SEM9060 Dissertation Project
Development of a Control System for a Skid-Steer Amphibious Off-Road Vehicle

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Project Objectives

- Develop a control system for a skid-steer amphibious vehicle:
  - Turn to heading, turn by angle, move forwards (speed control).
  - Additional objectives: GPS way-point navigation.
- Develop a simple two-dimensional simulator:
  - Simulate all control set, sensor data etc.
  - Loadable maps with dynamic surface types.

Scientific Objectives

- Can a vehicle such as an ARGO be automated, what complexity of control system is required?
- What level of accuracy can be expected from skid-steering system, and to what extent is a control system more or less accurate than a human?
- What effects do surface type have on the operation of the vehicle?
- Given observed characteristics of the vehicle (under both manual and automated control) is it possible to identify the surface type?

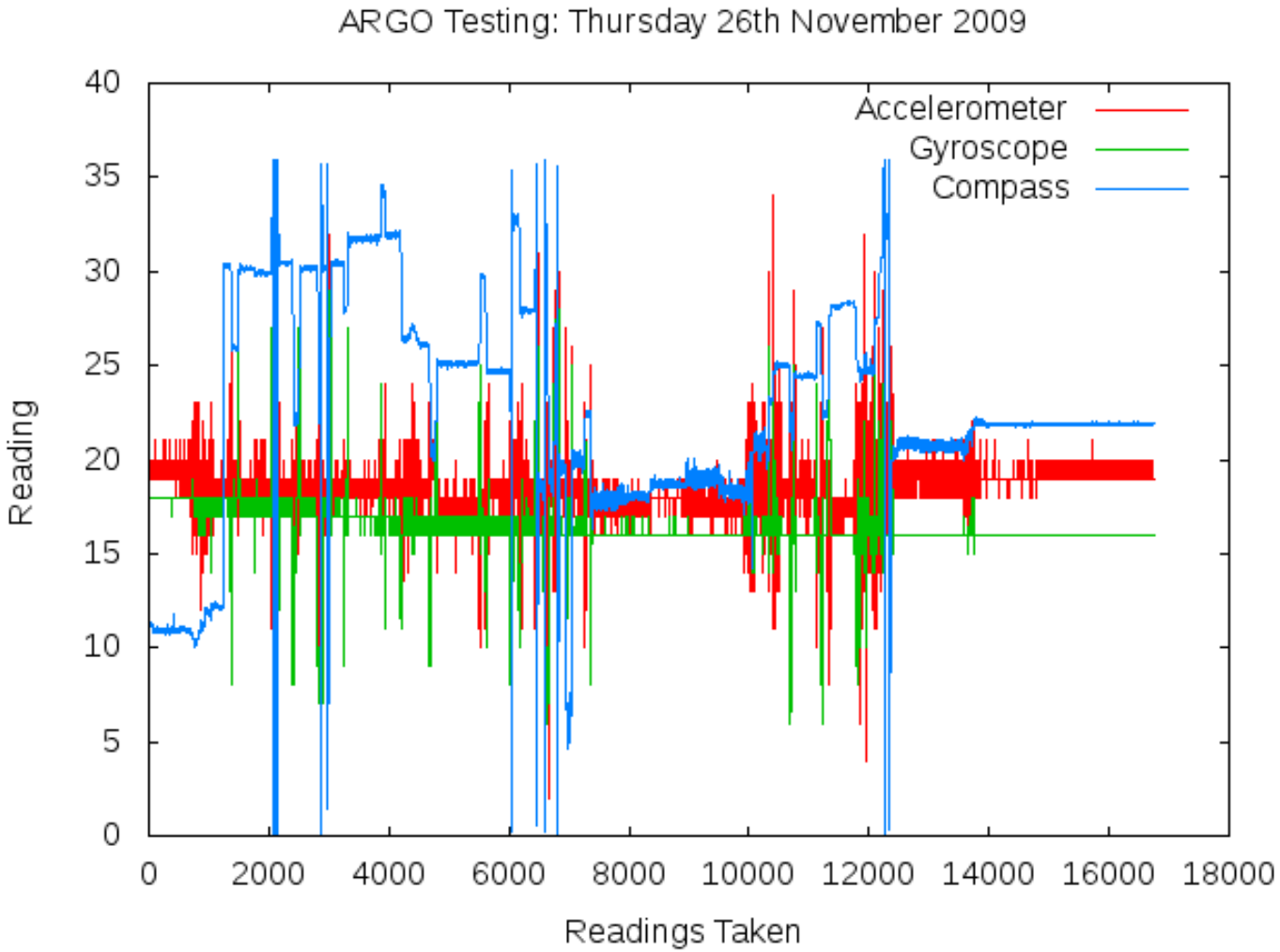
Development Methodology

- Agile methodology: SCRUM
- 5 iterations were anticipated.
  - Actually used 6 iterations.
- Currently in the end-game gathering results.

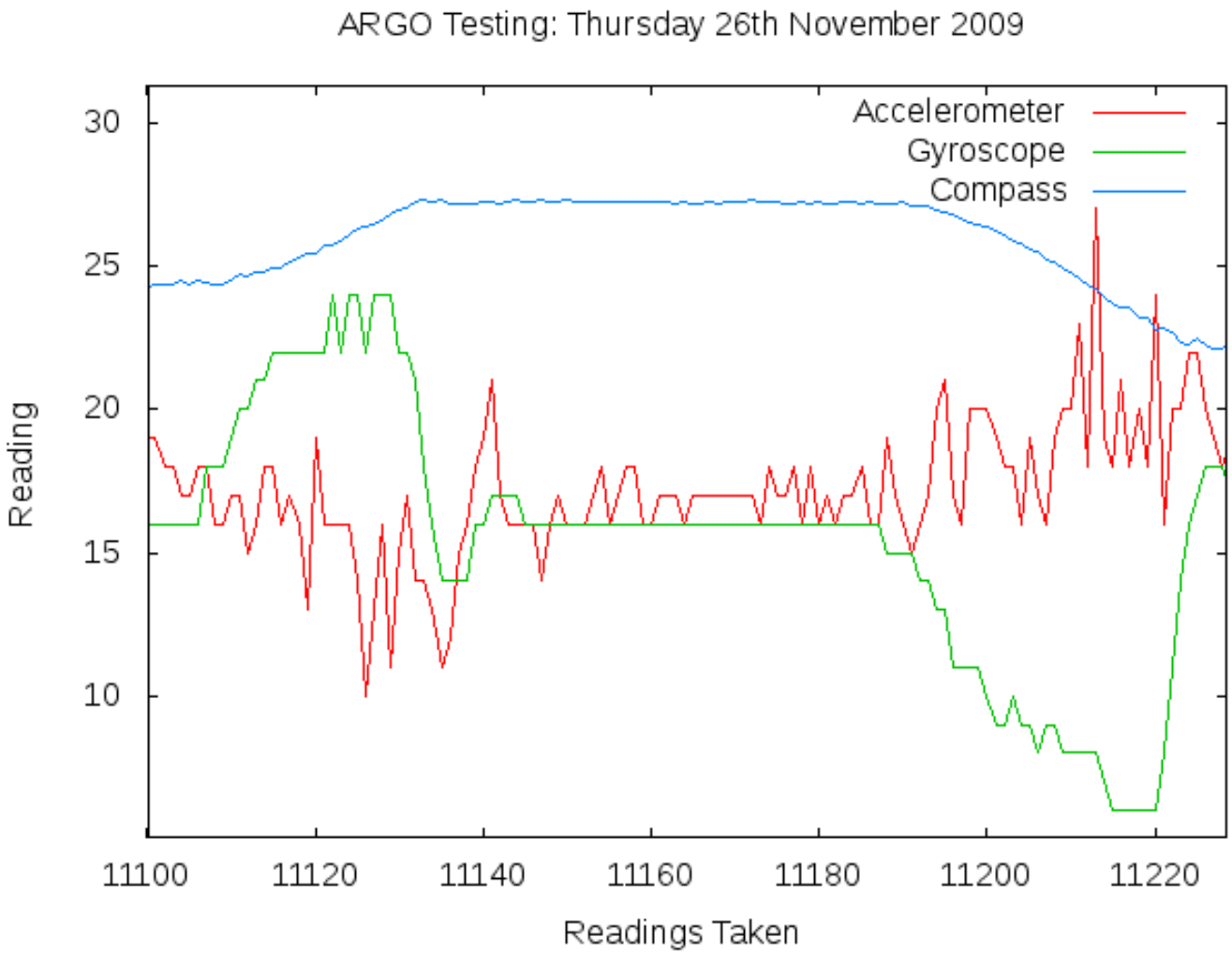
Pre-Game

- Four test runs, increasing data gathered.
- Initial ‘high-level design’ of simulator and control software.
- Spike work with hardware.

Test Results



Test Results



Game: Sprint 1 - 6

- Sprint 1: Development of simulator framework and early development of software to get sensor data: accelerometer, compass, gyroscope.
- Sprint 2: Control of steering and throttle on ARGO.
  - Faulty compass?
- Sprint 3: (Christmas) Work on dynamic surface types.
- Sprint 4: (Exam Period) Continued development of control system algorithms:
  - Tuning of the control system.
  - Angle wrap-around issues.
- Sprint 5: Realised need for controlling wheel rotations. Added sprint to deal with this.
- Sprint 6: GPS way-point navigation (sort of working, spirals...)

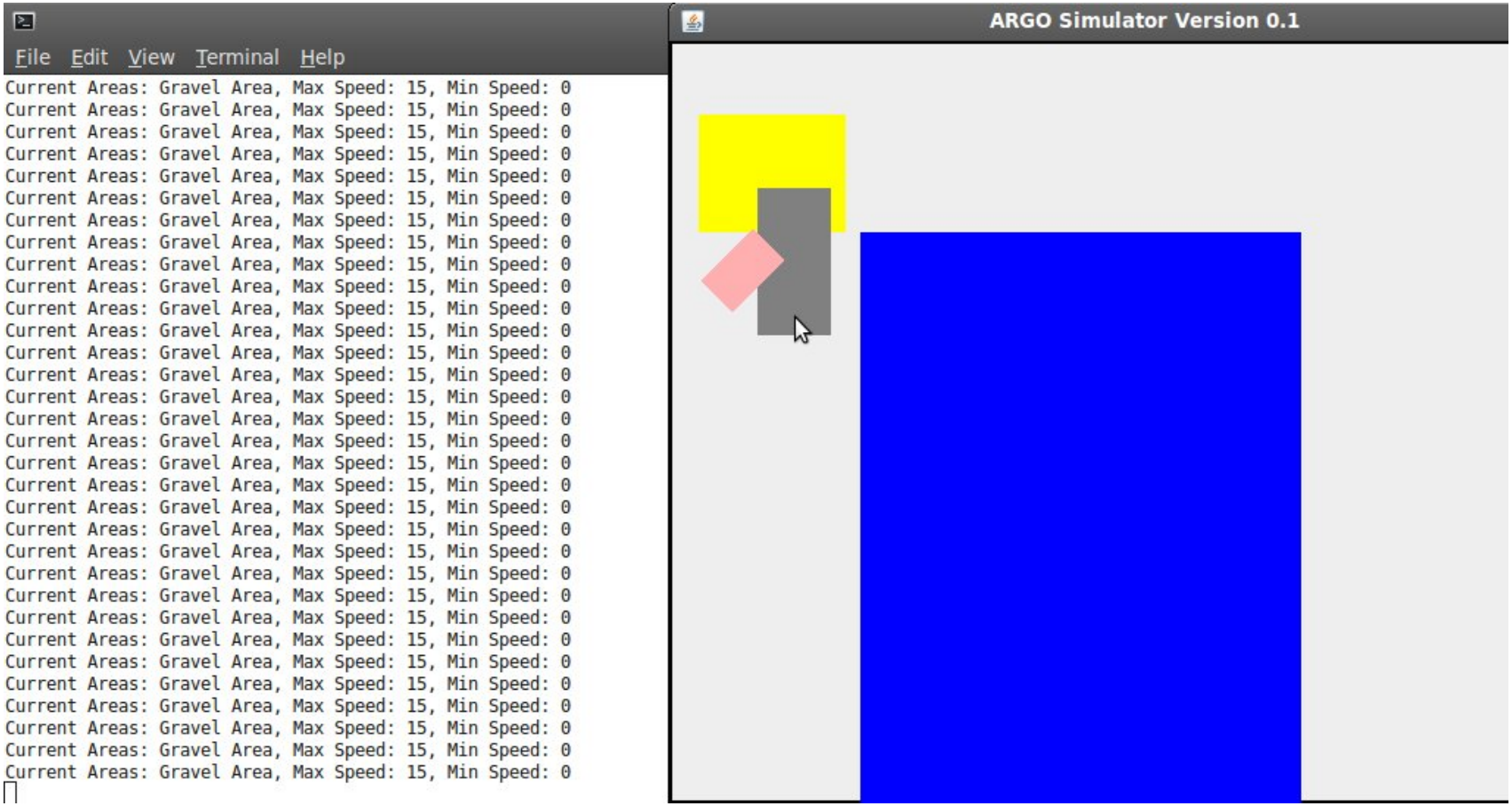
The Simulator - Map File Example

```
<world>

  <width>800</width>
  <height>600</height>
  <description>A sample world.</description>

  <area>
    <name>Aberystwyth Beach</name>
    <surface>surfaceTypes.Sand</surface>
    <coordinates>
      <x>20</x>
      <y>50</y>
    </coordinates>
    <dimensions>
      <width>100</width>
      <height>80</height>
    <dimensions>
   </area> ...
```

The Simulator - Surface Type Example

```
1  package surfaceTypes;
2  import java.awt.Color;
3  import uk.ac.aber.dcs.sem9060.api.*;
4
5  public class Gravel implements SurfaceType {
6
7    int currentSpeed = 0;
8
9    public void setSpeed(int currentSpeed) {
10         this.currentSpeed = currentSpeed - 2;
11   }
12
13   public int turnByAngle(int angle) {
14
15     if (angle >= -45 && angle <= 45)
16       return Angle.getTurnAngle(angle, 0, 2);
17
18     ...
```

The Simulator - Screenshot



Some video clips of the ARGO in Action!

What now?

- Basically have a working system, so now in the end-game...
- Would like to tune control system more to try and improve turn accuracy - thus improving GPS navigation too.
- Need to do more testing to gather more results for scientific analysis.
- Use the data from analysis to generate more accurate surface types for the simulator.
- Spend some more time thinking about the report!