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Real World Indoor and Outdoor Navigation Experiences with ROS

ROSCON 2013

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INTRODUCTION

- What is this presentation about?
- Navigation outdoor (Summit XL)
  Waypoint following using GPS DGPS (SBAS) and IMU in ROS
  =>Test low-cost hardware performance for outdoor localization and navigation
- Navigation indoor (AGVS)

  Indoor mapping and localization

  =>Analyze the applicability of Gmapping and AMCL for indoor logistic transport

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Outdoor Navigation

- Robot Simulation – packages used:

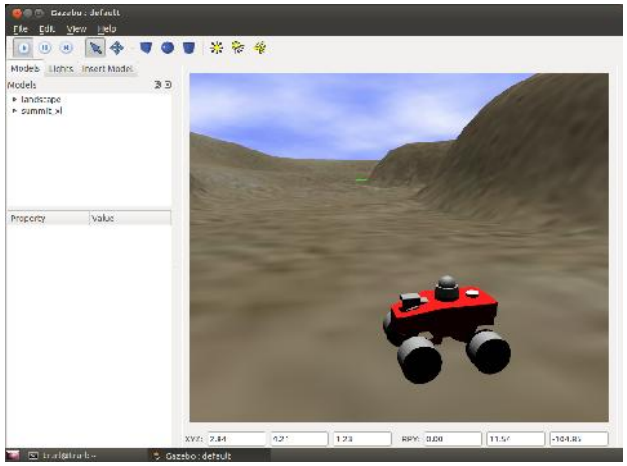
-**hector_gazebo_plugins** outdoor environment and gps plugin, NavSatFix message type

-gps_common, **utm_odometry_node** sensor_msgs/NavSatFix → sensor_msgs/Odometry (geodetic coordinates → cartesian coordinates)

-**robot_pose_ekf**: odometry_estimation (fusion of gps, imu, odometry)

-**summit_xl_wpts**: send a sequence of goals

-**summit_xl_2dnav** (move_base)



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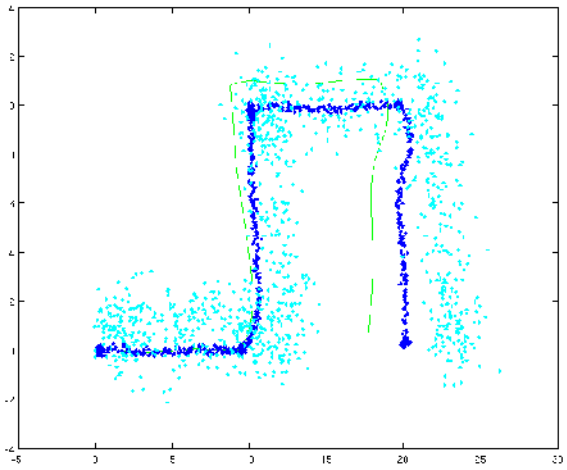
Outdoor Navigation

- robot_pose_ekf

Sensor inputs:

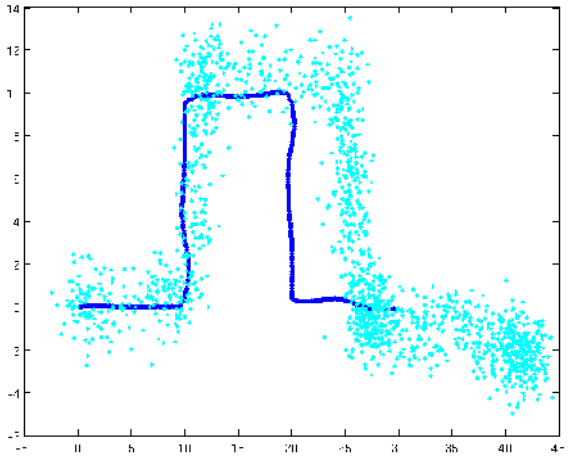
/summit_xl_odometry/odom @ 50Hz
/imu_data @ 1000Hz
/vo @ 4Hz
(/gps_conv converted gps data)

$\sigma_{gps} = (0.3\text{m})$



Desinged to filter only relative location estimations, it will provide an odometry estimation with an error that will grow unbound.

$\sigma_{gps} = (2.0\text{m})$



Covariance estimation is usually defined as constant and bound, this will lead to always believing the odometry over the gps as the odometry variance is usually in [mm] while the gps variance is in [m]

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Outdoor Navigation

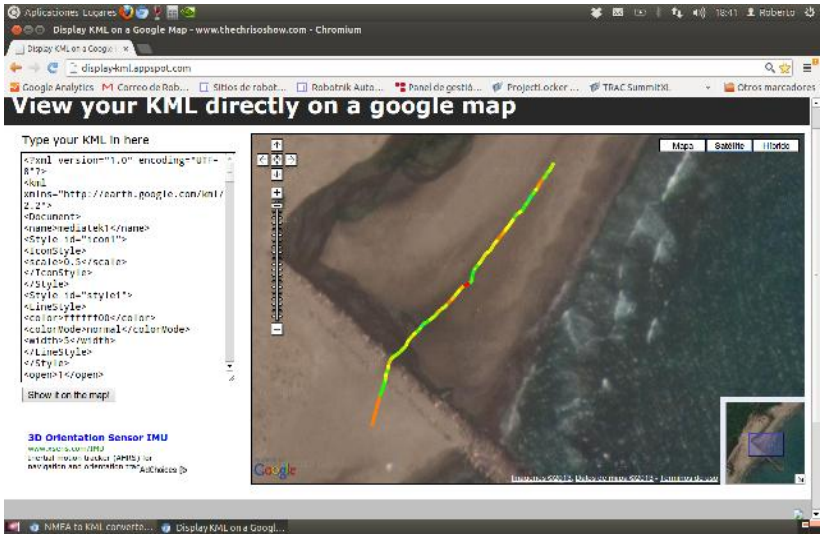
- SummitXL (sensor set)

  -GPS: Mediatek / uBlox-LEA6H / Novatel

(SBAS: EGNOS, WAAS, MSAS)

Precise point positioning for slow moving applications

-Internal Odometry (with gyro)



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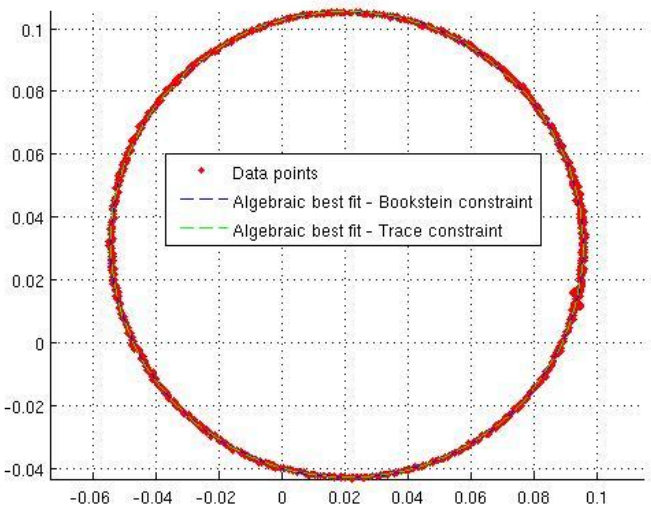
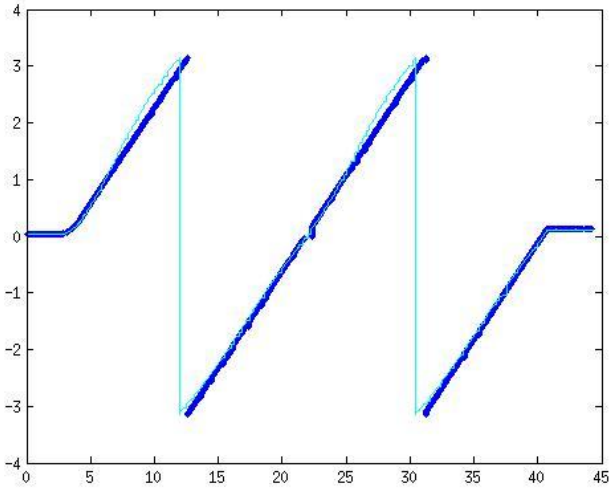
Outdoor Navigation

- SummitXL (sensor set)
  - -Absolute heading
    - -ArduImu
    - -GPS Heading – discarded





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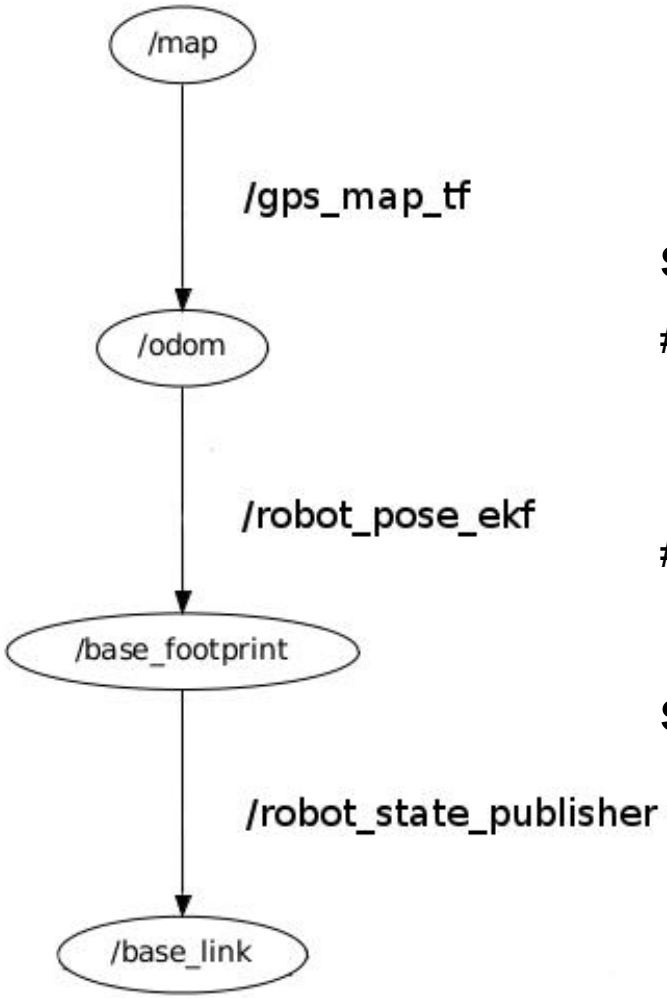
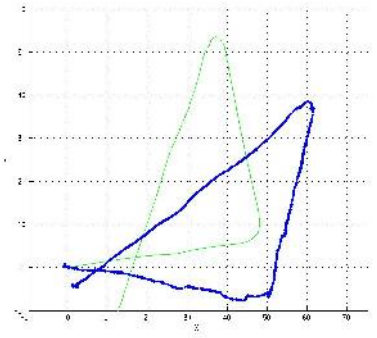
Outdoor Navigation



gps_map_tf :

set origin

align heading



summit_xl_navigation

Goal Tolerance Parameters

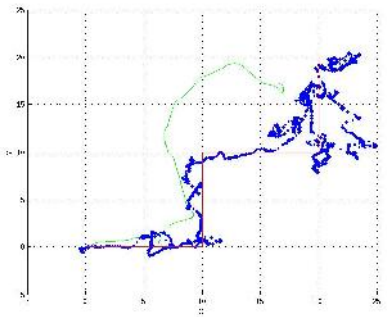
xy_goal_tolerance: 1.0

yaw_goal_tolerance: 0.3

Trajectory Scoring Parameters

heading_lookahead: 0.325

summit_xl_wpts



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Outdoor Navigation

- SBAS GPS Navigation

x2

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Outdoor Navigation

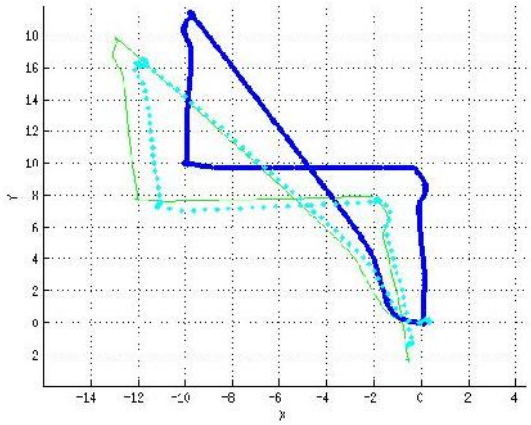
■Conclusions

-Easy implementation in ROS (gpsd_client, move_base, etc.)

-Able follow a path using low-cost GPS and imu, tested in SBAS conditions (full sky view)

-Allows to start working in outdoor navigation

-Long term accuracy not tested, but results seem to be enough for some applications (agriculture, lawnmovers, etc.)



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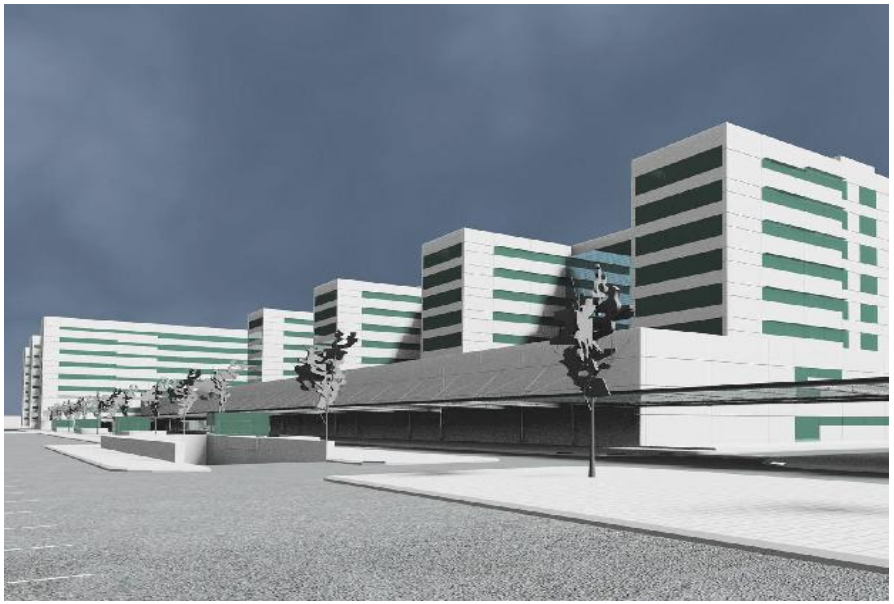
Indoor Navigation

- **Logistic intrahospital transporter**

-indoor transport (storage, medicines, clothes, food, waste)
-heavy trolleys
-about 20Km / person / day



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Indoor Navigation

- **Logistic intrahospital transporter**

-AGVS robot

Size – 1750x650x300 mm
Weight – 250 kg
Payload – 500 kg
Speed – 1,25 m/s
Communication – Wifi/3G/ETH
OS - LinuxRT

AGVS (Sensor set)
-S3000
-High accuracy odometry
-Magnetic landmark sensor

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Indoor Navigation

-Analyze the possibility of using only SLAM or a combined solution.

Traditional Landmark based localization	2D SLAM
+robustness +accuracy +speed	+flexibility +lasers already used for safety
-fixed (low flexibility) -installation cost	-reliability -accuracy -speed (?)

Indoor Navigation

- **Environment**

-Structured but changing environment (trolleys, persons, boxes, etc.)

-Characterized by long corridors (amcl position uncertainity)

-Several floors each one with a different map

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Indoor Navigation

- **Packages used**

  -**gmapping**, **amcl**, **s3000_laser**

- **Procedure**

  -Creation of a 2d Map of the largest navigation area
  -Pose estimation by using amcl
  -Analysis the amcl pose compared to the landmark based localization (ground_truth) and the raw odometry.

Indoor Navigation

- **Map**

Route length: ~200 m

Differences of gmapping map vs ground truth (orientation)

Indoor Navigation

x5

x1

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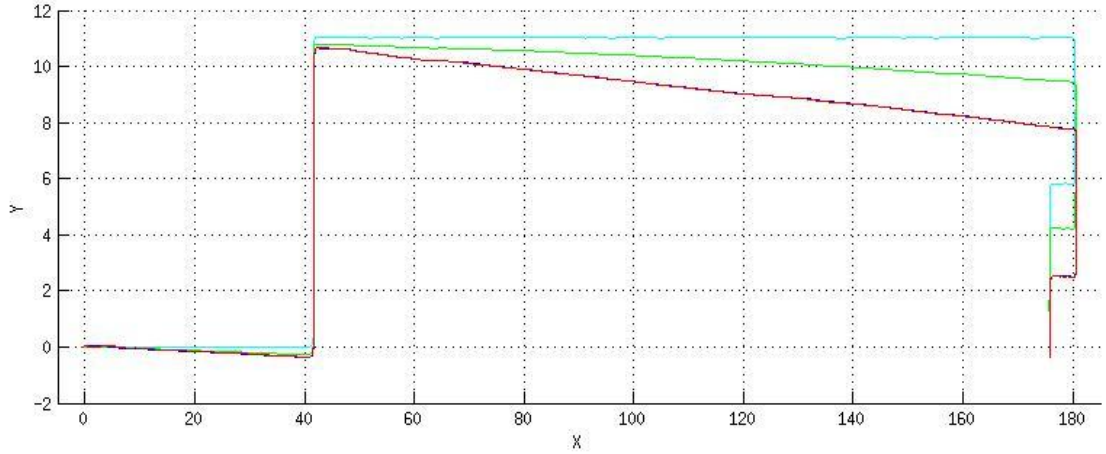
Indoor Navigation

- **Conclusions**



-amcl proves to be reliable in this environment (not a single loss in not crowded conditions)

-amcl has repeatability (using different sources of odometry and even using only one laser scanner)

-difficulty to get accurate map

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THANK YOU

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