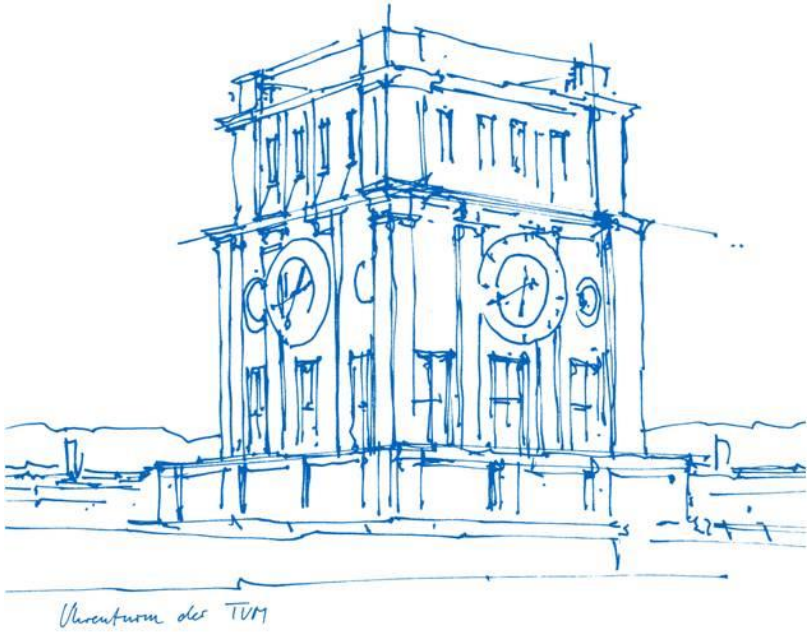
Autonomous Systems – Avalanche Mission Team Pi

Team Pi

Technical University of Munich

TUM Department of Aerospace and Geodesy

Munich, 24. March 2022



Content

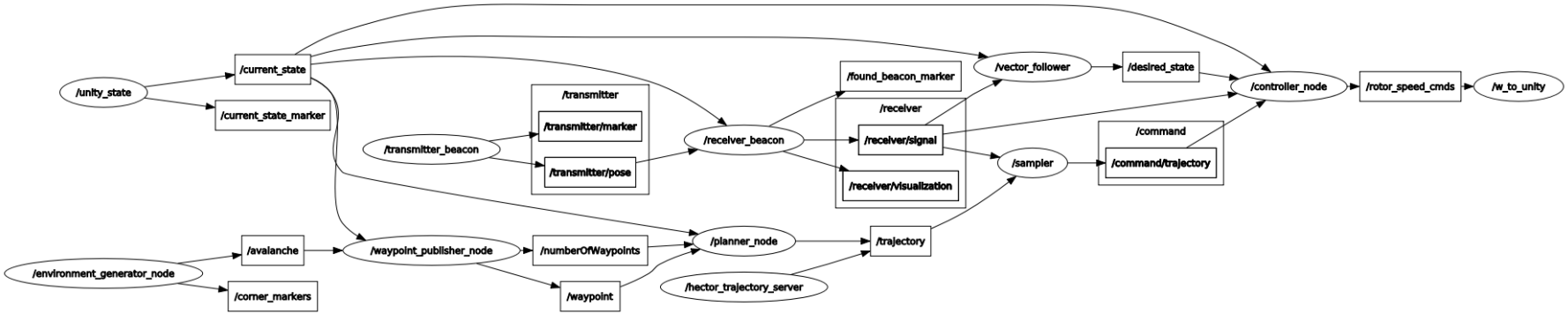
- Mission Statement
- Our solution explained
- A mission run visualized
- Who did what?

Mission Statement

- Find randomly place avalanche beacons within a rectangular search area
- Beacons only have a limited sensor range
- Intelligent search strategy with switching between search pattern and signal handling needed

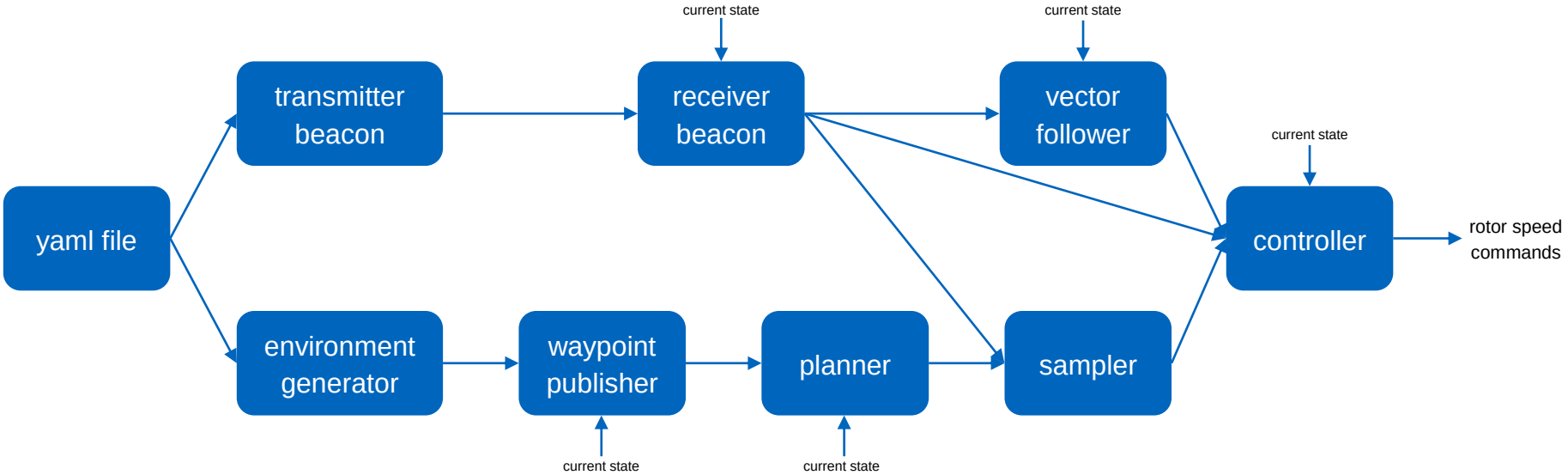
Our solution explained

rqt graph

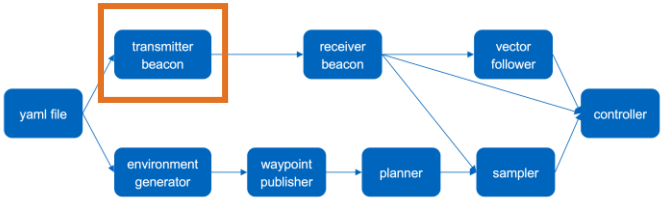


Our solution explained

Simplified rqt graph



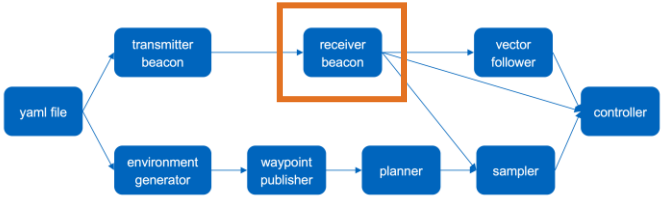
Transmitter beacon

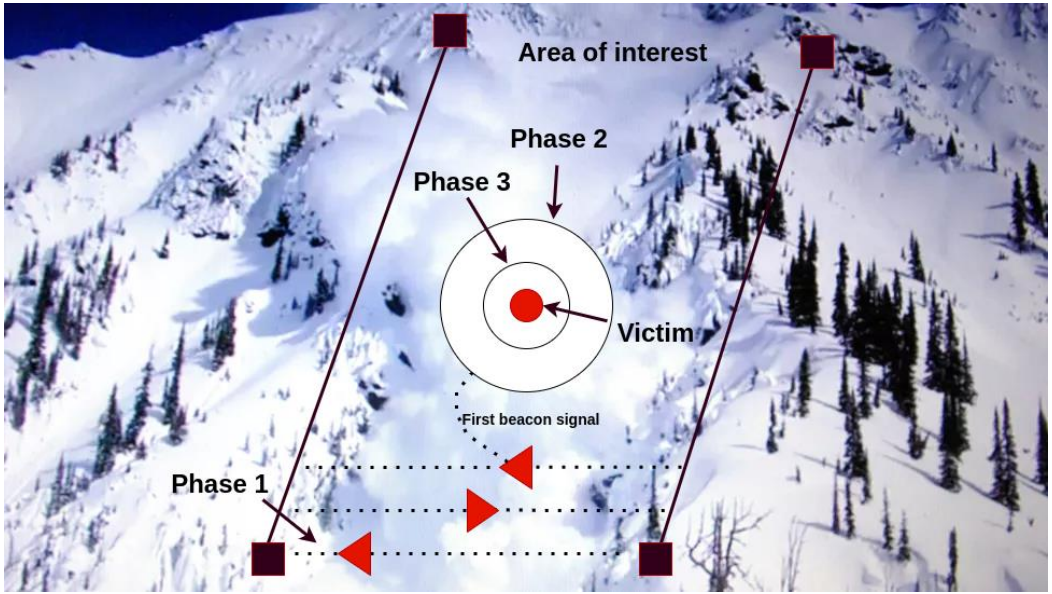


- Corners of search area and number of beacons are defined within a .yaml file
- Creates random positions of beacons and sets their orientation in space
- Sends the pose information and a beacon ID to the receiver node

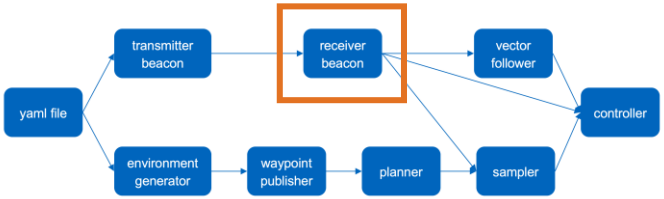
```yaml
# Set the three corners of your search area (parallelogram) here
avalanche:
  cornerA:
    x: 411
    y: 127.2
    z: 90
  cornerB:
    x: 60
    y: 175
    z: 10
  cornerC:
    x: 31.6
    y: -17.5
    z: 10

#Set the number of beacons here
numberOfBeacons: 4
```

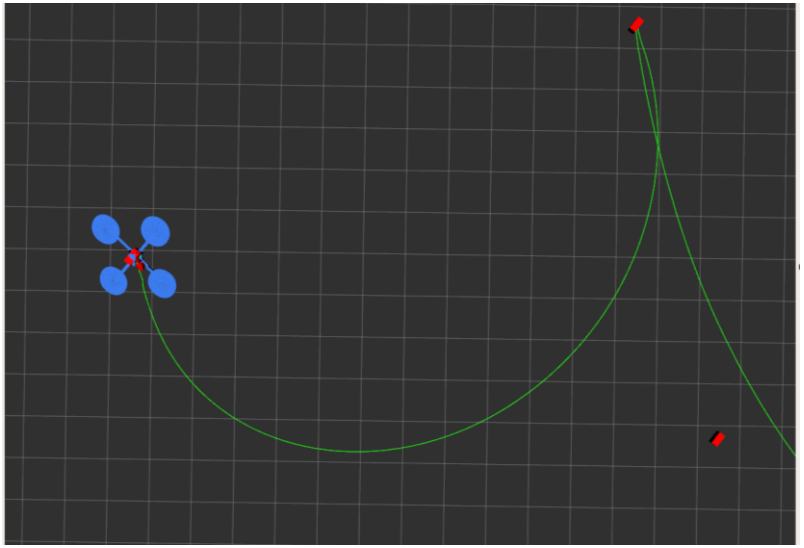
Receiver beacon

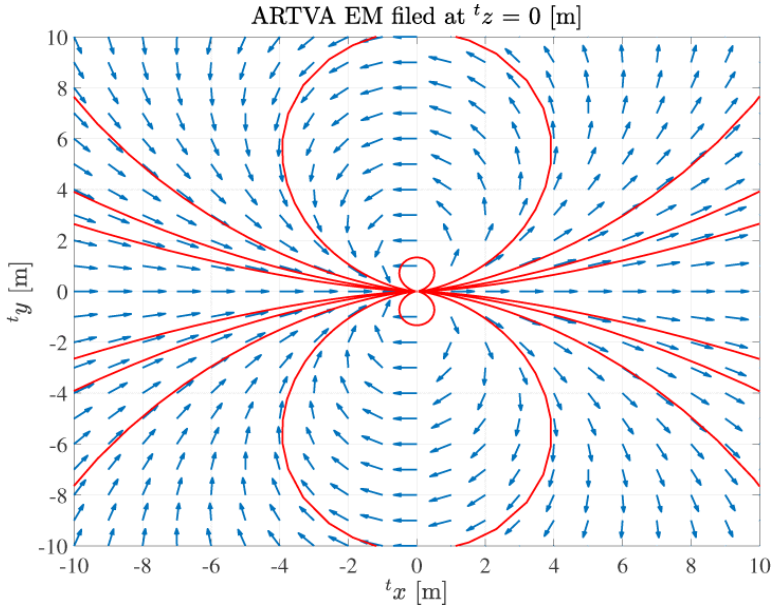




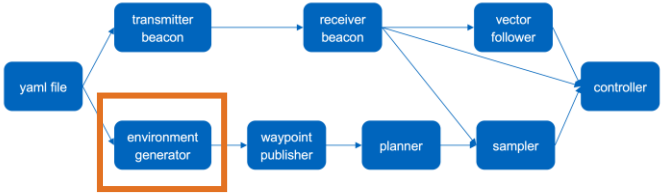
Receiver beacon







Environment Generator



Input:

- Configuration file

Function:

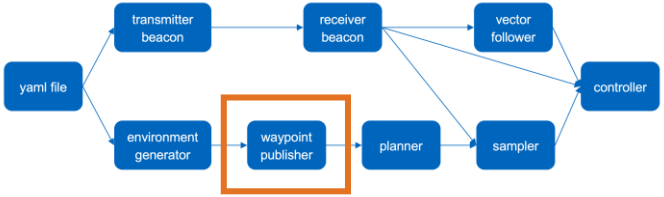
- Define search area

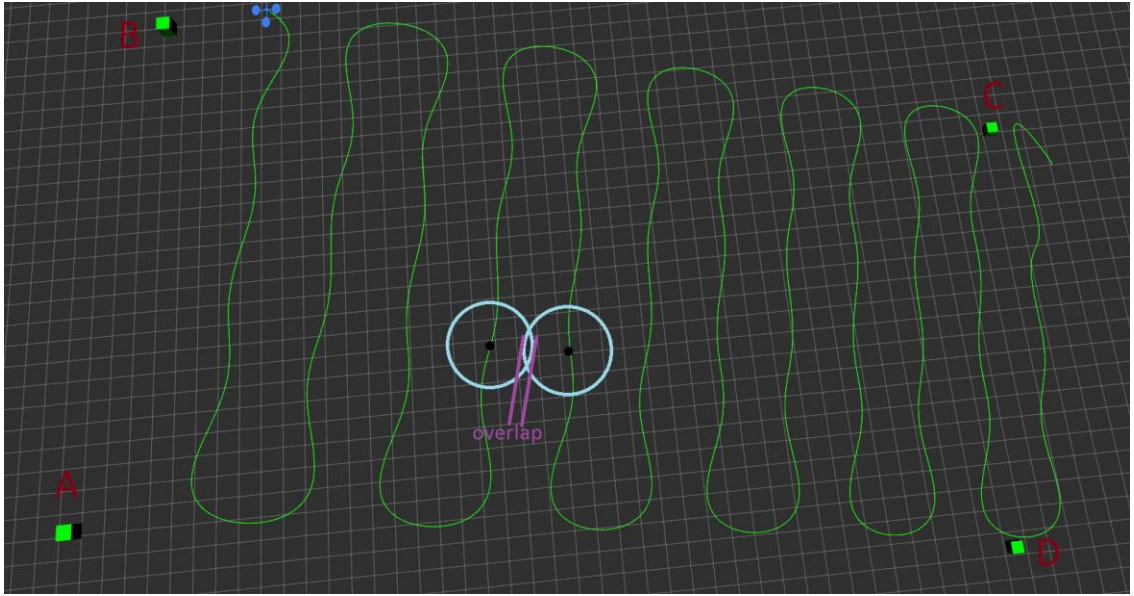
Output:

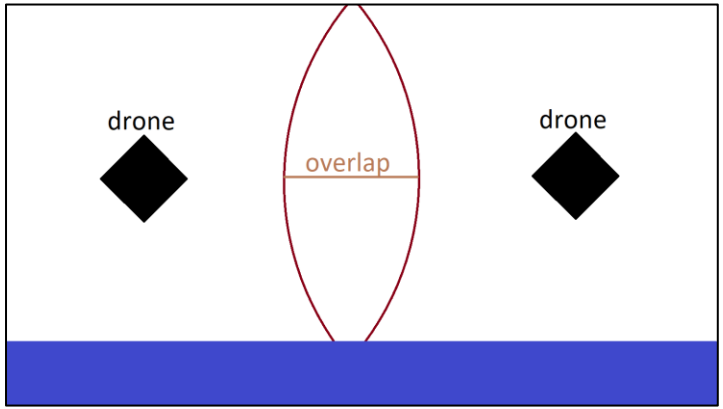
- Corners of the search area
- Markers for visualization

Waypoint Publisher

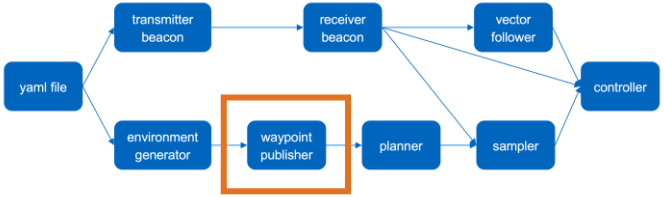
mission planning







Waypoint Publisher



mission publishing

Input:

- corners of search area

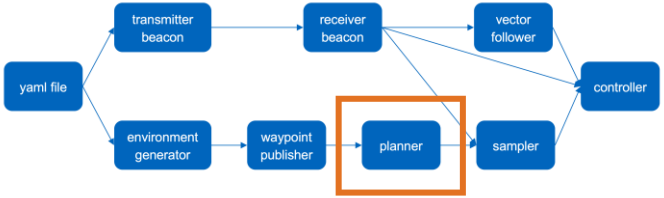
Function:

- generate search pattern

Output:

- number of waypoints
- waypoints

Planner



Input:

- number of waypoints
- waypoints one by one

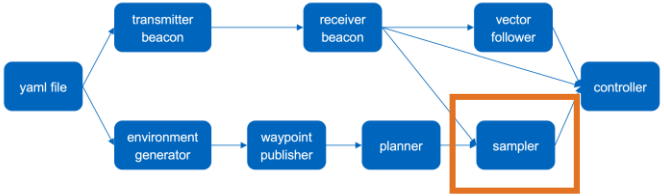
Function:

- generate snap trajectory

Output:

- trajectory

Sampler



Input:

- trajectory
- receiver beacon distance

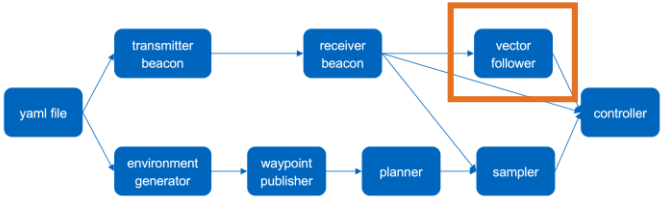
Function:

- generate desired state message for controller
- pause publishing during victim search

Output:

- desired state message

Vector Follower



Input:

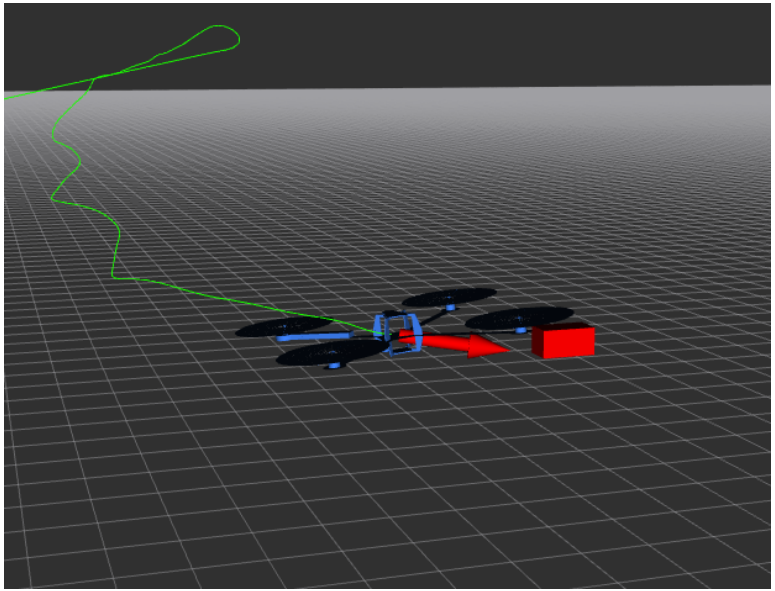
- Beacon signal (flux vector, distance)
- Current state

Function:

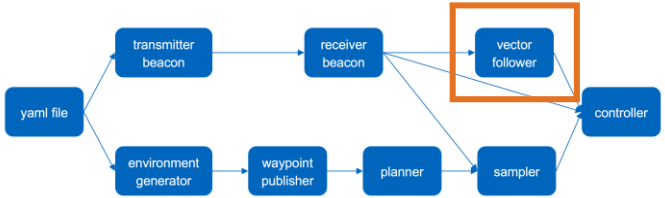
- Follows the flux vector
- Calculates speed and position boundary

Output:

- Trajectory for beacon approach



Vector Follower



Input:

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- Current state

Function:

- Follows the flux vector
- Calculates speed and position boundary

Output:

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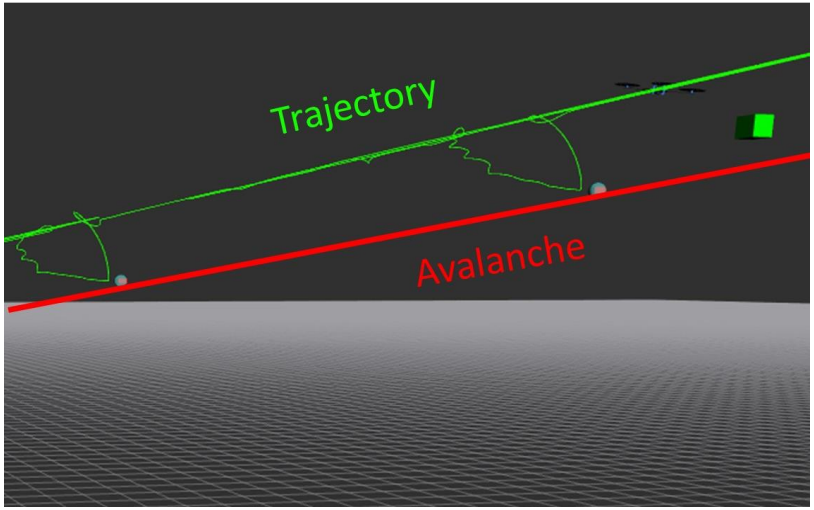
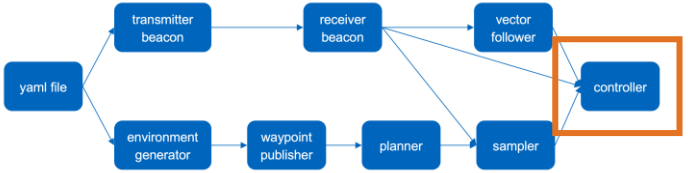


Controller



Input:

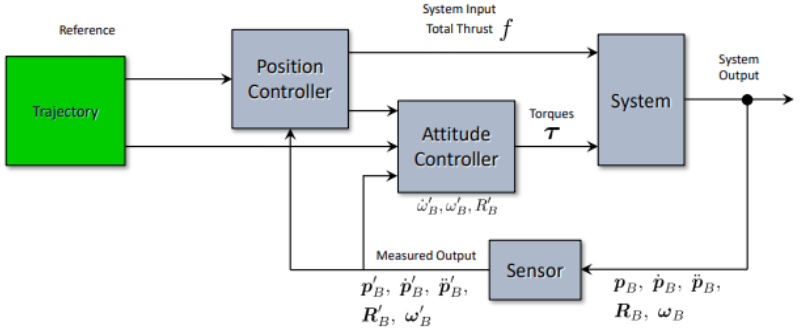
- Beacon signal (distance)
- Trajectory (vector or waypoint follower)
- Current state

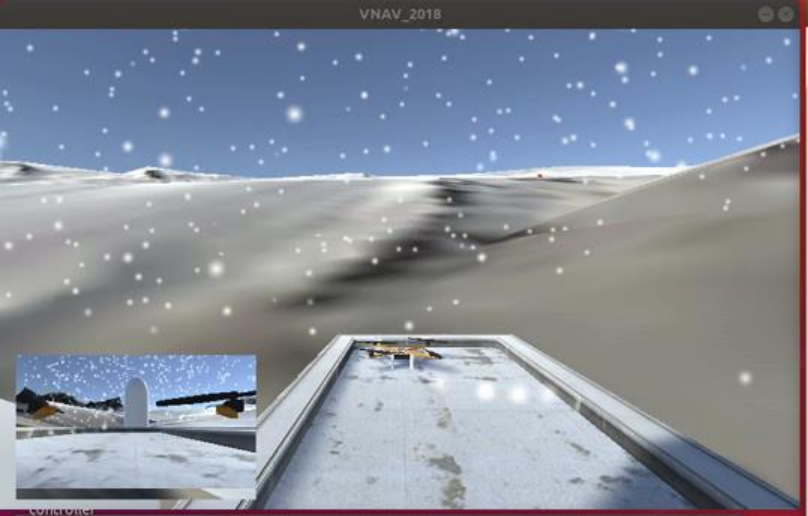
Function:

- Decision logic for vector or waypoint following
- Geometric controller (from Lecture)

Output:

- Rotor speeds





/home/nico/autonomous-systems-2021-group-pl/Project/simulation/unity_template/catkin_...

File Edit View Search Terminal Help

```
--------------------------------------------------
FINAL LOCATION REPORT

Real locations of beacons:
Beacon ID: 1 x: 152.954 y: 39.1241 z: 35.2478
Beacon ID: 2 x: 179.742 y: 33.0287 z: 41.434
Beacon ID: 3 x: 171.989 y: -13.7944 z: 41.2451
Beacon ID: 4 x: 285.769 y: 69.3802 z: 63.9253

Approximated locations of beacons:

0/4 beacons found!

--------------------------------------------------
[ planner ] Start optimizing, please wait...
[ERROR] [1648033056.713340753]: Client [/sampler] wants topic /trajectory to have datatype/md5sum [nav_planning_msgs/PolynomialTrajectory4D/4d68d15524ede489eecd674bb6dc3ee8], but our version has [nav_msgs/Path/6227e2b7e9cce15051f669a5e197bbf7]. Dropping connection.
[ERROR] [1648033056.714192214]: Client [/rviz] wants topic /trajectory to have datatype/md5sum [nav_msgs/Path/6227e2b7e9cce15051f669a5e197bbf7], but our version has [nav_planning_msgs/PolynomialTrajectory4D/4d68d15524ede489eecd674bb6dc3ee8]. Dropping connection.
```

rviz_config.rviz* - RViz

File Panels Help

Interact | Move Camera | Select | Focus Camera | Measure | 2D Pose Estimate | 2D Nav Goal | Publish Point

Time

ROS Time: 1648033167.97 ROS Elapsed: 126.37 Wall Time: 1648033168.00 Wall Elapsed: 126.34 Experimental

Reset **Left-Click:** Rotate. **Middle-Click:** Move X/Y. **Right-Click/Mouse Wheel:** Zoom. **Shift:** More options. 31 fps

Team member contribution?

- Mission planning: Nicholas
- Trajectory: Maximilian
- Beacon simulation: Divij & Benedikt
- Control: Samuel
- Visualization and location report: Benedikt & Samuel

Any Questions?