INF FAKULTÄT FÜR INFORMATIK

Kickoff Digital Engineering Projects SwarmLab

Prof. Mostaghi, Christoph Steup
Chair of Intelligent Systems

OTTO VON GUERICKE UNIVERSITÄT MAGDEBURG | INF FAKULTÄT FÜR INFORMATIK

Organization

- Time and location:
  - Start: 13.04.2016
  - End: 15.07.2016 ++
  - Place: G29-035
- Contact:
  - Christoph Steup: steup@ovgu.de
  - Sebastian Mai: sebastian.mai@st.ovgu.de
- Meetings:
  - Individual meetings organized by periodically by Team Leader

Teams

- Teams of max. 3 DE Students
- One leader (chosen by team) :
  - Organize project (sub-tasks, milestones, documentation)
  - Communication to staff
- Presentation by all members
- Prerequisites:
  - Courses: PKES, TI2, Swarm Intelligence, Control Theory
  - Programming: C++/C, Ocaml, Lua, Python, Latex …
  - Enthusiasm and Teamwork

Registration

- In case more then 9 Students want to take part:
  - Write an E-Mail to steup@ovgu containing:
    - Your Name
    - Your Field of Studies (IF-B, CV-M, DKE …)
    - Your experience with robotics in years
      - Either Robotic Simulation (VREP, Gazeebo, MRDS …)
      - Or real Robotic Systems
    - Your Expertise with the following programming languages in years:
      - C/C++
      - Lua
      - Ocaml
      - Java
    - If you visited the following courses (marks are optional)
      - Technical Computer Science
      - Principles of Embedded Systems
      - Swarm Intelligence
      - Control Theory
    - Your favorite Topics in descending order

Evaluation

- You deliver:
  - Working Prototype
  - Code
  - Documentation
  - Project Management
  - A talk including video or demonstration

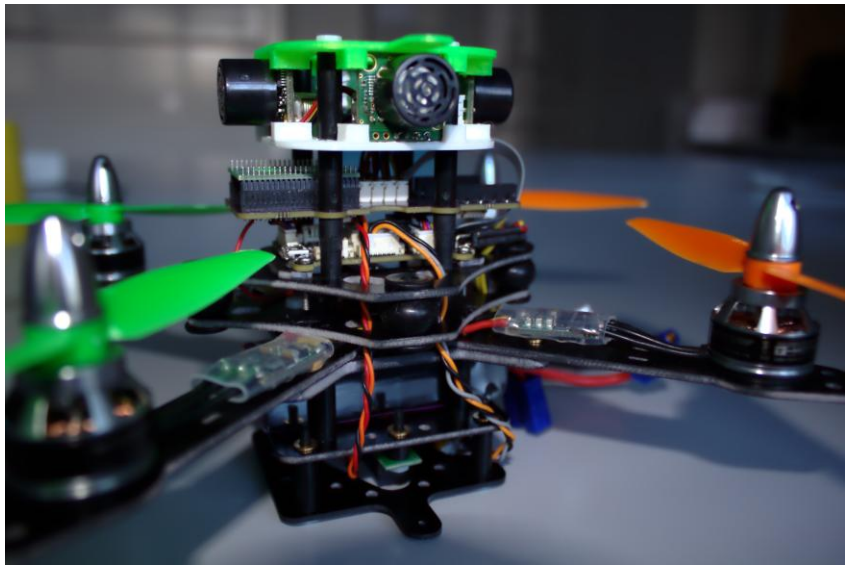
- We deliver:
  - Guidance
  - Introductory meetings to show you your way around the used systems
  - A (probably good) grade after everything is done

Topics

- External tracking of copter's position and attitude
- Sonar-based position estimation and attitude estimation
- Extended Kalman filter for position estimation

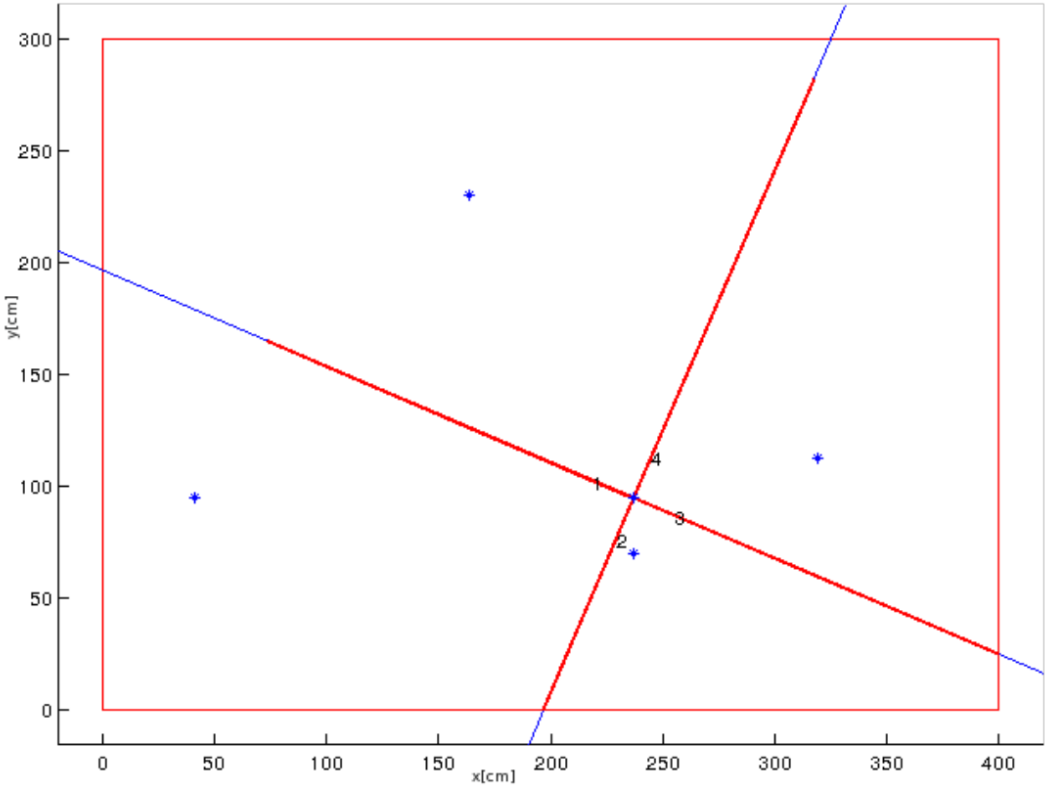
External tracking of copter's position and attitude

- No GPS
- Only Accel, Gyro, Mag + Sonar
- Position is necessary for Evaluation
- Goal:
  - Provide x-y-Coordinate in Arena
  - Provide yaw-angle
  - Identify Copter
  - Multiple Copters
- We have:
  - Working Camera
  - Single Copter Localization
  - Instable Yaw



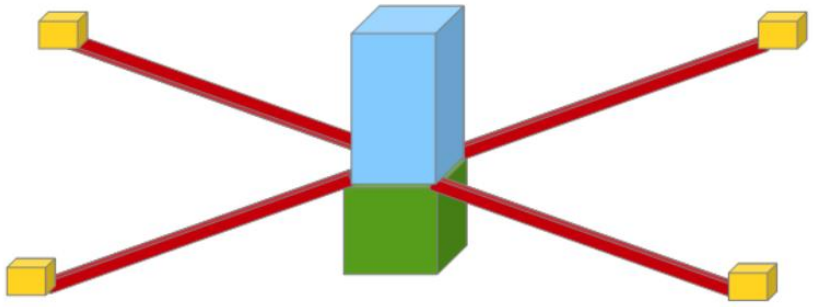
Sonar-based position estimation and attitude estimation

- Use acceleration, turn rate and distance to walls
- Known arena
- Known start positon
- Maybe magnetometer
- Compute on copter
- Basic algorithm exists
- Goal:
  - Estimate x-y pos
  - Estimate yaw
  - Evaluate quality
  - Evaluate robustness



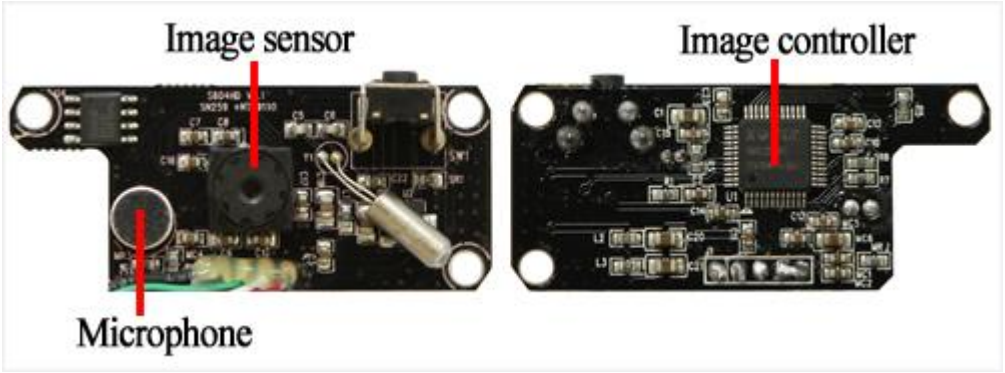
Extended Kalman filter for position estimation

- Idea: Estimate position based on movement commands and sensors
- Input:
  - Movement commands (tilt, thrust++, thrust--)
  - Sensors: acceleration, turn rate, magnetometer, speed over ground
- Non-linear model of copter
- Extended Kalman-Filter:
  - Non-linear prediction of future state
  - Evaluates predicted state vs real state
  - Evaluates trustworthiness of sensors
- Goal:
  - Construct Kalman-Filter
  - Evaluate precision
  - Evaluate stability
  - Evaluate Performance



Visual SLAM-based Position Estimation

- Position Estimation using landmarks
- Landmarks are visual features of the environment
- Landmarks are put into a local map, which extends over time
- Strategies to handle inconsistent data
- Goal:
  - Build hardware setup
  - Investigate possible algorithms
  - Evaluate best suited algorithm
  - using external Tracking



Pictures by hardkernel.com