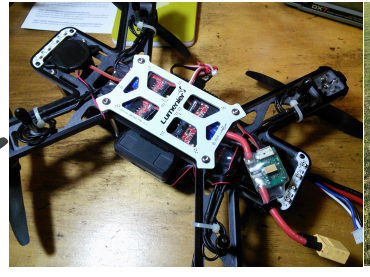
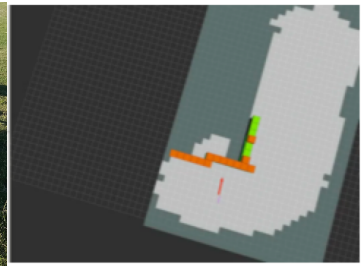
# TOWARDS OBSTACLE AVOIDANCE ON OPEN SOURCE DRONES







Lorenz Meier / http://px4.io

# PERSONAL CONTRIBUTION TIMELINE

pixhawk

QGROUNDCONTROL
GROUND CONTROL STATION FOR SMALL AIR · LAND · WATER AUTONOMOUS UNMANNED SYSTEMS

AVOIDANCE
LOCALIZATION

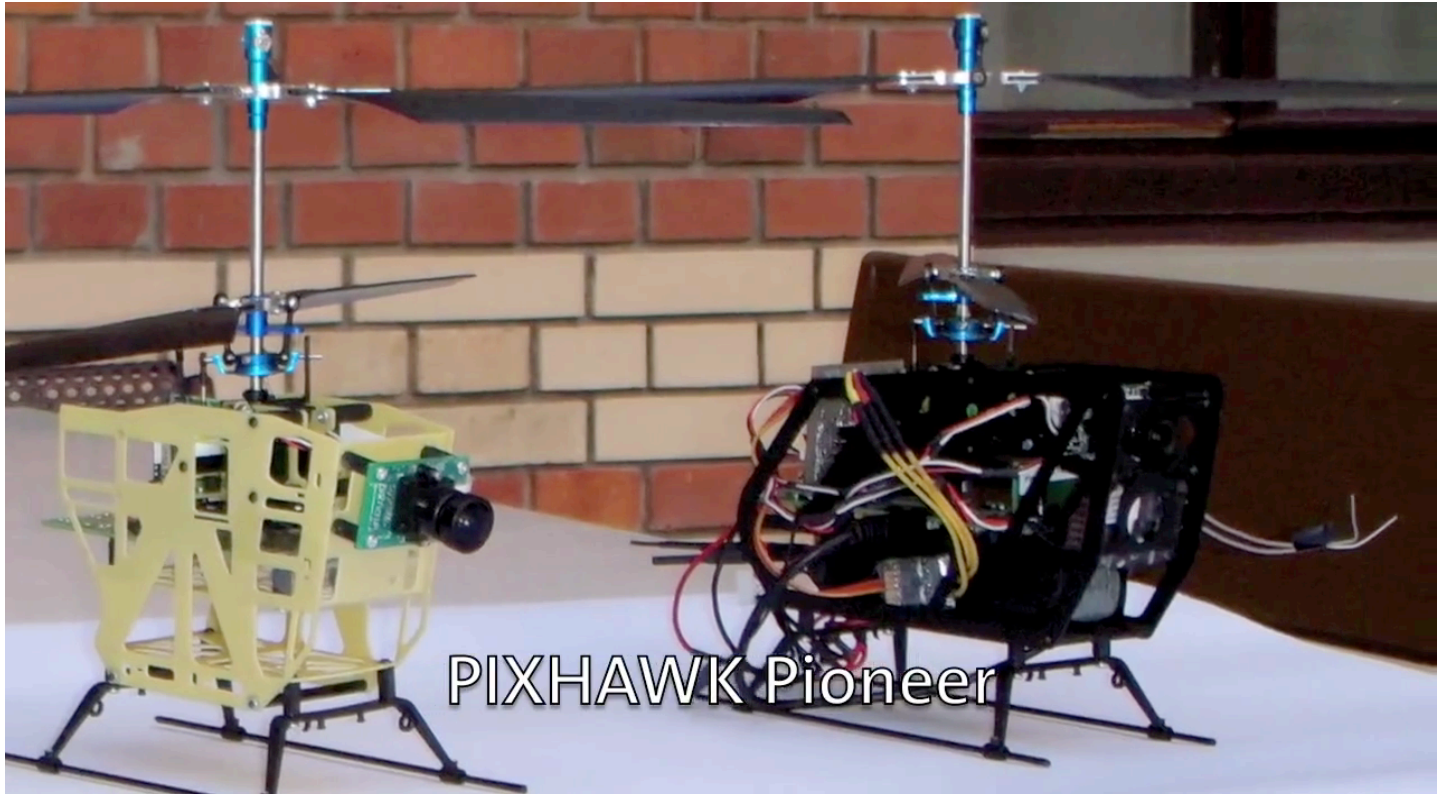
MAVLINK
MICRO AIR VEHICLE COMMUNICATION PROTOCOL

PX4 inside

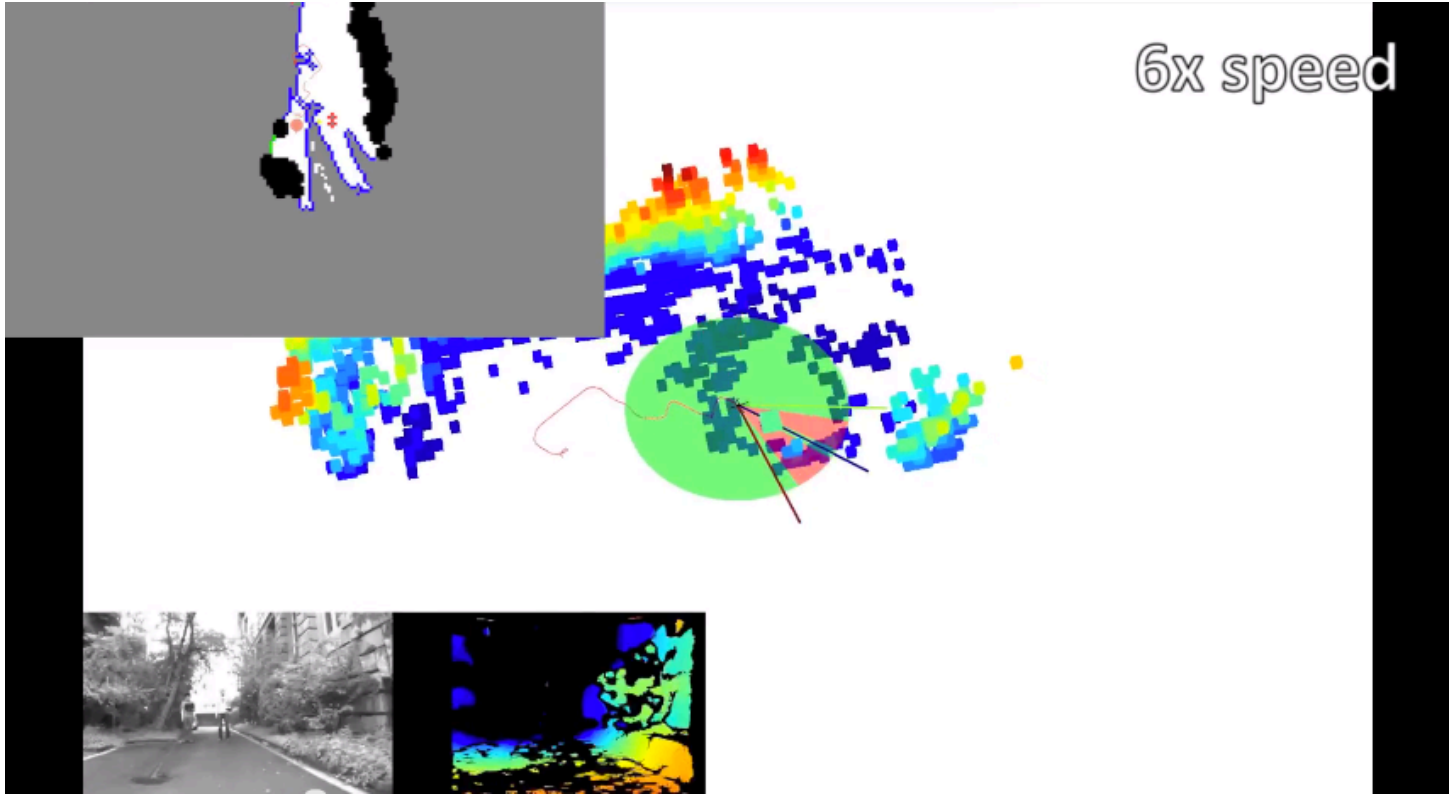
2008 2010 2011 2013 2016

Dronecode CVG Computer Vision and Geometry Lab ETH zürich

# LINUX ON DRONES IN 2008



# LINUX ON DRONES IN 2012




IROS 2012, Friedrich Fraundorfer, Lionel Heng, Dominik Honegger, Gim Hee Lee, Lorenz Meier, Petri Tanskanen, and Marc Pollefeys

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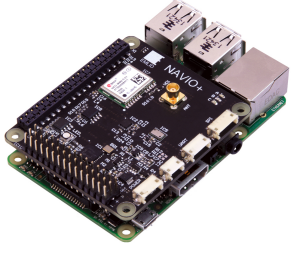
# PX4 PROGRESS UPDATE

- VTOL (Tiltrotor / Tailsitters / Quad Planes)
- Hardware support
- Dronekit – first steps
- MAVLink based Simulationkit
- Building a complete stack:
  - Simulation in 3D including cameras / flow
  - High speed computer vision
  - Obstacle avoidance

# HARDWARE SUPPORT

## Autopilot Hardware



## Operating Systems

- Linux (user space)
- QuRT (kernel)
- NuttX (kernel)
- OS X (user space)

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# VTOL CONTROL

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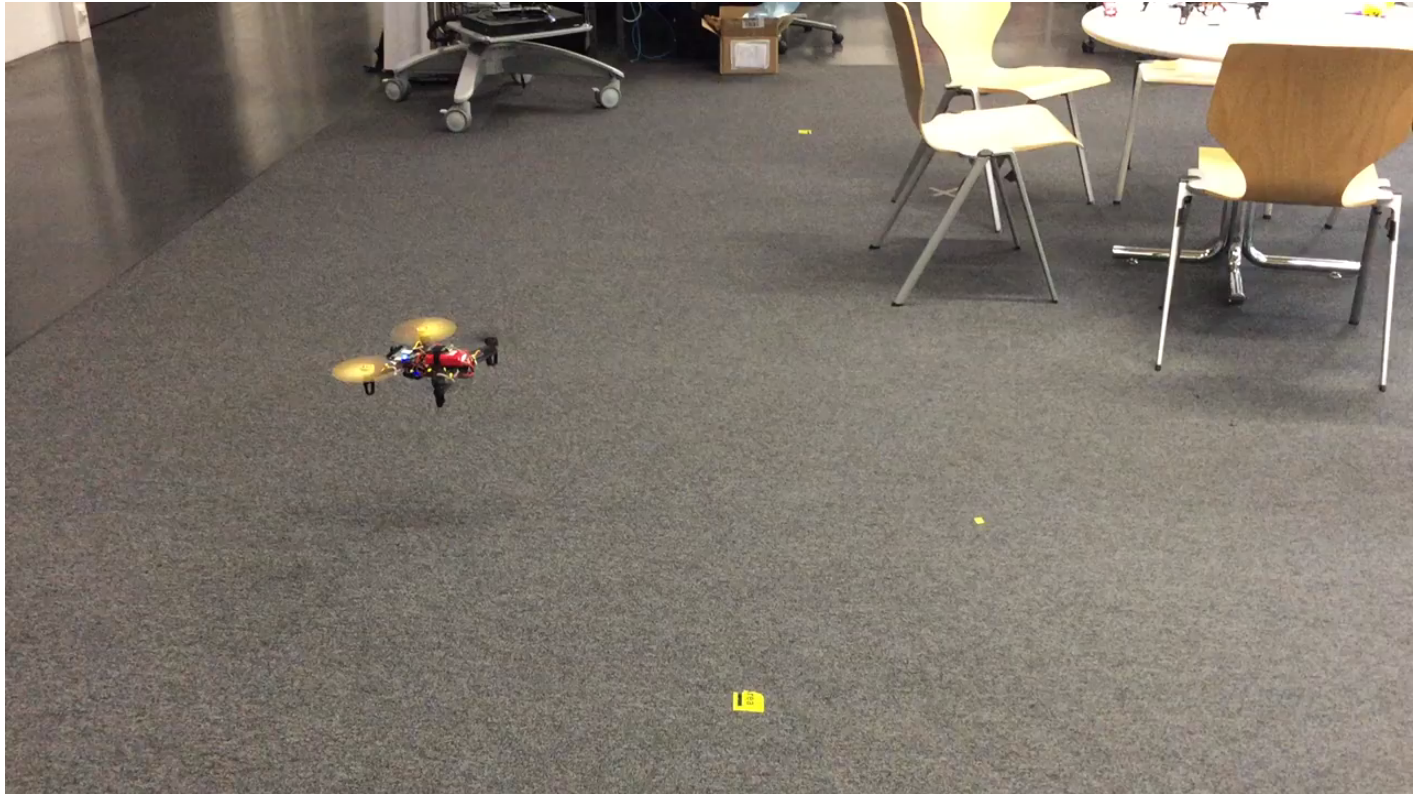
# SNAPDRAGON ON OPEN SOURCE DRIVERS



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# DRONEKIT SUPPORT

- Basic support in Dronekit upstream (community-contributed)
- Mode setting, missions, arming
- Still work in progress (unpolished)

Try it:
http://dev.px4.io/dronekit-example.html

# SIMULATIONKIT (MAVLINK API)


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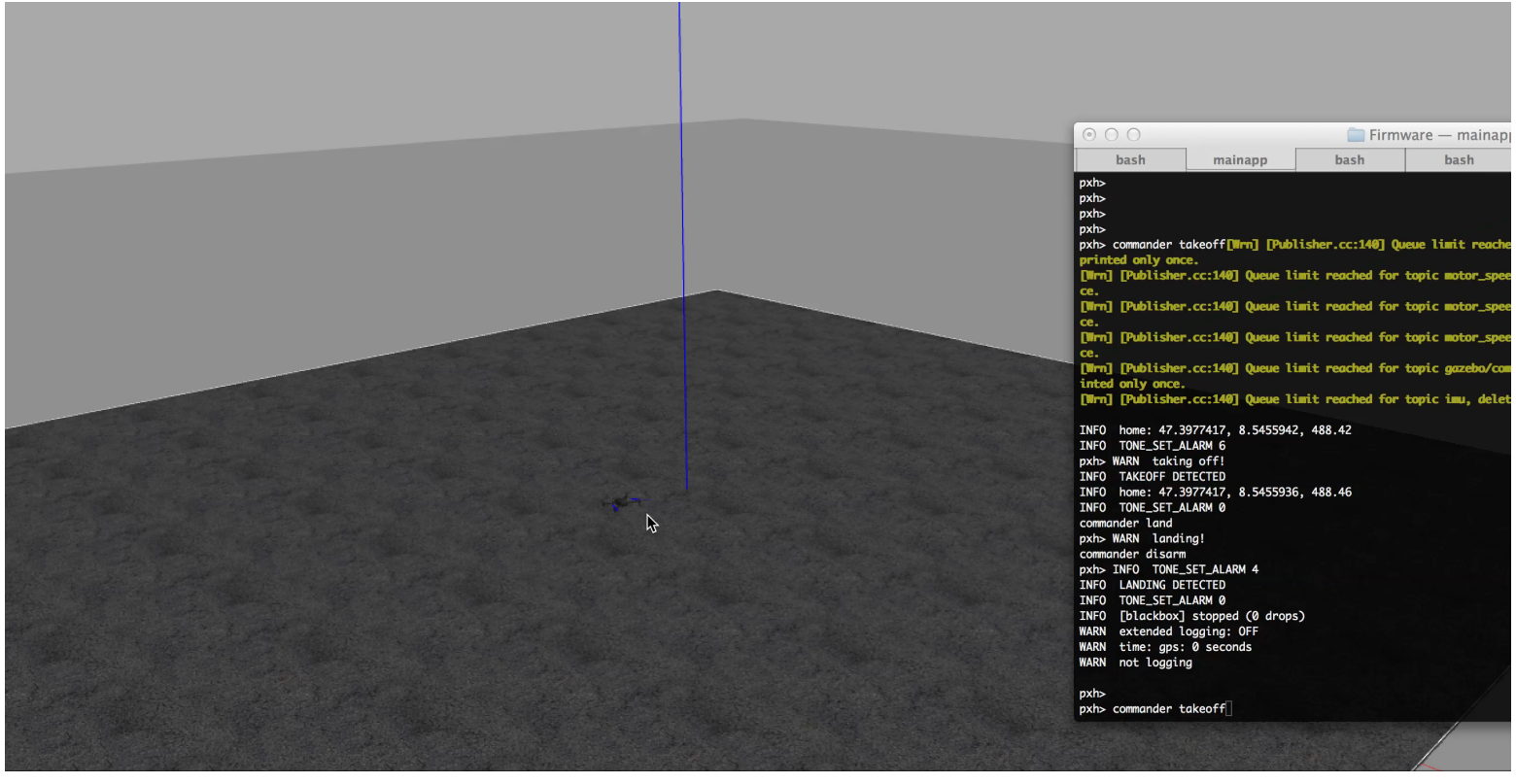
# SIMULATIONKIT (MAVLINK API)

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# SIMULATIONKIT (MAVLINK API)


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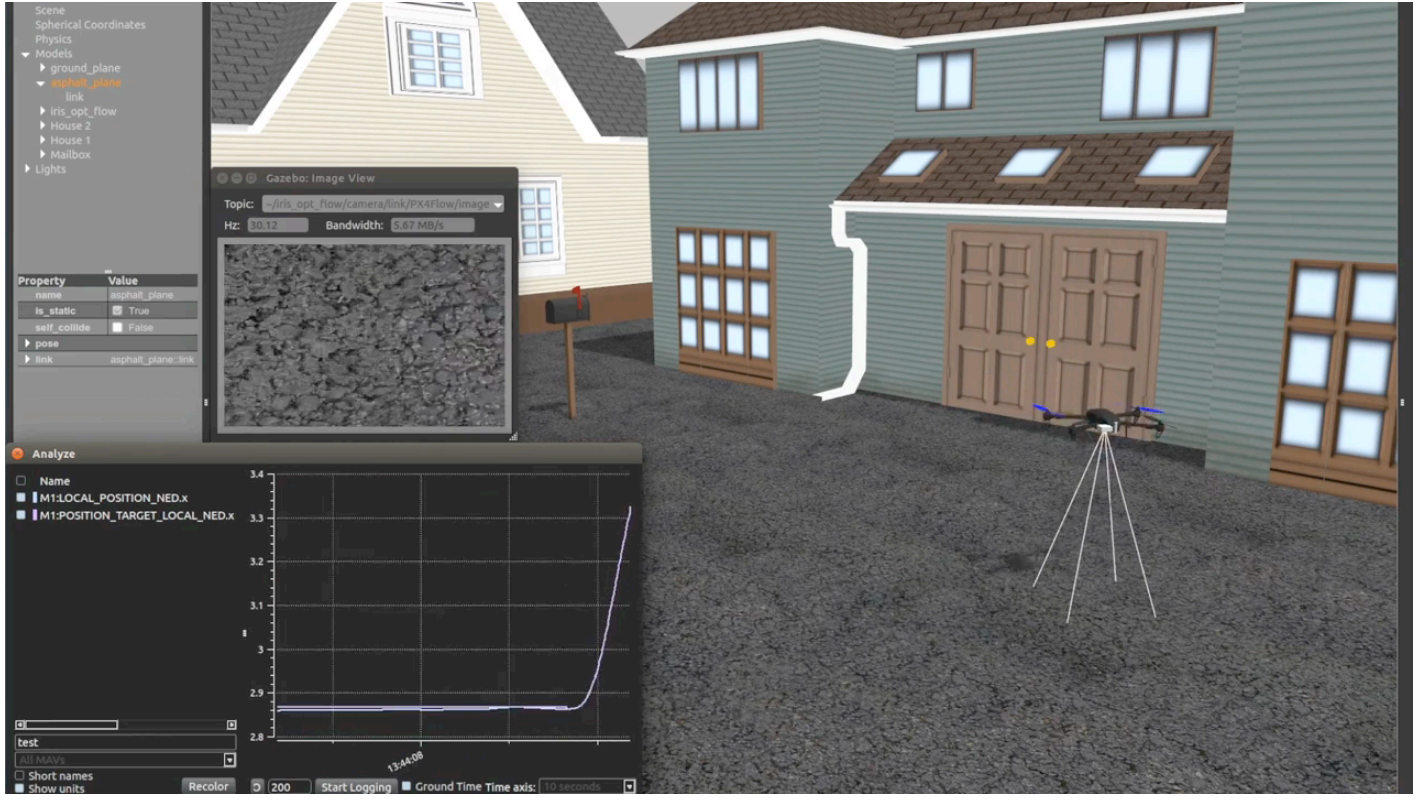
# BUILDING A COMPLETE STACK?

- Dronecode flight stack (PX4 / APM)
- Simulationkit
- High speed stereo
- AIT-Visual Inertial Odometry
- Local avoidance planner (VFH+ 3D)
- Global path planner (Octomap + graph)

# OPTICAL FLOW SIMULATION

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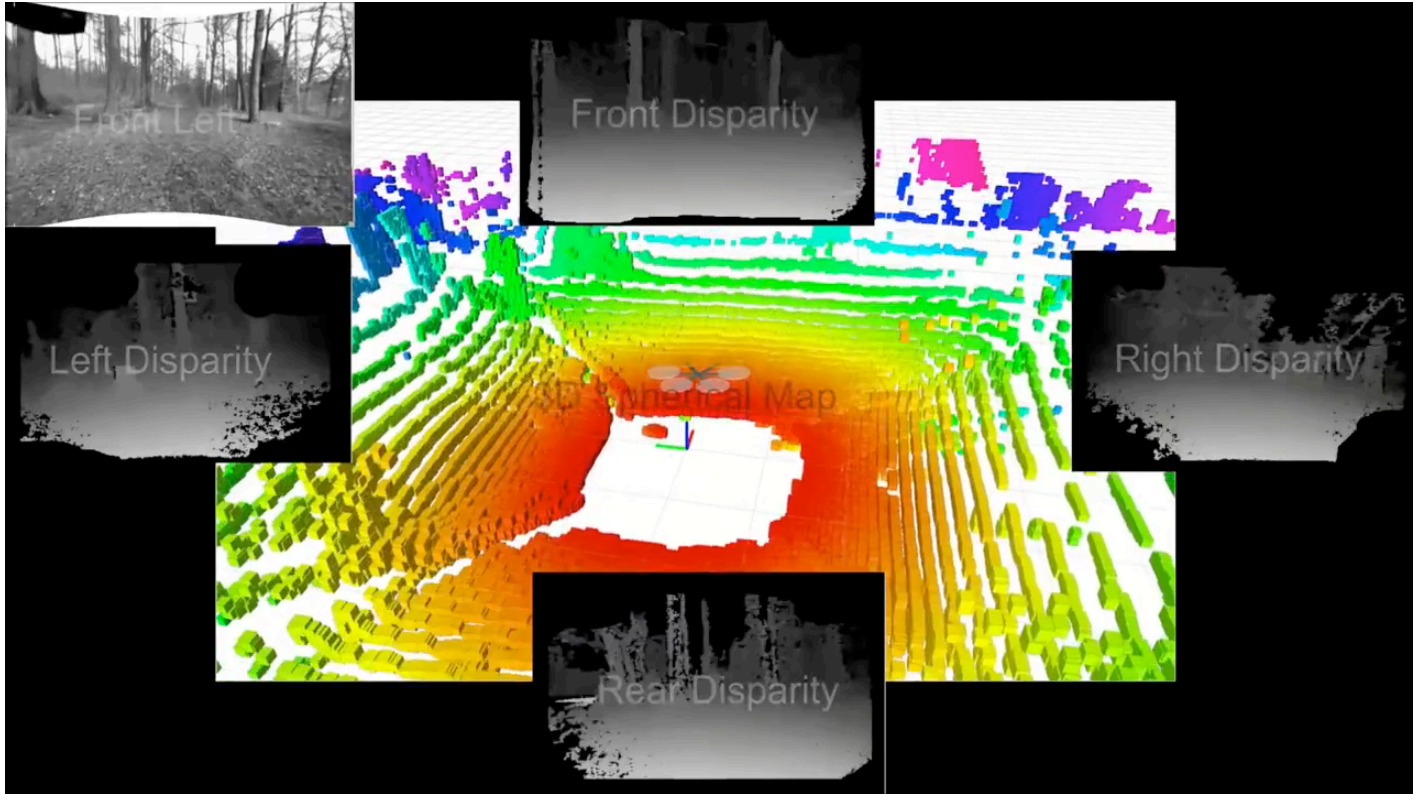
# REALTIME VISION




Pascal Gohl, Dominik Honegger, Sammy Omari, Markus Achtelik, Marc Pollefeys and Roland Siegwart. **Omnidirectional Visual Obstacle Detection using Embedded FPGA**. Proc. IEEE/RSJ Int. Conf. on Intelligent Robots and Systems (IROS), 2015

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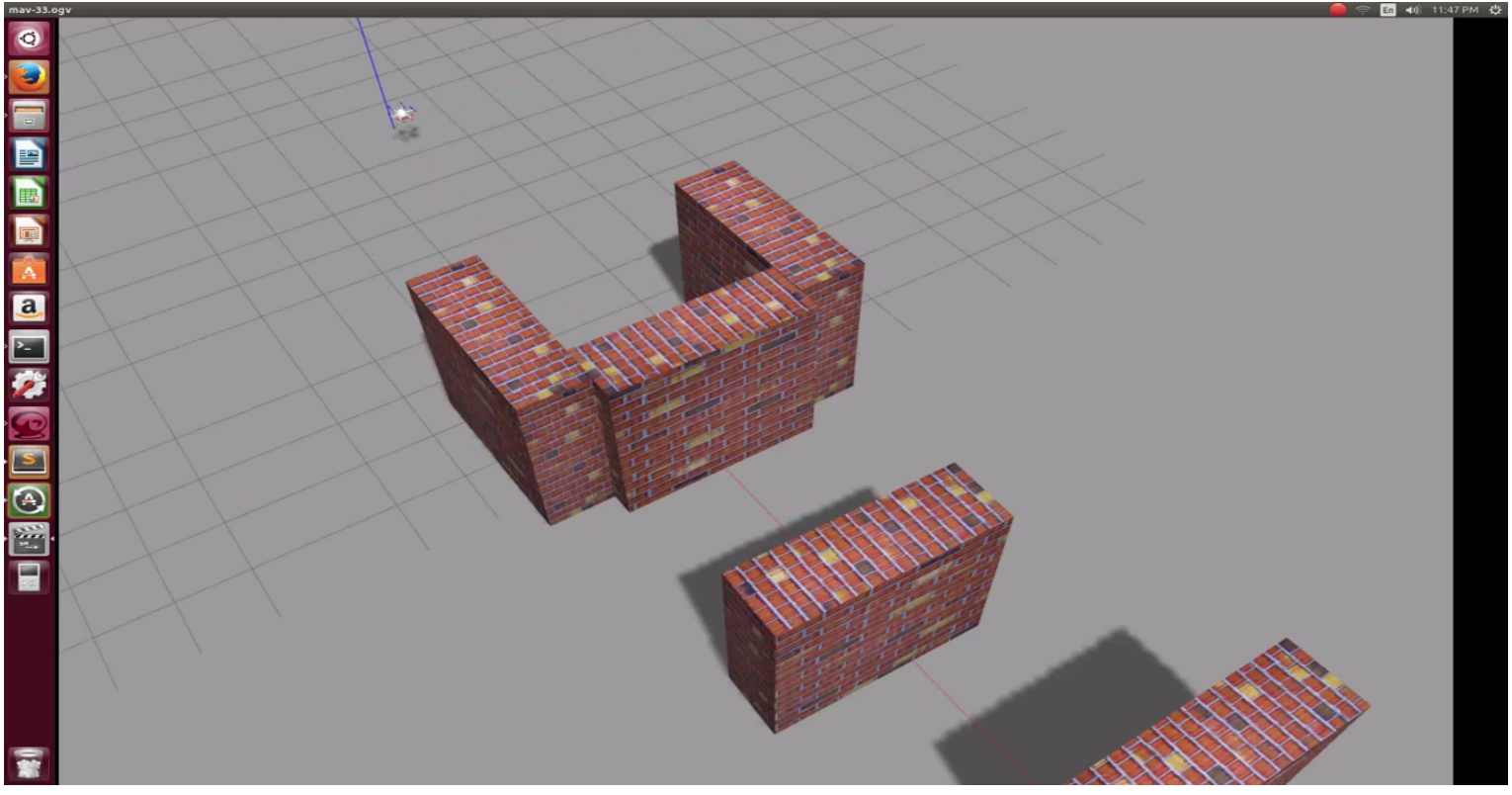
# AVOIDANCE

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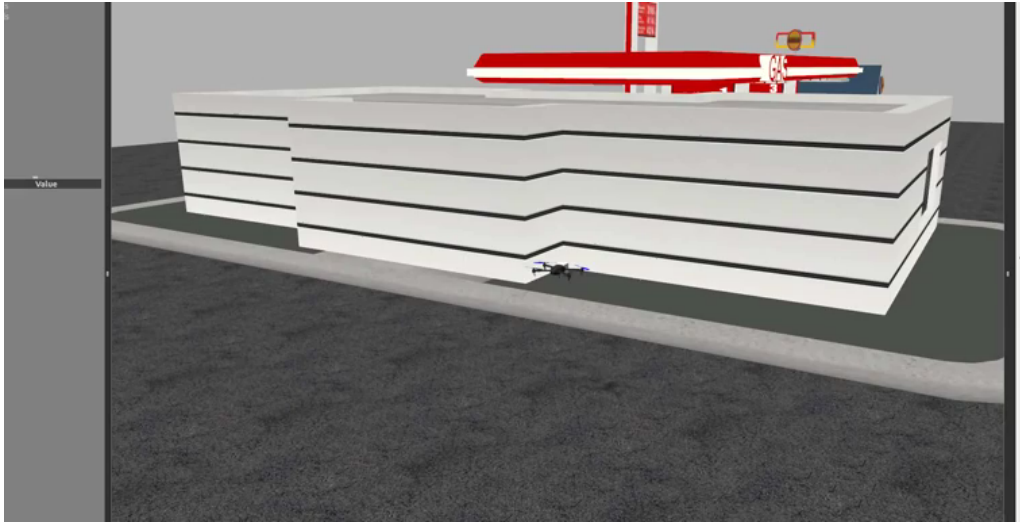
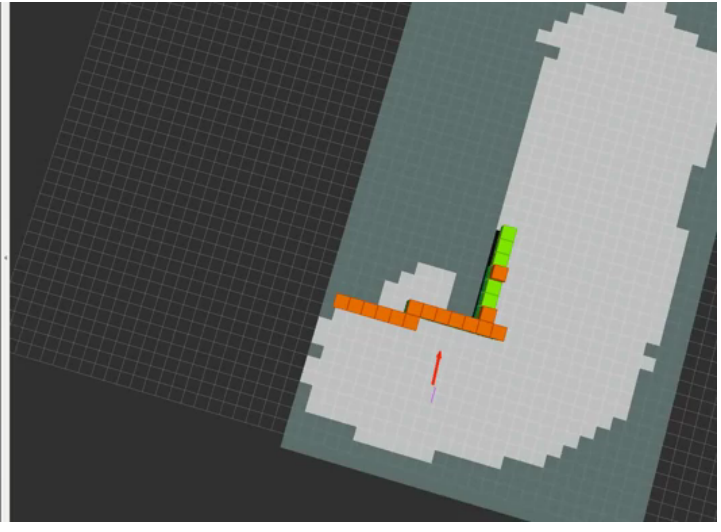
# GLOBAL PLANNING





# ACKNOWLEDGEMENTS / THANKS!


- ETH Zurich, CVG Lab
- Master students of ETH Zurich
- APM Dev team on middleware
- OSRF / ETH Zurich on Gazebo Simulator
- Paul Riseborough on EKF Fusion framework
- Pavel Kirienko on UAVCAN