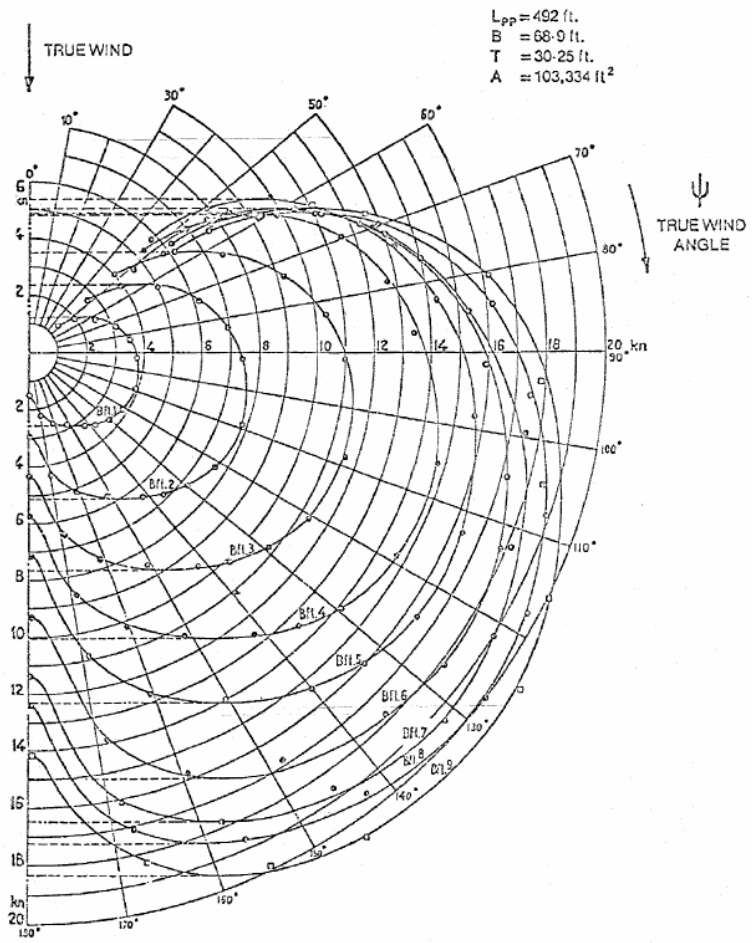
Project Overview

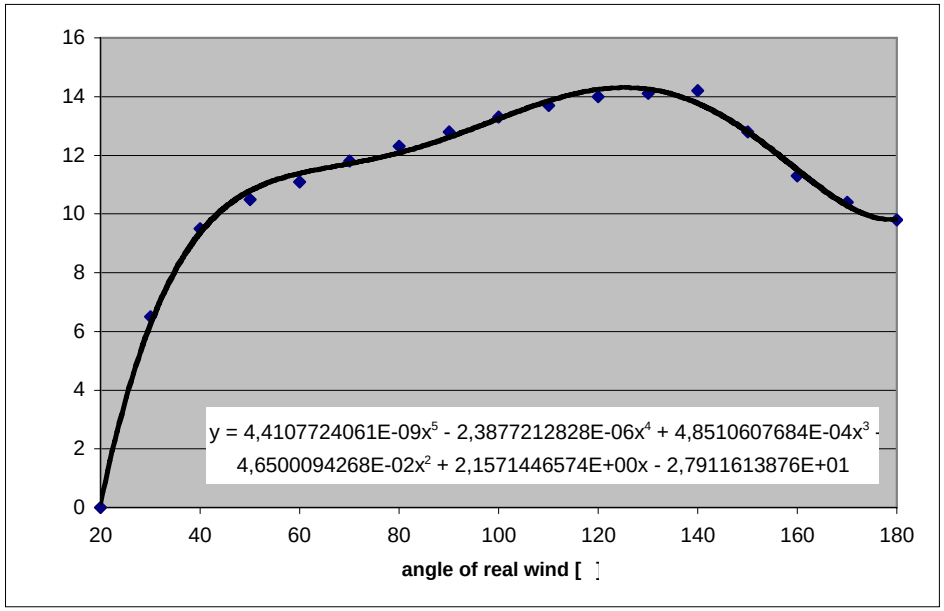
Project Structure

- Sensors & System Topology
- Navigation & Control Logics
- Simulation & Visualisation
- Radio & Power Concept
- Boat Construction

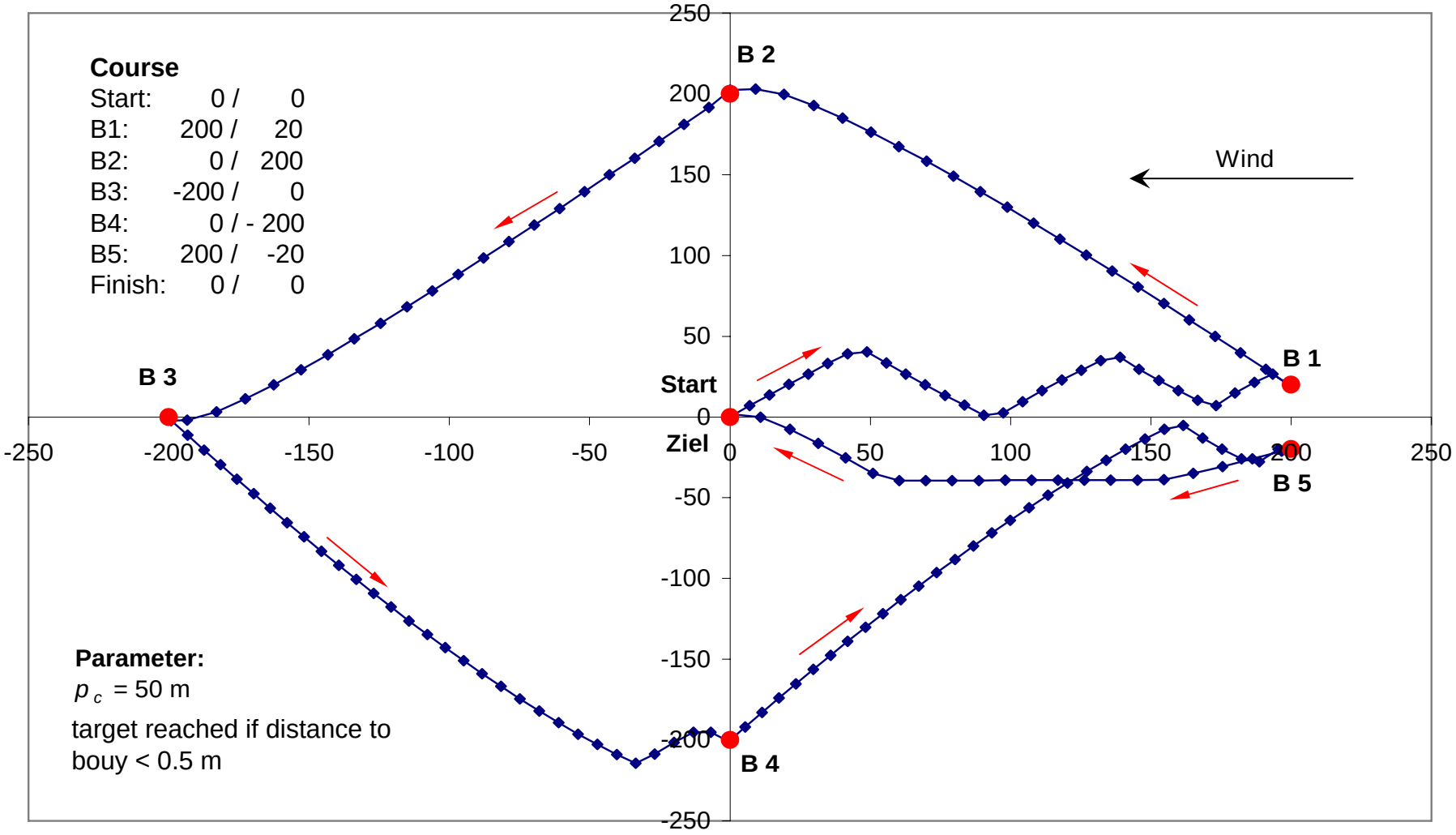
Weather Routing

Boat Polar Diagram





Example Route



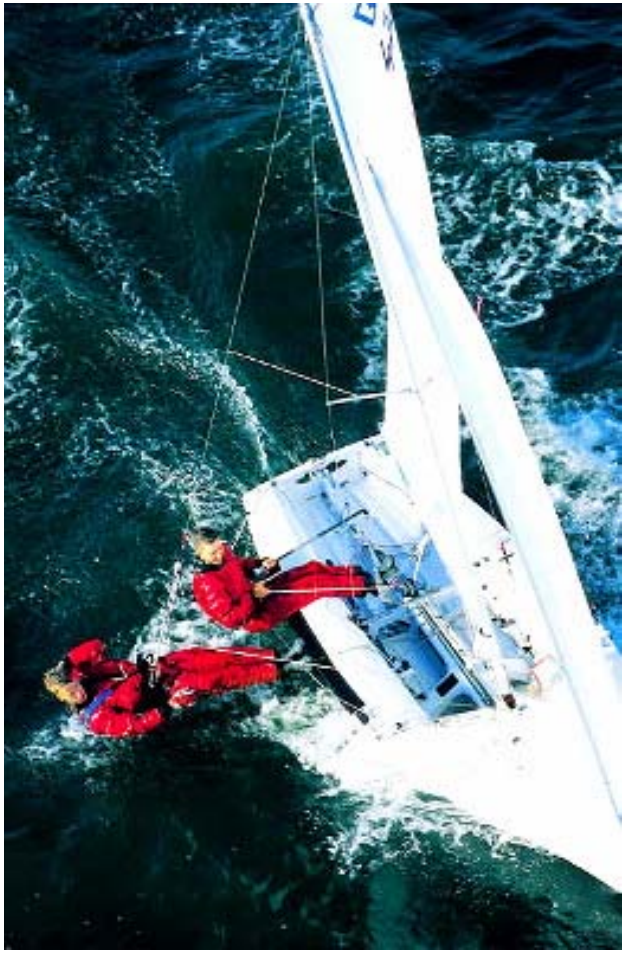
Control Algorithm

Overview

- Goal
  - sail in the direction given by the Navigator.
- Concrete Accomplishment
  - set rudder
  - set sails

Two Simple Control Circuits

- Rudder-Control-Circuit
  - Keep boat on the course given by the navigator.
  - Compensation of crabbing
- Sail-Control-Circuit
  - avoid capsize
  - flow in the sails



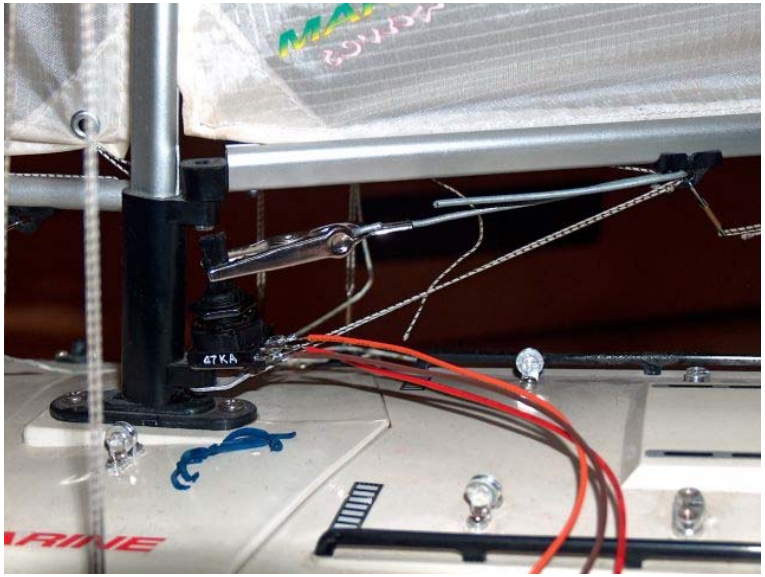
Control System Summary

- Implemented with Fuzzy Logic
- Two simple control circuits + a special rule for the jib:
  - sail courses at any wind
  - tack
  - jib
- Only 4 sensors needed:
  - compass
  - heeling
  - boom position
  - apparent wind direction

Sensorics & System Topology

Wind Direction

- Potentiometer



Boom Position

Wind Speed

- Anemometer
- Reed Contact

GPS

- Serial Output
- NMEA Protocol

Direction and Heeling

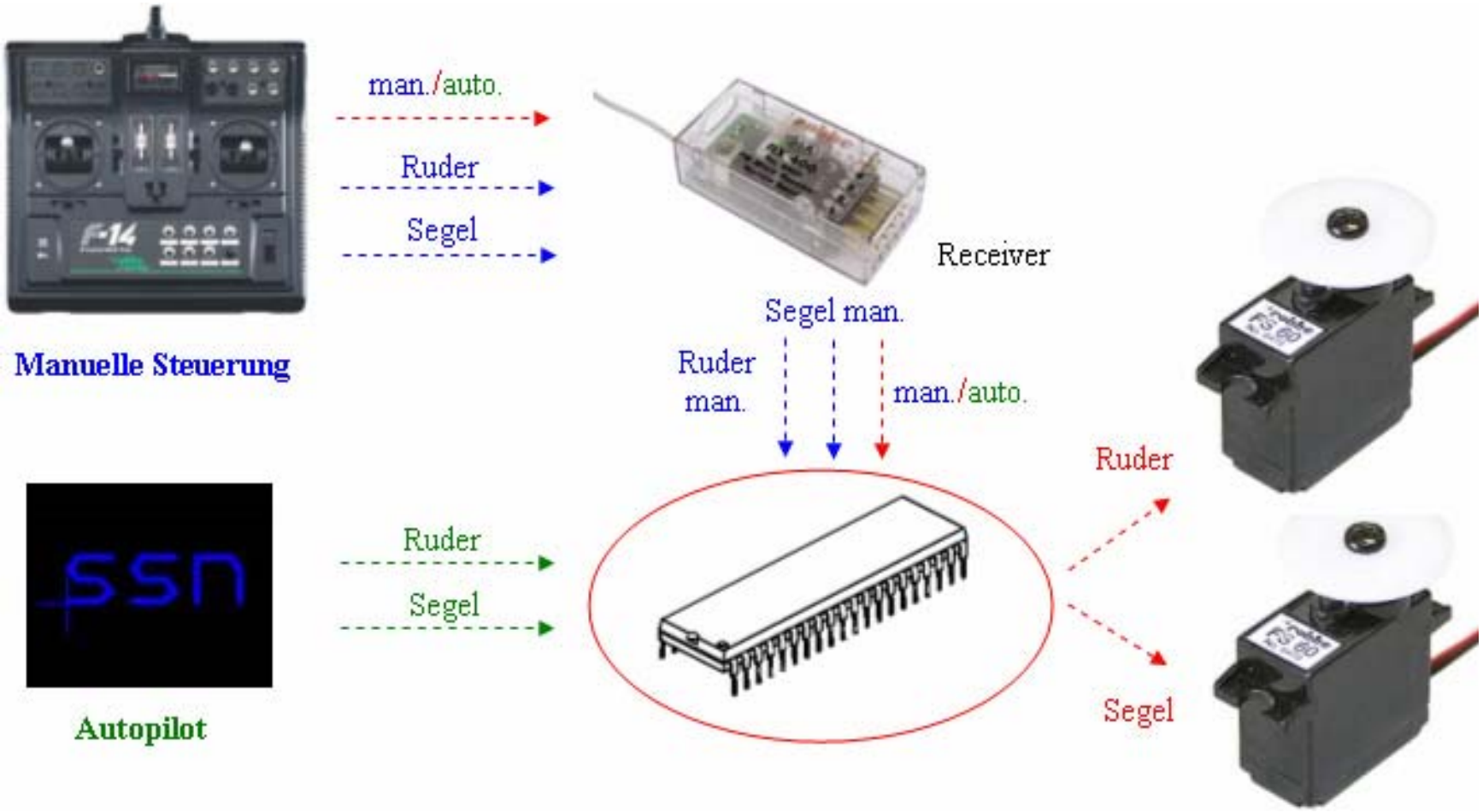
- Tilt Compensated
- Serial Output

Actuators

- sail winch
- rudder

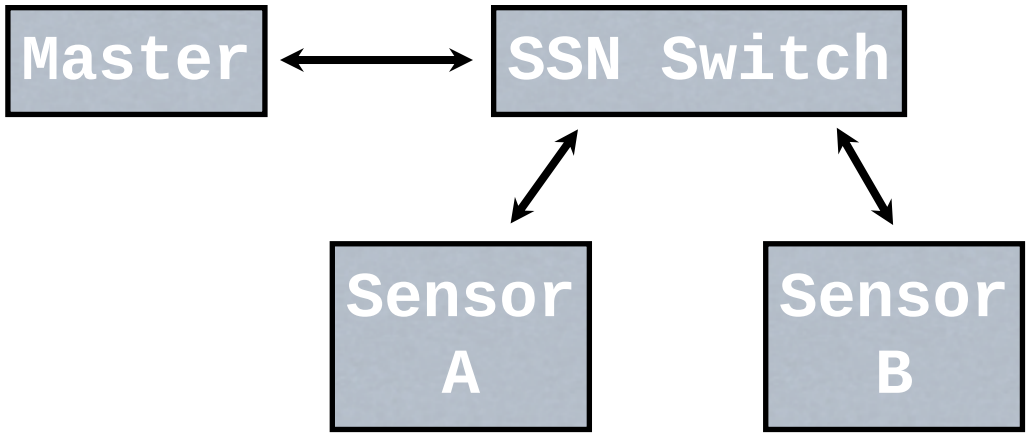
- Manual control has to be possible!

Autopilot / Manual Control

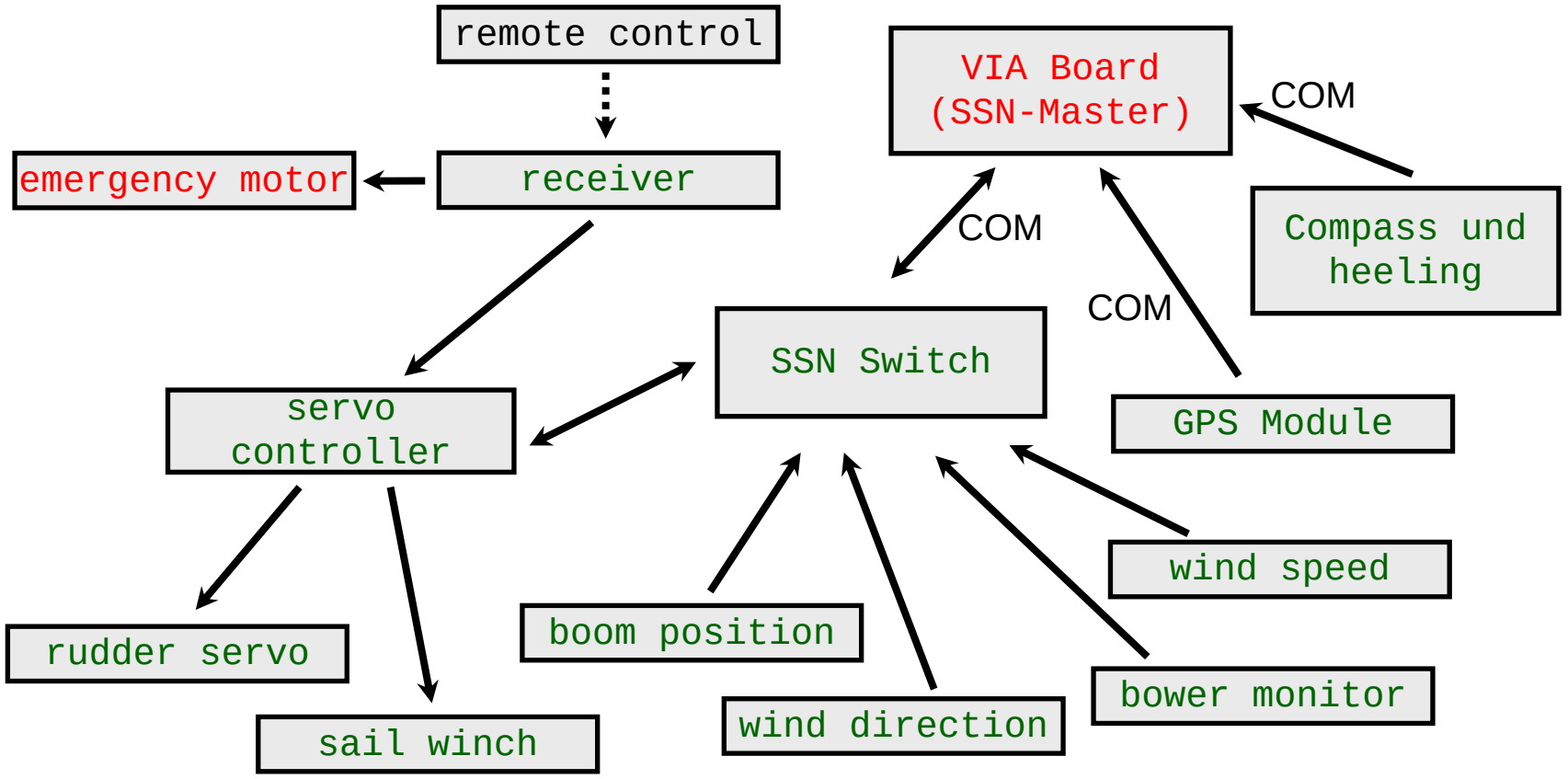


SSN - Simple Sensor Network

- Communication with Sensors/Actuators
- Based on RS232 Connections
- Easy Adressing



Overview


remote control
VIA Board
(SSN-Master)
COM
emergency motor
receiver
COM
Compass und
heeling
COM
SSN Switch
servo
controller
GPS Module
wind speed
rudder servo
boom position
bower monitor
wind direction
sail winch

Master

- VIA EP MII-6000E
- 17 x 17 cm

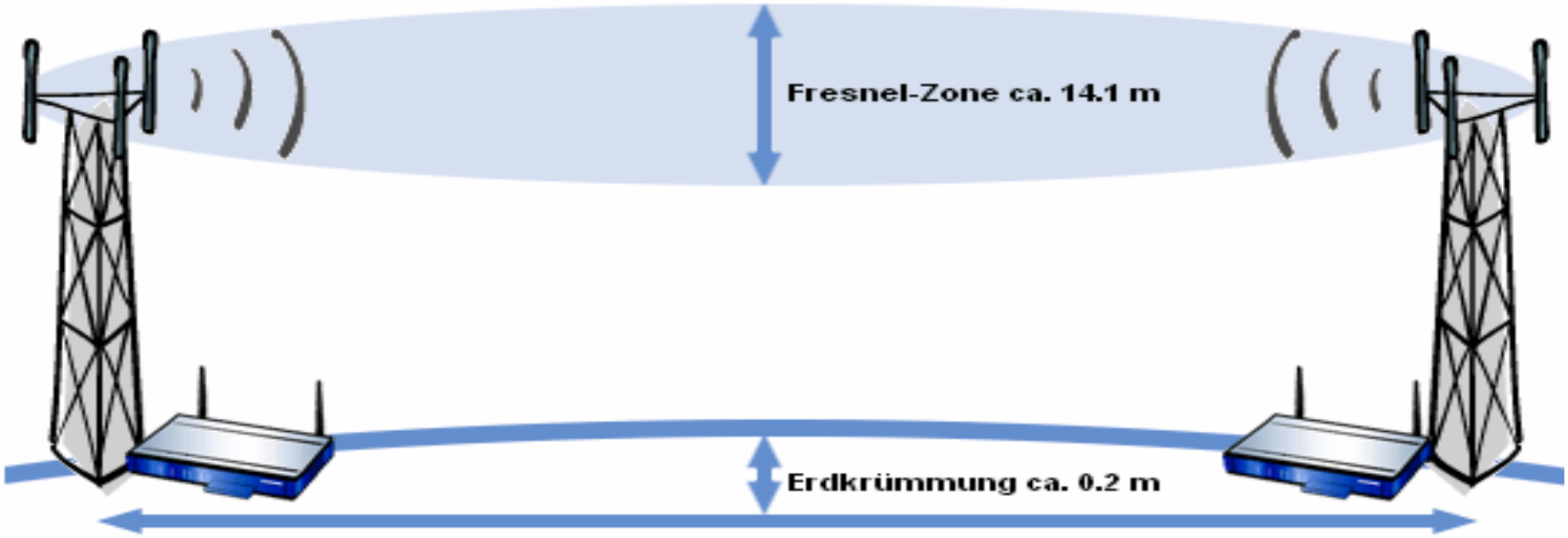
- Passiv cooled
- 2x serial, Compact Flash, Cardbus, USB, ...
- Standard x86 Linux

Wireless Communication

Datalink

- 1000m ?
- noise-independet
- close to water(!)
- direction independent on the boat
- base station on shore

Fresnelzone



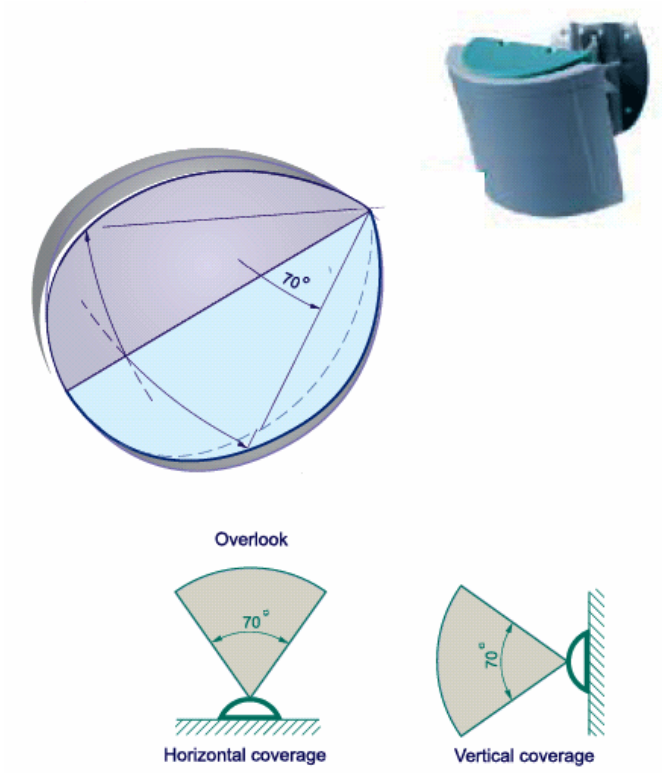
Die Antenne sollte bei der Frequenz von 2,4 GHz mindestens in einer Höhe von
7.3 m montiert werden.

Tests

- Nordbrücke > Floridsdorferbrücke
- Brigittenauerbrücke > Reichsbrücke
- height above the water is important!

Antennas

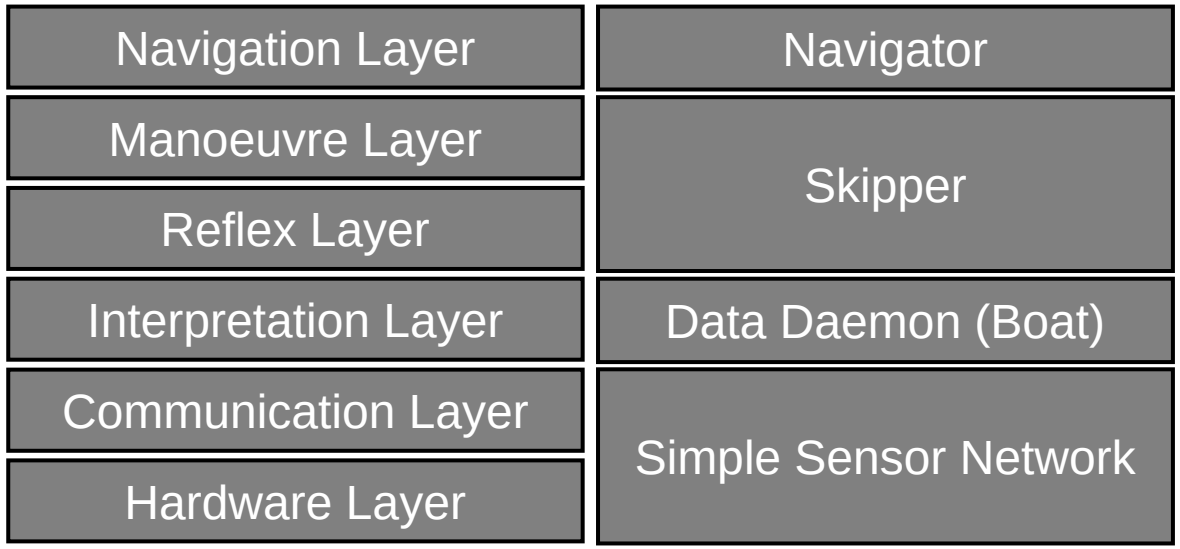
- Sektor antenna



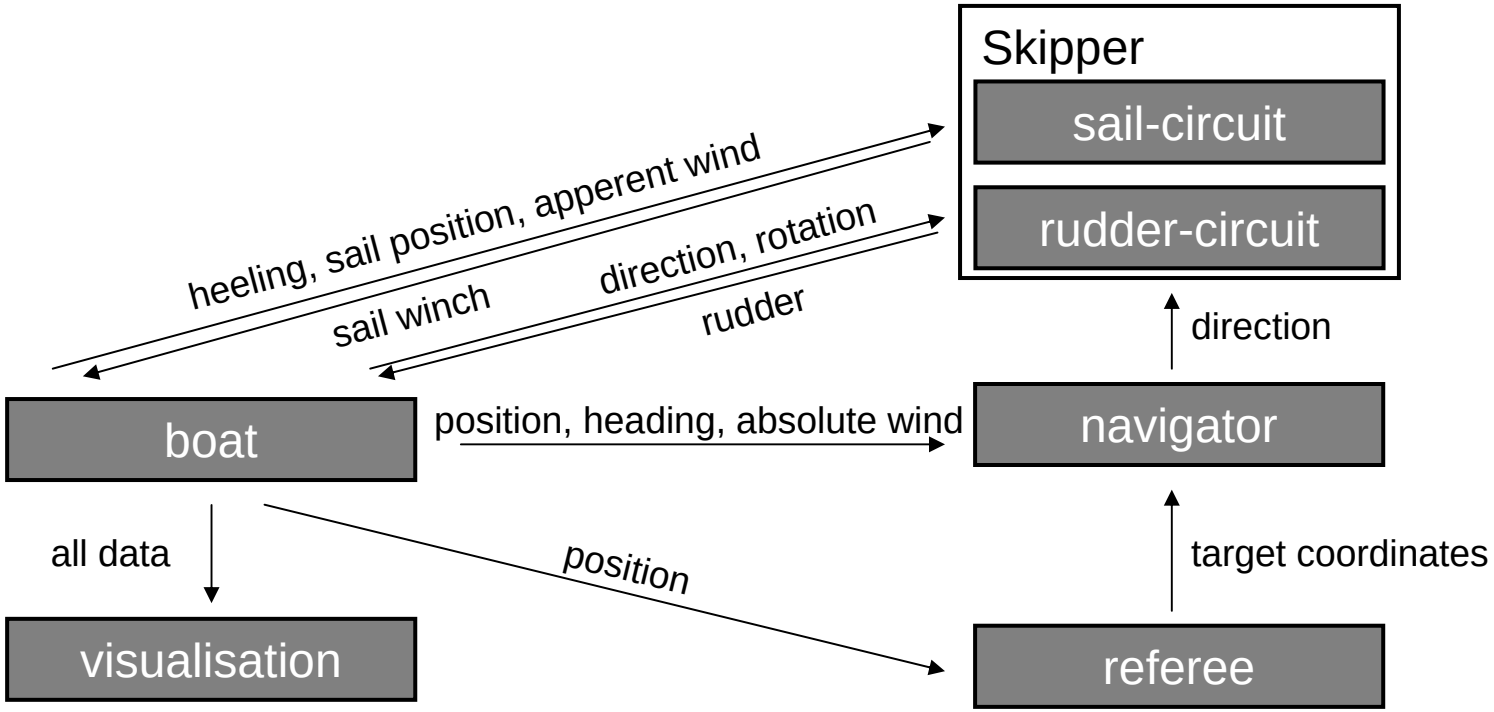
- Yagi

Software Structure

Layered Architecture



Software Modules



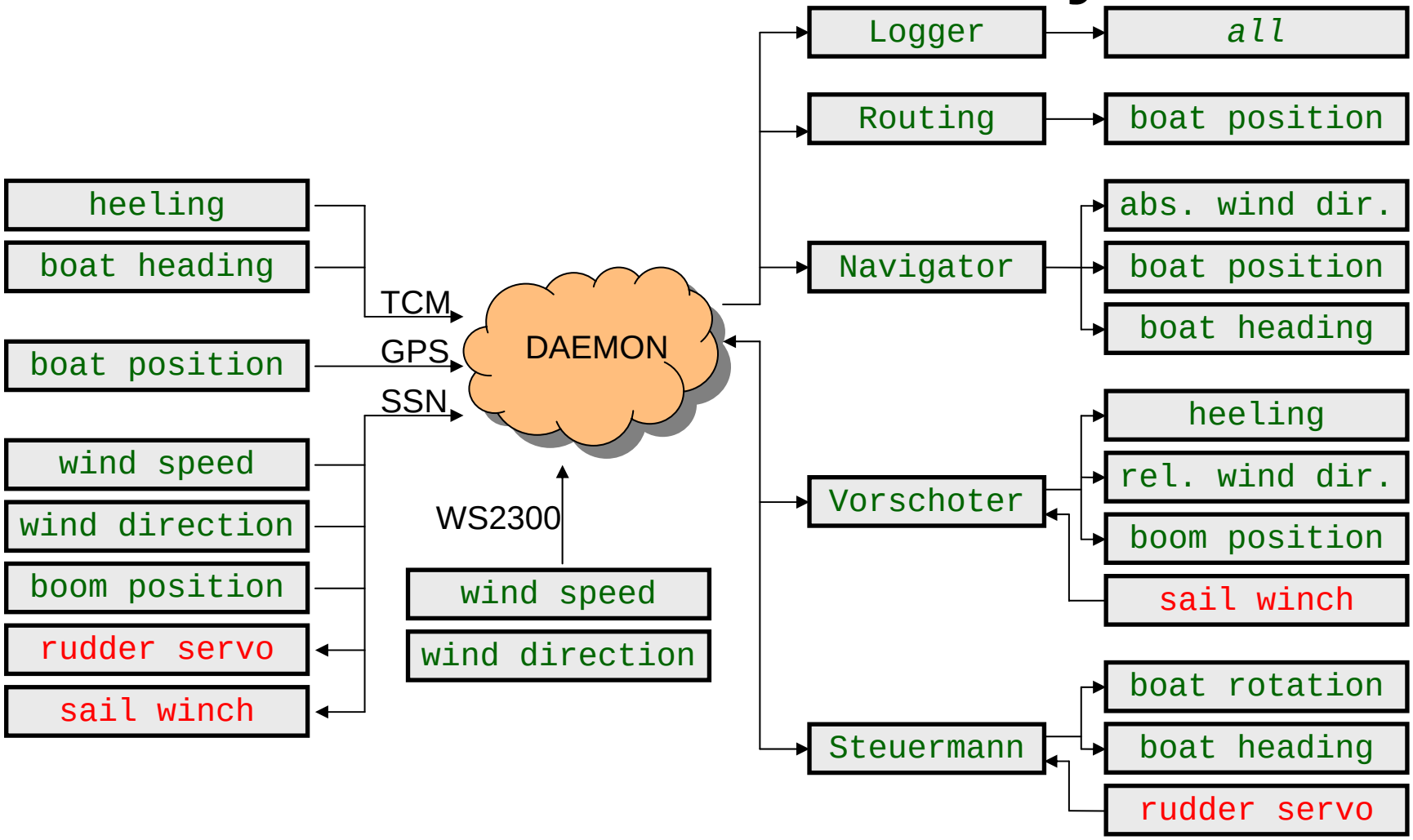
Implementation

- Boat-Daemon: Java multithreaded TCP-Server
  - data preperation („Interpretation Layer“)
  - communicates over RS232 with SSN-Switch and Sensors
- Navigator
  - implemented in C++
  - communicates over TCP with Boat-Daemon
- Skipper:
  - Base: FuzzyWeb C-Codegenerator
  - communicates over TCP with Boat-Daemon
- Visualisation and Logging
  - implemented in C++
  - is detached from the rest (on shore)
  - communicates over TCP with Boat-Daemon

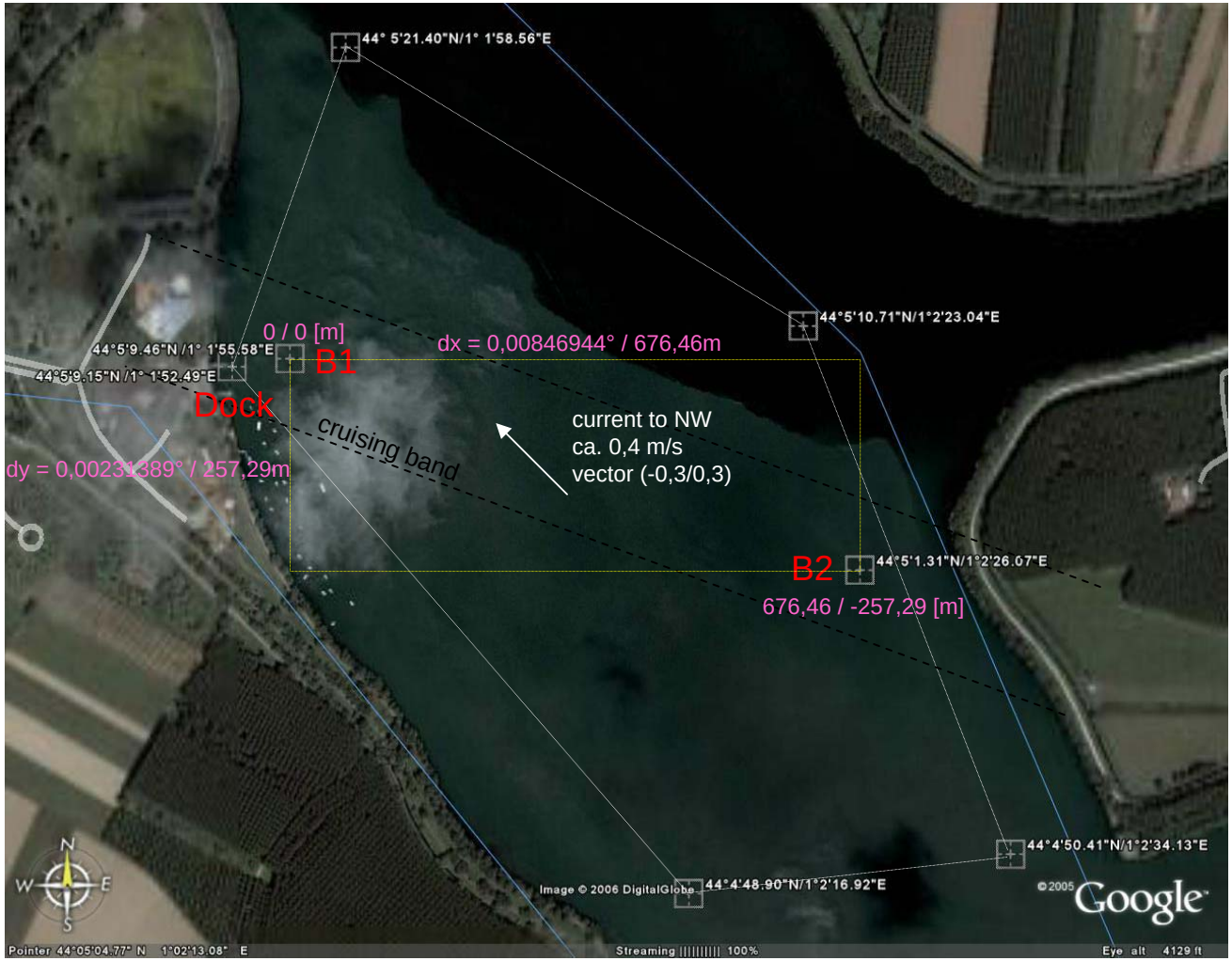
SSN Daemon

- reads sensor values continously
- offers values to other parts of the program
- conversion / abstraction
- data logging

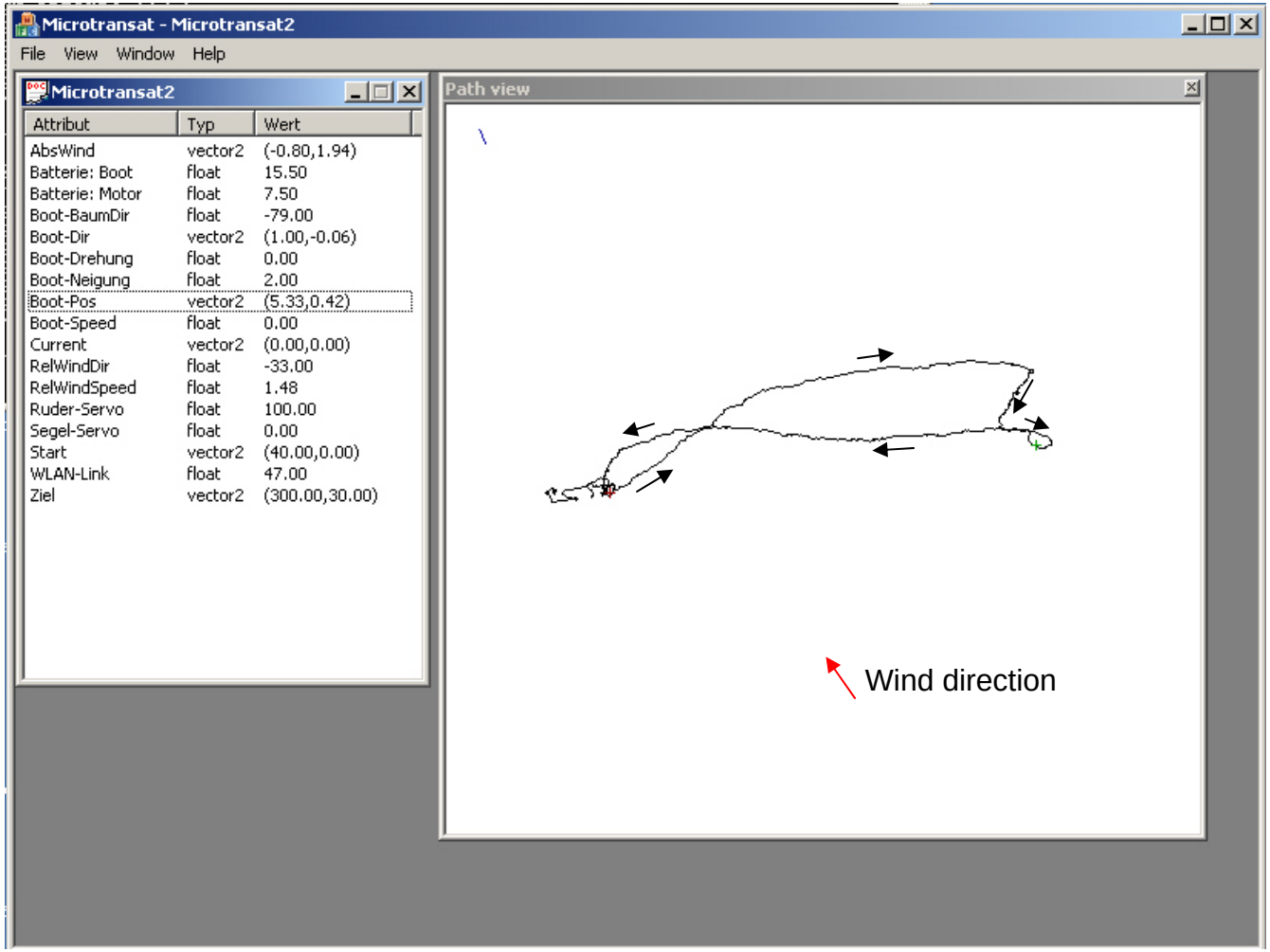
Daemon: HW- / SW-Layer



Coordinate Transformation



Final Test, France 07.06.2006



GPS Coordinates

- Buoy 1: LAT 44.08605 N / LON 1.03274 E
- Buoy 2: LAT 44.08545 N / LON 1.03623 E
- Buoy 3: LAT 44.08217 N / LON 1.03968 E