GEOREFERENCING OF ROBOTIC BEES TO AVOID COLLISIONS BETWEEN THEM

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ABSTRACT

Bees pollinate a third of everything we eat and play a vital role in sustaining the planet's ecosystems. But due to the deforestation, climate change, and many other reasons, the bees are dying. This can cause the amount of fruits and vegetables production to drop up to 50%, causing starving, high prices, and even wars. That's why we need to find a solution for this problem.

Bees fulfill an essential mission in the cycle of life, pollinate innumerable plants that serve as food for many species of animals, which in turn, serve as food for the human being. Due to modern practices, urbanization, the use of chemicals, insecticides, climate change and intensive farming, bees are dying.

2. PROBLEM

This would cause starving in animals and humans, food wars, and an environmental imbalance that would probably end much of life as how we know it, affecting both animals and plants

3. RELATED WORK

3.1 Australia leads the development of an algorithm to avoid RPAS collisions

As is logical, in the near future all unmanned aerial vehicles are going to need some form of avoiding collisions.
Using LiDar technology and its 360 x 360 degrees sensor, and the Hovermap algorithm, the drones would calculate the distance between them and the obstacles in real time, avoiding collisions with other devices or obstacles

3.2 Trajectory Planning and Collision Avoidance Algorithm for Mobile Robotics System

Therefore, an efficient collision avoidance and path following methodology is needed to develop an intelligent and effective autonomous mobile robot system. The proposed technique relies on the use of low-cost infrared sensors, and involves a reasonable level of calculations, so that it can be easily used in real-time control applications. The simulation setup is implemented on multiple scenarios to show the ability of the robot to follow a path, detect obstacles, and navigate around them to avoid collision.

3.3 Efficient algorithms for collision avoidance at intersections

We consider the problem of synthesising the least restrictive controller for collision avoidance of multiple vehicles at an intersection. The largest set of states for which there exists a control that avoids collisions is known as the maximal controlled invariant set. Exploiting results from the scheduling literature we prove that, for a general model of vehicle dynamics at an intersection, the problem of checking membership in the maximal controlled invariant set is NPhard. We then describe an algorithm that solves this problem approximately and with provable error bounds. The approximate solution is used to design a supervisor for collision avoidance whose complexity scales polynomially with the number of vehicles. The supervisor is based on a hybrid algorithm that employs a dynamic model of the vehicles and periodically solves a scheduling problem.

Algorithmic solution: Two problems P1 and P2 are equivalent, denoted P1 ' P2, if P1 $\propto$ P2 and P2 $\propto$ P1. Problem DEC(1|ri|Lmax, 0) has been shown to be NPcomplete by reduction of Knapsack [19]. It can be solved by enumerative algorithms that systematically test all the possible permutations of jobs. Unlike DEC(1|ri|Lmax, 0), DEC(1|ri, pi = 1|Lmax, 0) has an exact O(n 3)-time solution, reported in [12] and implemented in Algorithm 1. The solution of the decision problem only requires the binary answer, but Algorithm 1 returns a schedule T along with the binary answer. The information on the schedule is used in the following sections to design an approximate solution to Problem A. The algorithm starts by computing a set of forbidden regions, i.e., intervals Fi $\subset$ R during which no job can be started. Then, it schedules jobs by increasing deadline order, ensuring no job is started during a forbidden region.

3.4 Multi-Sensor Based Collision Avoidance Algorithm for Mobile Robot

Collision Avoidance (CA) systems have been used in wide range of different robotics areas and had extraordinary success in minimizing the risk of collisions. Collision avoidance systems are mostly applied in transportation systems such as aircraft traffic control, autonomous cars and underwater vehicles etc. Collision avoidance is a critical requirement in building mobile robot systems where they all featured some kind of obstacle detection techniques in order to avoid two or more objects from colliding (two mobile robots or one robot with an obstacle).

The main purpose of obstacle avoidance is to obtain a collision-free trajectory from the starting point to the target in monitoring environments. Obstacles can be divided into two types, static where the obstacle is predefined and has a fixed position and dynamic obstacle where the position is not pre-known and has uncertain motion patterns (moving objects).

Detecting dynamic obstacles is more demanding than detecting static obstacles since the dynamic has a changeable direction and requires a prediction of dynamic obstacle position at every time step in order to achieve the requirement of a time-critical trajectory planning.

REFERENCES

Reference sourced using ACM reference format. Read ACM guidelines in http://bit.ly/2pZnE5g

As an example, consider this two references:

1. Alison Benjamin. 2015. Why are bees important? You asked Google | Alison Benjamin. (June 2015). Retrieved February 25, 2018 from https://www.theguardian.com/commentisfree/2015/jun/17/why-are-bees-important
2. Tomás Lara Pérez, Tu Papu Pro, La avispa asesina se extiende imparable por España… | Guia natural y ecológica, and Duvan Gonzalez. 2016. ¿Qué pasaría si las abejas desaparecieran? (May 2016). Retrieved February 25, 2018 from https://noticias.eltiempo.es/que-pasaria-si-las-abejas-desaparecieran/
3. Anon. 2016. Australia leads the development of an algorithm to avoid RPAS collisions. (May 2016). Retrieved February 25, 2018 from http://www.acgdrone.com/512-sistema-para-evitar-colisiones-de-rpas/
4. Almarsi M. Marwah, Khaled M. Elleithy and Alajlan M. Abrar. Trajectory Planning and Collision Avoidance Algorithm for Mobile Robotics System. Retrieved February 25, 2018 from http://ieeexplore.ieee.org/document/7451174/
5. Alessandro Colombo. Efficient algorithms for collision avoidance at intersections. Retrieved February 25, 2018 from https://scripts.mit.edu/~ddv/publications/PaperHSCC5.pdf