

CS22510 Assignment

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The aim of this assignment was to build a program that creates occupancy grids from data gathered by a robot exploring its environment.

I designed a Grid class that represents a grid of cells. Class consists of two-dimensional array of cellIndexType.

Each cellIndexType in the array represents one cell on map and its value tells if there could be obstacle or is it free or not marked yet.

CellIndexType is an alias for int8_t. So the cell can have an 8-bit value that represents a probability of obstacle occurrence.

If it is not known if it is free or if there could be something in this cell then it has got value 0. If the cell is free then has got value -1. As number is bigger as probability of obstacle occurrence is bigger. If something was found by robot sensor then it is increased by 4. Surrounding cells of one that has been found by robot are increased by 1.

Cell struct represents a cell of grid and has got two parameters of cellIndexType that are X and Y of cell position.

Grid class constructor sets all values of array to 0 so it means that all cells are not marked yet.

ReadGridFromFiles function takes filenames, creates a vector of RobotReadings type and populate it with values read from files.

These RobotReadings objects can be used later by markCells function that takes one of these, calculates readings and mark cells. It checks if each readings is in range (smaller than 2.5 for the assignment) and if cell to mark is located in the grid. It also executes markSurroundingCells, that increases surroundings cells probability by 1, and executes markAsFreeCellsOnTheWay that mark all cells that are crossed by line from robot to found obstacle as free.

There is used a function called calculateObstaclePosition to get coordinates of found obstacle that are passed later to coordinateToCellIndex function that converts coordinates into cell index. Coordinates is a structure that consists of two double values: X and Y.

CalculateObstaclePosition function calculates angle between sensors (could

be any number of them but must be at the same spacing) and calculates coordinates of the obstacle.

Function that marks cells as free is called `markAsFreeCellsOnTheWay` and uses `findCellsOnTheWay` function that returns a vector of Cells to mark as free. It takes every X and Y axis that are borders of cells between robot and obstacle and checks in which place these axes are crossed by this line and then adds this cells to the vector.

`RobotReadings` structure consists of robot coordinates, its degree of rotation and a vector of sensor readings. Sensor readings are stored in vector of double type. There are two functions to read poses from file and two to read readings from file. Two populate vector of `RobotReadings` with coordinates and degrees from file and other two functions populate vector with readings passed by `istream`. Functions that take a file name try to open a file and pass it to the second function that needs `istream` as argument. They are overloaded to make it more flexible that poses and ranges could be read from file or from `istream`.

To create a graphical interface I used Allegro 5 library because is very simple and it is very suitable for such purposes as this assignment. `GuiMain.cpp` file creates new windows and draws each reading every 0.4 of second. Beige color squares are unmarked and white are marked as free. Grey and black means that something could be there. As darker color as the probability is higher.