs in crowded areas
* Connected vehicles
* Commercial floor cleaning
* Drone inspection
* Industrial automation

Engineering context (technological aspects)

The goal is for a robot to move from point A to B continuously while avoiding obstacles.

We are constraint to using specific hardware, which is already available at the DTPA-lab, as well as a local library with assets that are provided by previous master students. These assets may be the low-level control systems for the Nexus robots.

For the software we use an open-source operating system, named ROS (Robotic Operating System). Its goal is to support code reuse in robotic research and development, which is also why we are going to use it. It provides easy testing and it is already implemented in Python and C++.

Another engineering tool we will use is the Dynamical System (DS). The dynamical system is one of the fundamental tools used by engineers to model a large variety of physical systems, from electrical to mechanical systems. DS provide an analytical description of the evolution of a system over time. Therefore, it can be used to predict a systems behavior, which allows correction of the system before a failure occurs.

References on next page (as taken from my Overleaf project)

