1. Lab 1(c): ERTS Simulator

[Preliminary]

This part of the Laboratory Assignment 1 introduces the framework for developing navigation functions and uses the ERTS simulator.

2. Overview

You are to write three “dead reckoning” navigation functions to:

(a) Drive 30 m in a straight line and stop.

(b) Repeatedly drive a figure-8 pattern no greater than 30 m in its longest dimension.

(c) Repeatedly drive a “square” pattern no greater than 30 m in size.

Develop and demonstrate these navigation patterns using the simulator.

3. Background

Navigation

Navigation is implemented in a common framework that provides for communication, logging, and so forth. One such function is called a driver. A driver module contains three entries (or methods if you must) for initialization, iteration, and termination. Initialization and termination are trivial in this assignment.

A given navigation component, D, is a function mapping

\[ D: \text{control\_frame} \times \text{parameter} \rightarrow \text{control\_frame} \]

representing one iterative step in a system cycle. The parameter argument is typically used to specialize D. For example, it might contain the distance to be traversed by a straight-line maneuver. The control\_frame argument is the communication channel to the vehicle. A independent communication task periodically (at 20 Hz), transmits the “current” control frame to the vehicle. An underlying model assumption is that all tasks, complete their operations within this communication cycle (50ms). A driver is just one of this set of tasks.

Thus, a more accurate model of driver is

\[ D: \text{parameter} \rightarrow (\text{control\_frame} \rightarrow \text{control\_frame}) \]

D(p) produces a specialized “next-state” function.
Control Frames

A control frame is a “snapshot” of the whole system's state, including the dynamic vehicle status (e.g. speed, turning position, etc), sensor readings (e.g. GPS), and the driver's command (e.g. “make your speed 3.5 m/s”). The design model is that of synchronized state transitions. During each cycle each component instantaneously reads all its inputs from the current system state, computes next-state values, and instantaneously broadcasts those values to the surrounding system. There is no interaction between components during the cycle, only “between” cycles.

Simulator

The ERTS simulator emulates the communication protocol used in the vehicle, simulates its physical movement and some sensor readings, and maintains a graphical display of the vehicle's path. The simulator and navigation subsystems are connected in exactly the same way as connecting to the real vehicle (by IP and PORT numbers), and employ identical communication protocols.

4. Methods

Developing a Driver

1. get a copy of the ERTS driver framework.

2. At top level, run ./configure, then make to rebuild the framework.

3. Run doxygen to rebuild the code documentation. You will find the result in the docs/ subdirectory.

4. Look in README for how to add a driver and invoke it.

5. The src/drivers subdirectory contains templates for the three assigned maneuvers, and an example called rosetta. point your browser to file ./docs/html/index.html to navigate through the code.

6. Develop and install implementations of the assigned maneuvers. These are dead-reckoning (“blind”) maneuvers, so don't try anything fancy. You should log GPS readings, though, for later evaluation.

Using the simulator

NOTE: Until freezing issues with the Linux simulator are resolved, you may prefer to use the Windows version, if you have Windows. Retrieve it from the course home page. If you use the Linux version, you should occasionally check for revisions and update the sim binary provided in Simulation_Homework/
Indiana University Computer Science Department
Lab x: Lab Title

To turn on simulated GPS (optional), you need to load an `RDDF.txt` file in the simulator. Here is a small course for this purpose:

```
1, 39.200100, -86.500000, 1.5, 8
2, 39.200300, -86.500100, 1.5, 8
3, 39.200100, -86.500200, 1.5, 8
4, 39.200300, -86.500300, 1.5, 8
5, 39.200100, -86.500400, 1.5, 8
```

Technical Profile (assignment)

<table>
<thead>
<tr>
<th>Objective</th>
<th>Deliverable</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

5. References