DE/Team-Projects Flying/Rolling Swarm

KickOff Meeting

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Magdeburg

Organisation

Important Information

- Time and Dates
  - Location: G29-035 (SwarmLab)
  - Time for KickOff Meetings: 04.04.18 13:00, 11.04.18 13:00 and 18.04.18
- Contact: Dr. Christoph Steup
- Periodic Meetings:
  - weekly with advisor
  - weekly with team
  - organized by team
- Registration Form due by 15.04.18 23:59

Important Information 2

- Teams:
  - Min. 2 Students
  - Max. 4 Students
  - One Team Leader chosen by team
- Deliverables:
  - Code (working)
  - Demo of the code (Video or Live)
  - Report (Wiki, HTML or PDF)
  - Presentation done by all members
- Support:
  - Hands-on introduction to topic
  - Existing documentation/reports of previous teams
  - HowTos of used systems: ROS Paparazzi
  - Collaboration and Project Management through GitHub
  - Flying Swarm: Jonathan Beckhaus
  - Rolling Swarm: Michael Faber

Rolling Swarm

Architecture

- DIfferential robot
- Large slip
- Movement with large errors
- Bluetooth Communication
- Central Server for processing and control

Task R1 - Establishing a Swarm-Behaviour API for the Sphero Robots integrated in a ROS-Environment

- Current applications access Sphero directly
- Lots of integration nodes exist for various purposes
- Different applications need different nodes to run and are implement against heterogeneous interfaces
- Goal: Analyze existing applications and develop a Swarm API for Sphero Robots
- The resulting API needs to be implemented and tested on at least on of the existing applications

Task R2 - Integrating the existing Race-Track Behaviour with the ROS-Navigation and evaluate Scalability

- Demo Application for Spheros: Interactive Race between Human and Autonomous Sphero
- Autonomous control is currently bad
- Goal: Integrate existing ROS Navigation Stack for Spheros to enhance autonomous behaviour
- Needs additional work to enable a periodic update of navigation goals to keep the Sphero moving
- System will be used as demonstration on next years LNdW

Task R3 - Overhaul of Adaptive Camera Tracking for Spheros

- Camera Tracking is core of Sphero control
- Camera Tracking provides position of Sphero to enable swarm behaviour
- Goal: Analyze, Design and Implement Enhancements to increase Reliability and Capabilities of Detection
- Example of Enhancements are:
  - Better identification using alternative colors of LEDs or other markers
  - Better tracking of Spheros by filtering outputs of camera tracking
  - More reliability by enhanced filter of detected LEDs

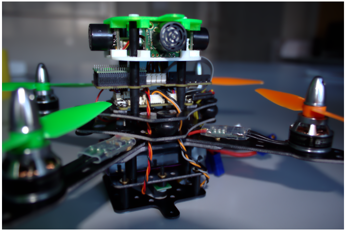
Task R4 - Virtual Sensor to Simulate Realistic Exploration Behaviour of Spheros

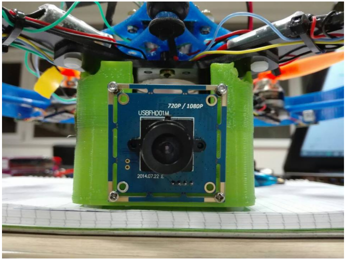
- Currently position is provides directly to Sphero
- Future Goal: autonomous Sphero without camera tracking
- Goal: implement virtual sensors imitating possible local sensors on a Sphero
- Possible Sensors:
  - Virtual Lidar: provides distances to closest points
  - Virtual Bumper: detects Sphero bumped into a virtual wall
  - Virtual Ranging: detects distance and possibly angle between Spheros
- All sensor need error models to mimic realistic behaviour

Flying Swarm

FINKen

- Autonomous Quadcopter
- No GPS
- Camera tracking for pose estimation
- Height Sensor
- 8 Sonars to detect obstacles and other FINken
- STM32F4 Microcontroller
- Some have Odroid C0 Linux/ROS extension board





Task F1 - Magnetic Mapping of 3D Environments

- Magnetometer of INS unusable indoor
- Disturbances by existing power cords and metal in walls, floor and ceiling
- Goal: Map the Arena to enable Compensation and possible Localization of Magnentic Field
- Needs evaluation of integrated Sensor in Copter
- Needs storage mechanism to enable persistent storage of magnetic map on copter
- Modification of INS Magnetometer software is necessary to integrate map

Task F2 - Porting the FINken to ArduPilot

- Copter using Paparazzi as flight control
- Many researchers use ArduPilot, because of easier integration
- Goal: Enable a FINken to fly manually using ArduPilot
- Needs evaluation of ArduPilots support for used hardware
- Missing drivers need to be implemented
- Communication system between GCS and copter needs adaption

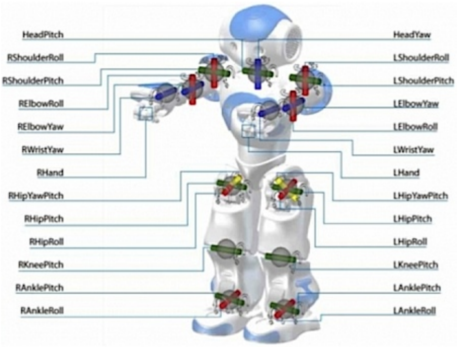
Task F3 - Analyze Flight behaviour of copter to infere Swarm Behaviour Rules for Local Sensors

- Swarm Behaviour exists for copter using Camera Tracking
- Final Goal: enable stable swarm behaviour using local sensors
- Goal 1: Analyze Flight Data of Copter with External Sensor Input
- Goal 2: Extract swarm behaviour rules from the data for local sensors
- Needs model generation of swarm behaviour
- Creation of flight data including sensor information
- Analysis of the data regarding correlation between pose/actuation and local sensor data

Special Projects

NAO

- Humanoid robot
- Many Actuators
- Many Sensors and Cameras
- Existing set of programs and software
- Used in RoboCup Soccer Leagues



Task S1 - Integrate NAO and the Spheros in an Autonomous Game

- NAO can already detect balls
- Spheros can be detected and controller using central server
- Goal: Let the NAO play football with an active "ball"
- 2 possible Scenarios:
  - NAO is Goaly and Spheros try to pass him
  - NAO is field player and wants to score by kicking or shoving Spheros in the goal
- NAO needs to be detectable by Camera Tracking
- Spheros or NAO detection needs to be modified to be detectable
- Ambitious Goal: Partial results are fully acceptable