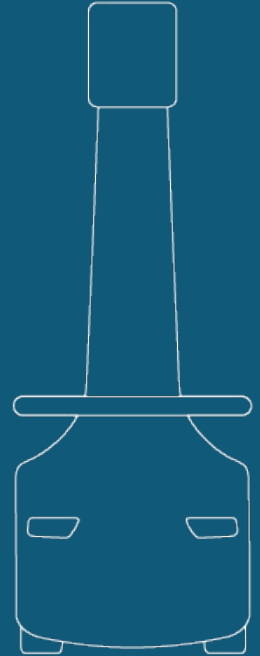


L O C U S

# Unleashing the GIS Toolbox on Real-Time Robotics

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ROSCon 2018  
Madrid, Spain



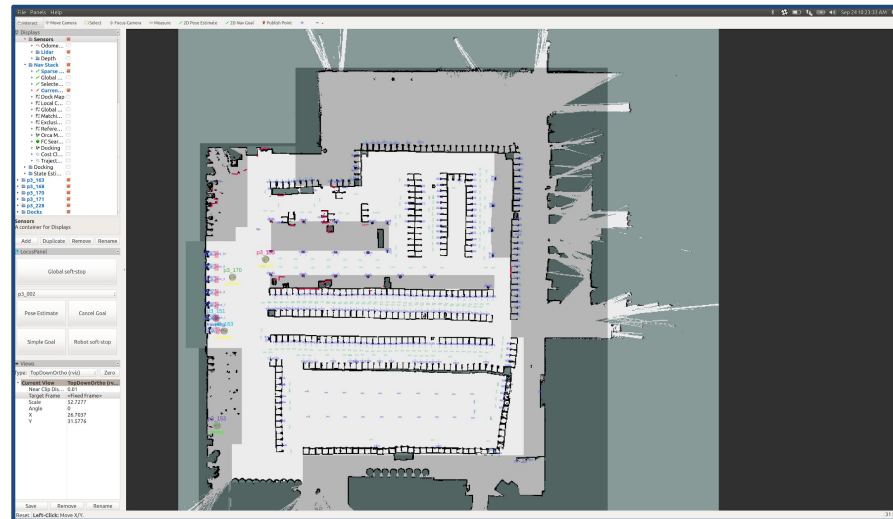
# Spatial Analysis in Mobile Robotics

- Understand real-time and historical state of an environment
- Explore spatial relationships
- Generate higher order datasets
- Communicate results



# RVIZ for Spatial Analysis

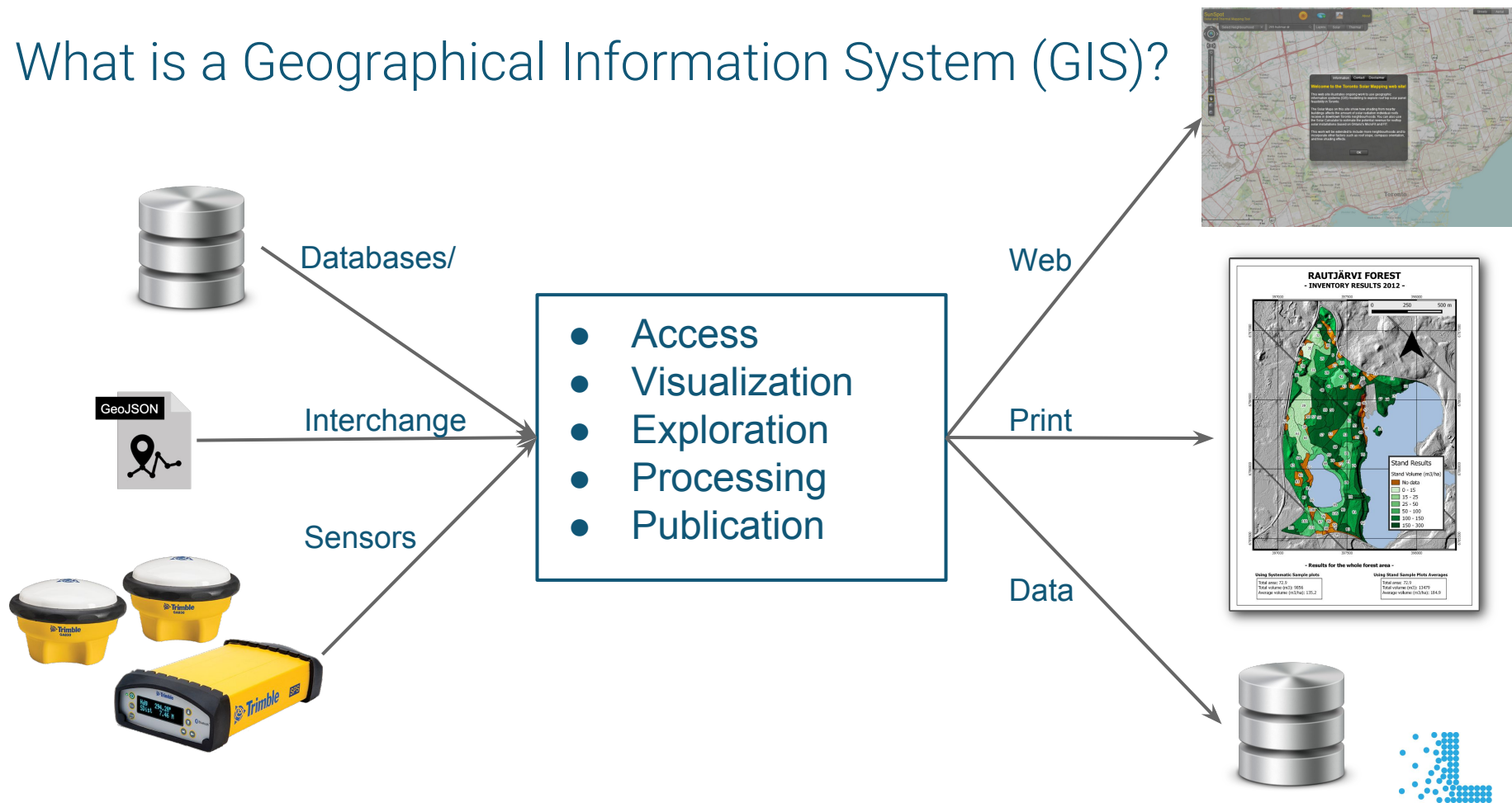
- Data exploration is expensive
  - RVIZ plugin development
  - Custom data processing nodes
- Visualization can be clumsy
  - Eg. republish data in a label-friendly format
- Sharing results is not first-class
  - Screen image/video capture



Let's use GIS!

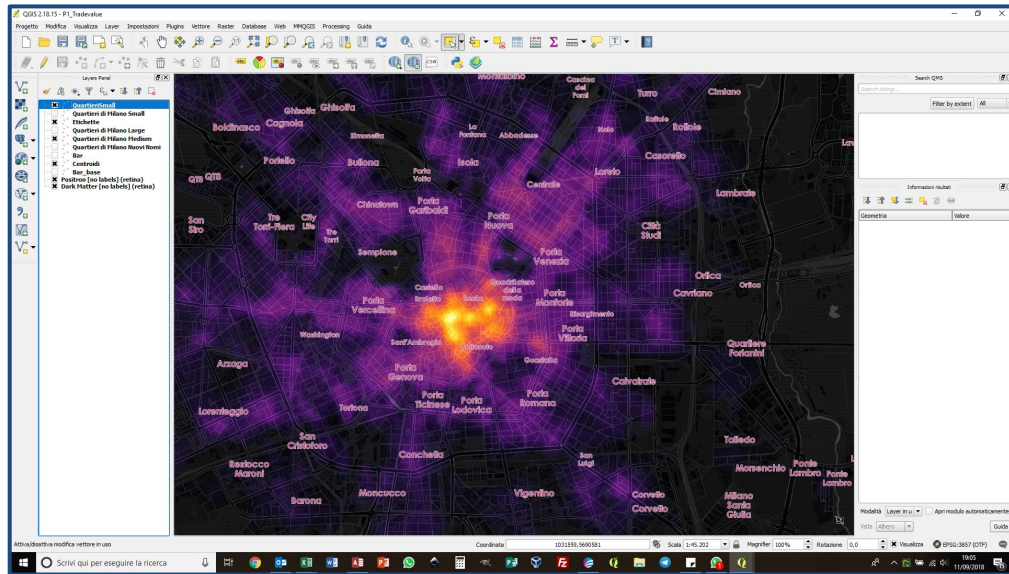


# What is a Geographical Information System (GIS)?



# What is QGIS?

- Open Source
- Linux, Windows, MacOS
- Qt4, Qt5
- C++ API
- Python API Bindings
- Plugin based
- Initial Release: 2002
- <https://www.qgis.org>

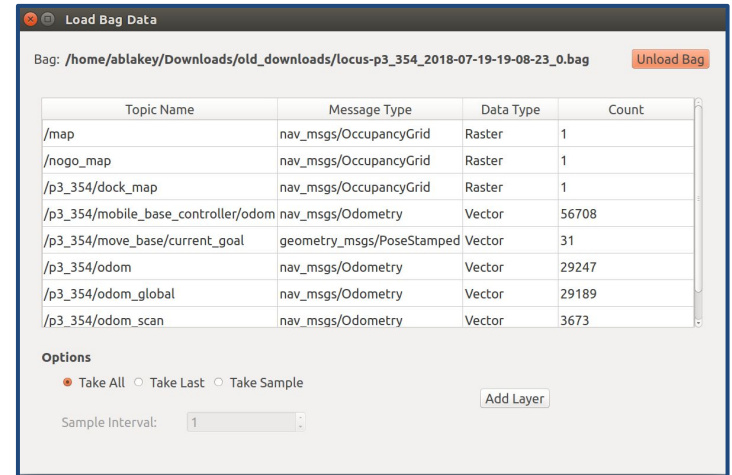
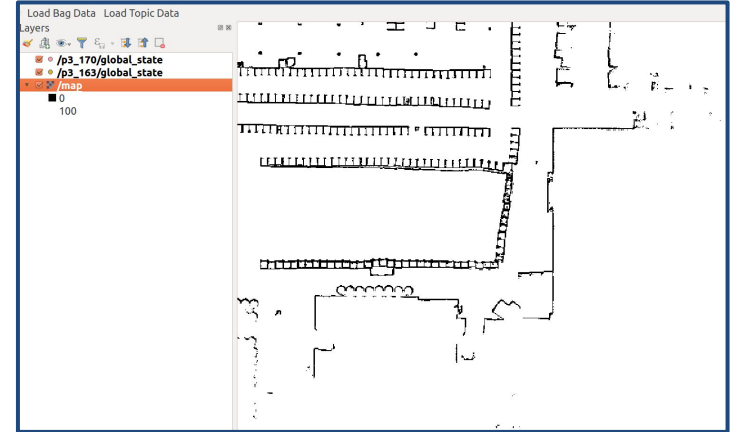


Source: Flickr/city-planner



# Introducing QGIS-ROS

- QGIS Plugin
- Access **live** and **bagged** ROS data
- Supports vector, raster, non-spatial layers
- Supports custom message types by implementing `Translator` subclasses.
- [github.com/locusrobotics/qgis\\_ros](https://github.com/locusrobotics/qgis_ros)



Load Bag Data Load Topic Data

Layers

- 1 /p3\_163/global\_state
  - /map
    - 0
    - 100

Processing Toolbox

Search...

- Recently used
- Cartography
- Database
- File tools
- Graphics
- Interpolation
- Layer tools
- Network analysis
- Raster analysis
- Raster terrain analysis
- Raster tools
- Vector analysis
- Vector creation
- Vector general
- Vector geometry
- Vector overlay

Load Topic Data

ROS Master: <http://wrangler.dev.locus:11311>

Topic Name	Message Type	Data Type
/p3_002/connection	wireless_msgs/Connection	Table
/p3_002/global_state	locus_msgs/GlobalState	Vector
/p3_002/move_base/current_goal	geometry_msgs/PoseStamped	Vector
/p3_151/cancel	std_msgs/String	Table
/p3_151/connection	wireless_msgs/Connection	Table
/p3_151/global_state	locus_msgs/GlobalState	Vector

Options

☐ Subscribe ☒ Take Latest

Sample Interval: 1 Keep older messages: ☐

Add Layer

/p3\_163/global\_state :: Features Total: 1, Filtered: 1, Selected: 0

	velocity_y	robot_name	velocity_theta	velocity_x	stamp
1	1.93620011...	p3_163	-3.263553663174...	-8.3644355...	153779984...

Show All Features



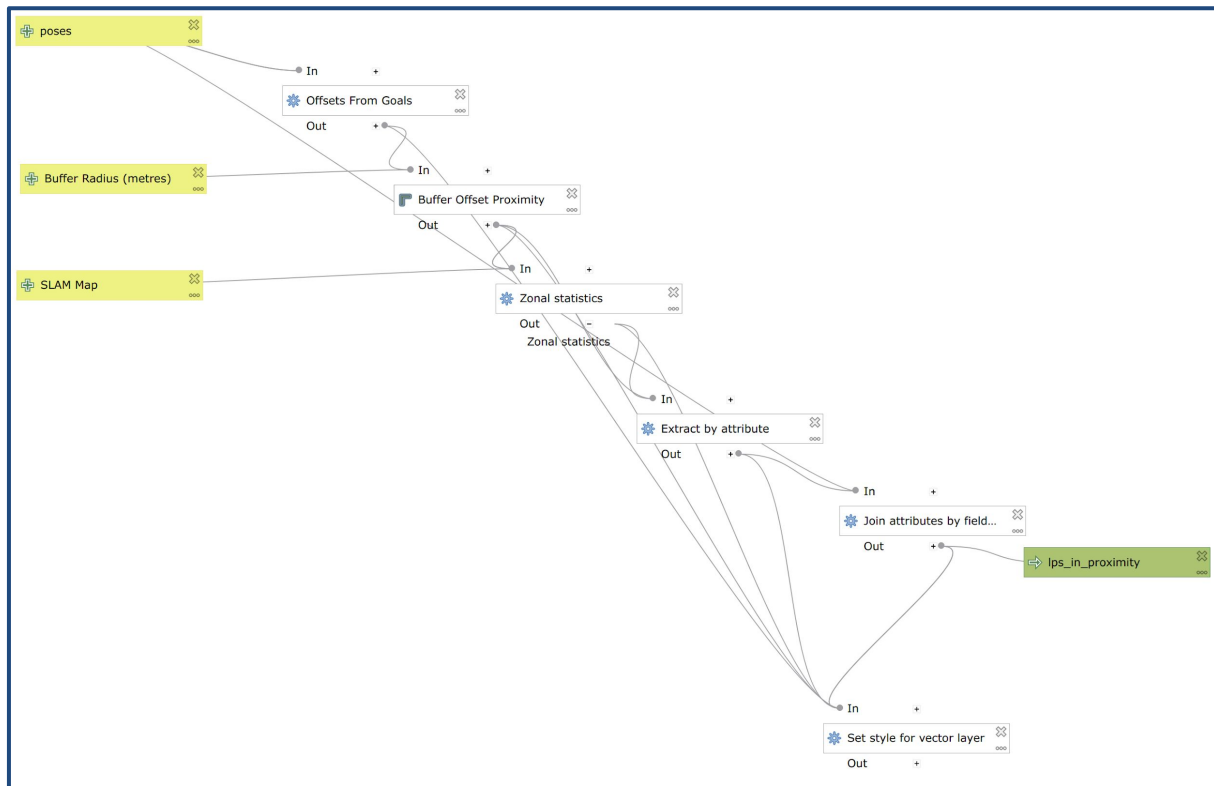
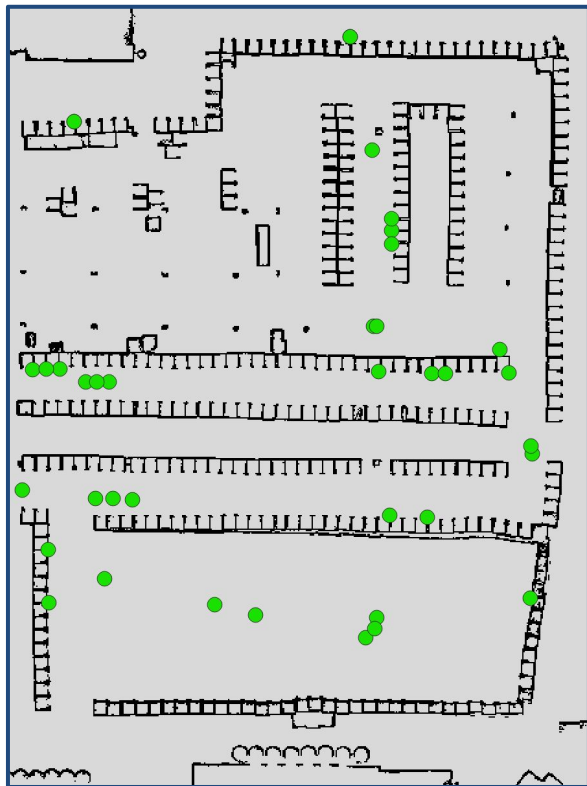
# Examples



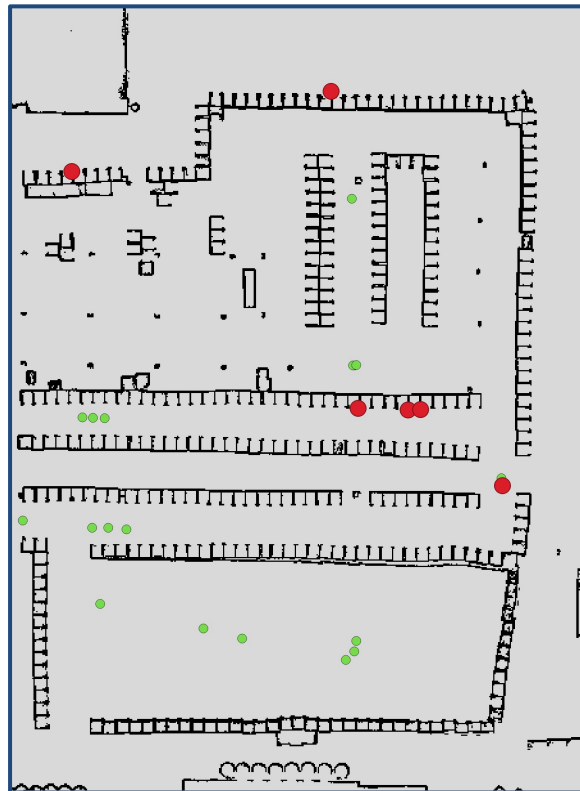
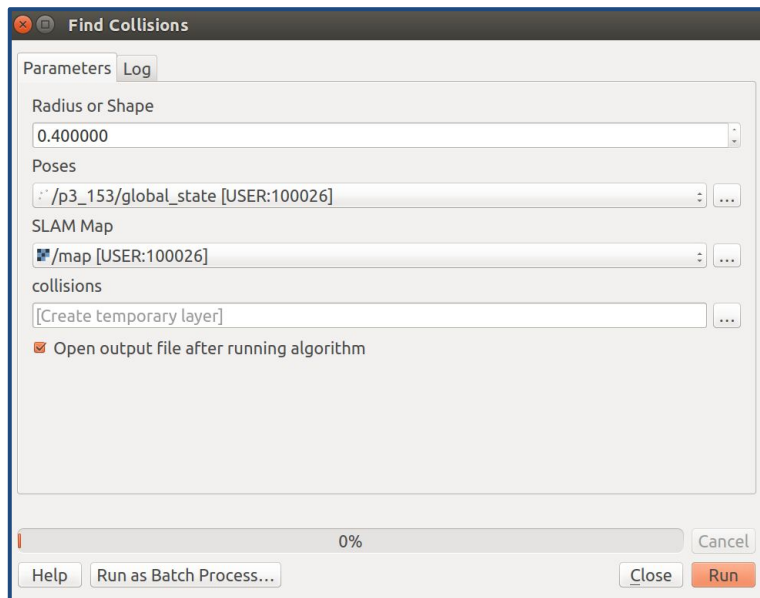
# Example 1: Processing Pipelines



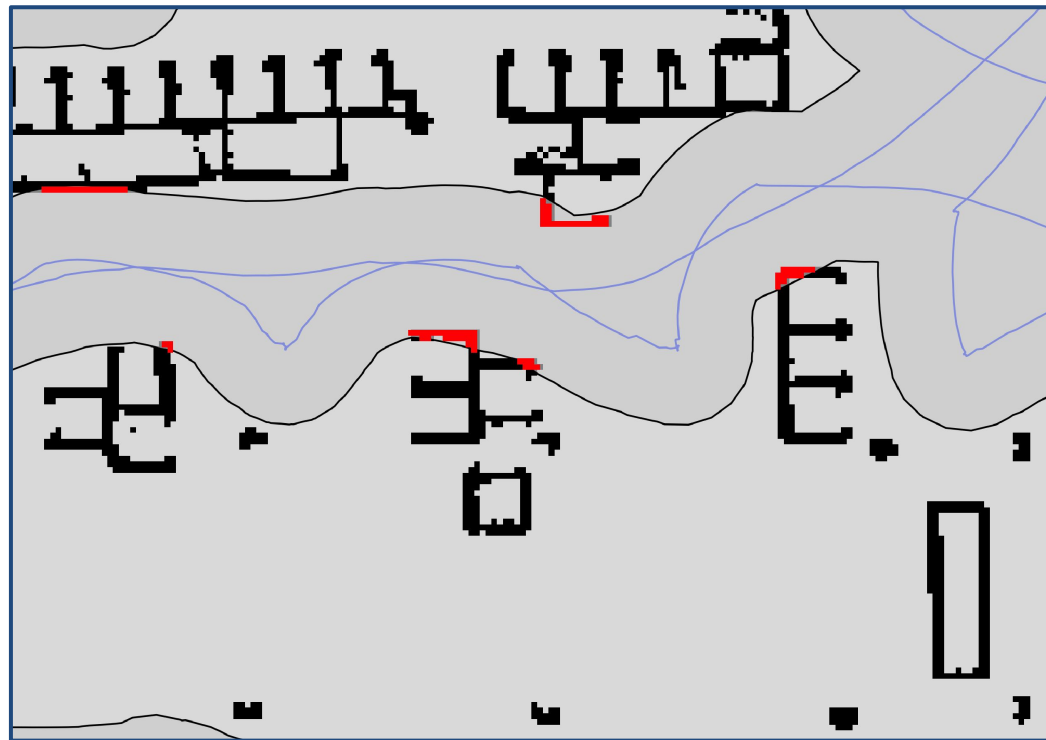
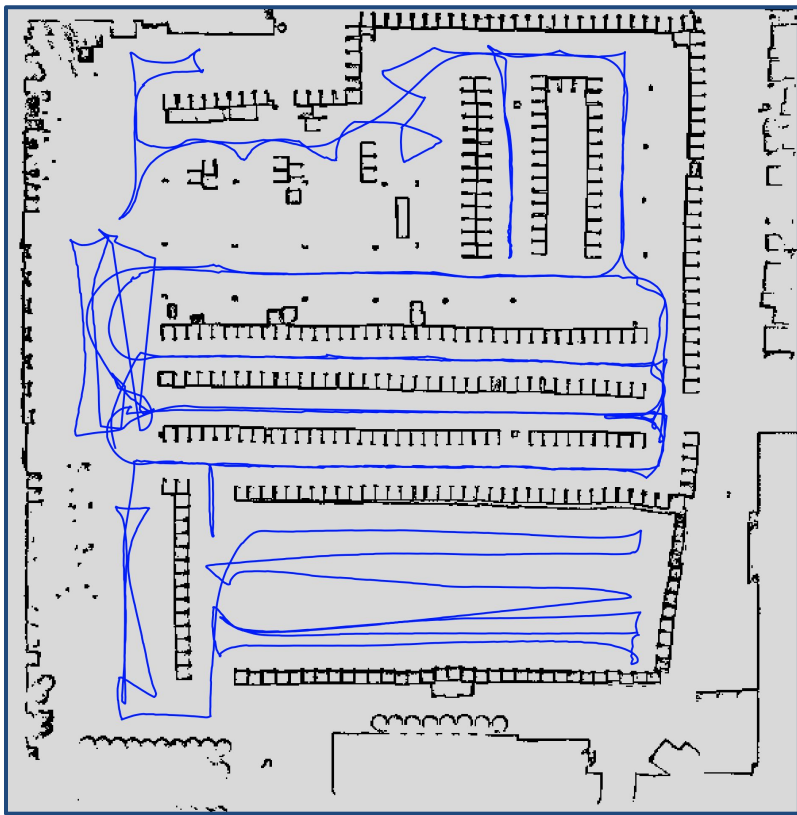
# Example 1: Processing Pipelines



# Example 1: Processing Pipelines



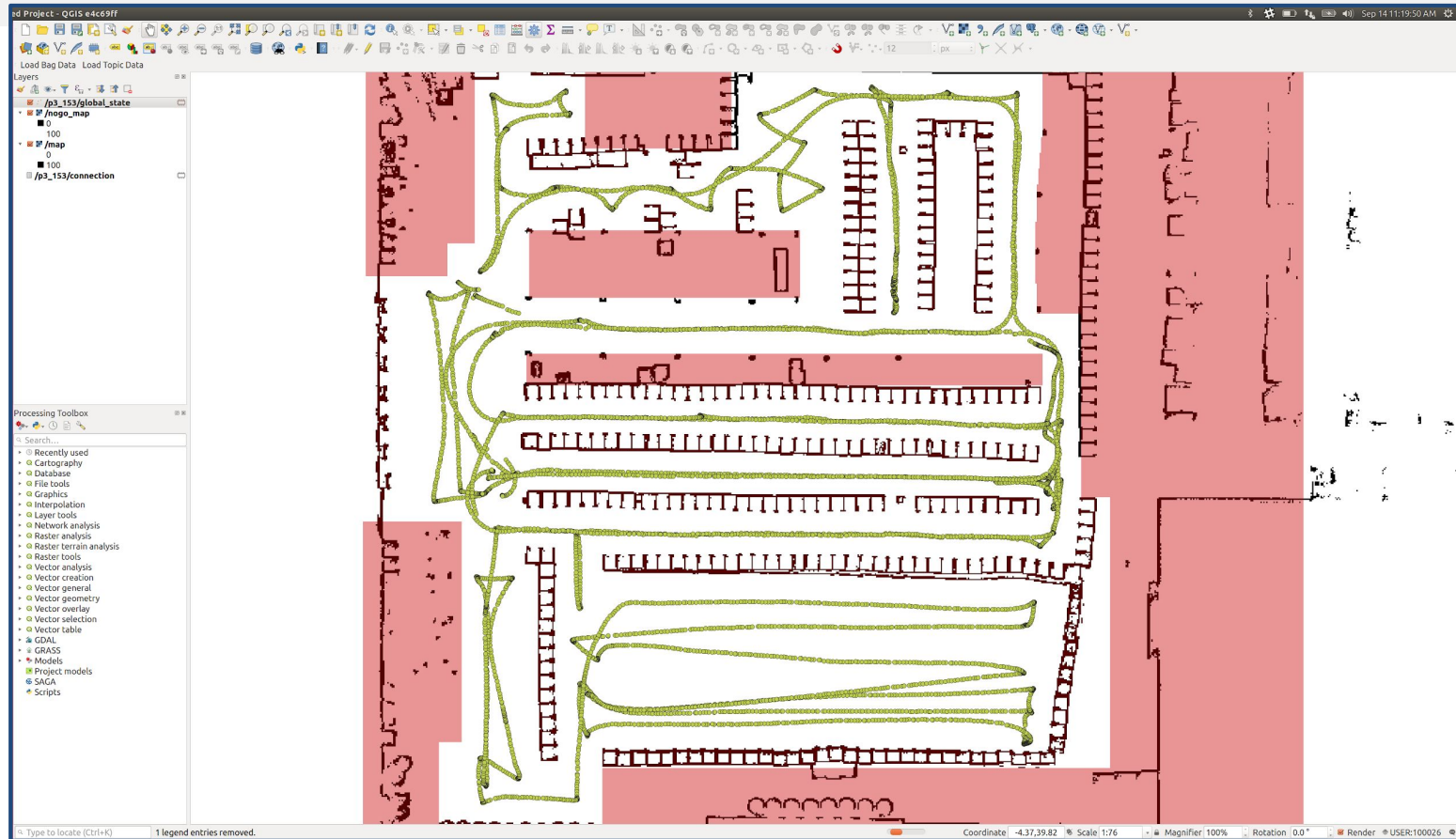
# Example 1: Processing Pipelines



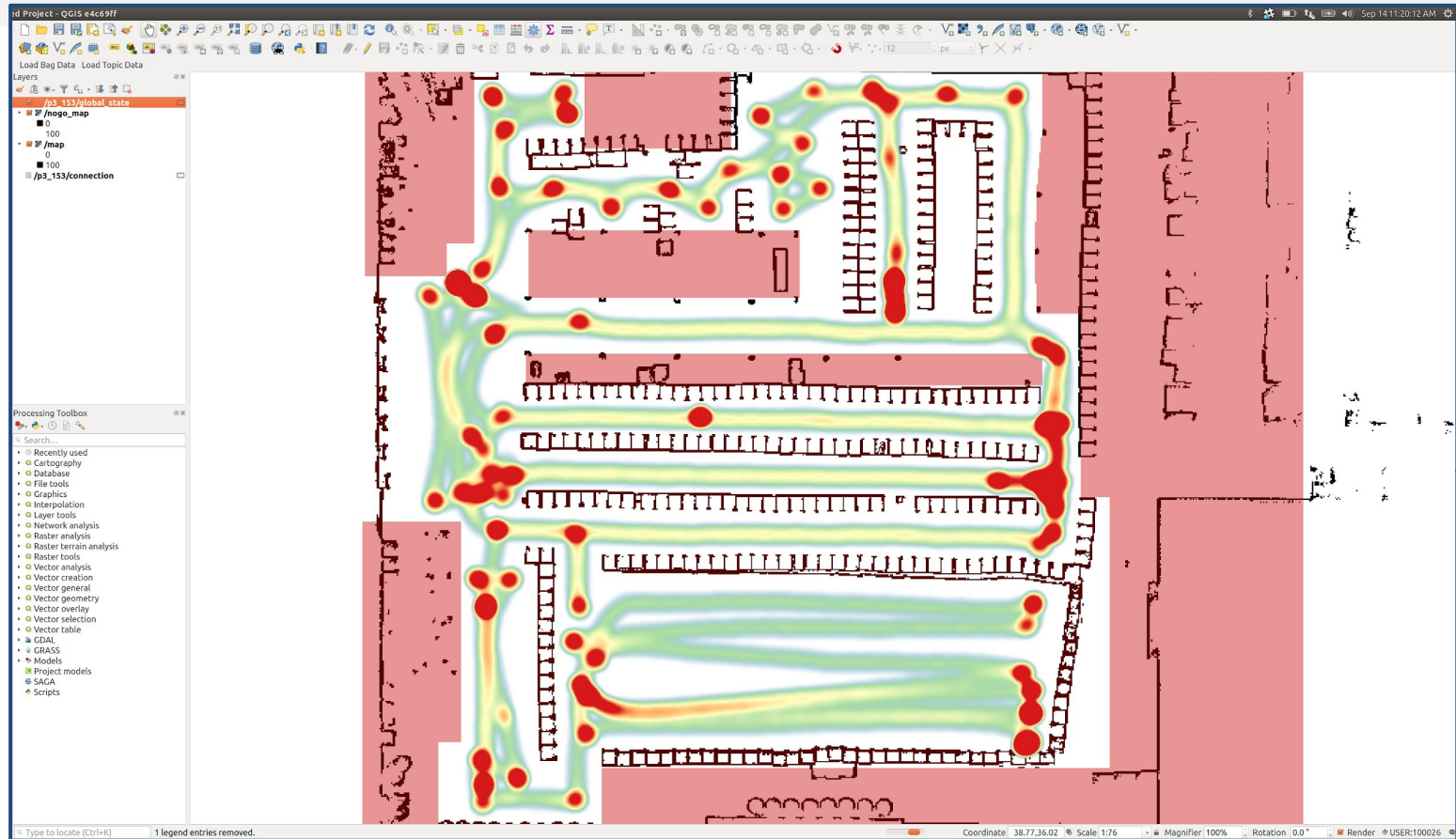
# Example 2: Data Visualization



# Example 2: Data Visualization

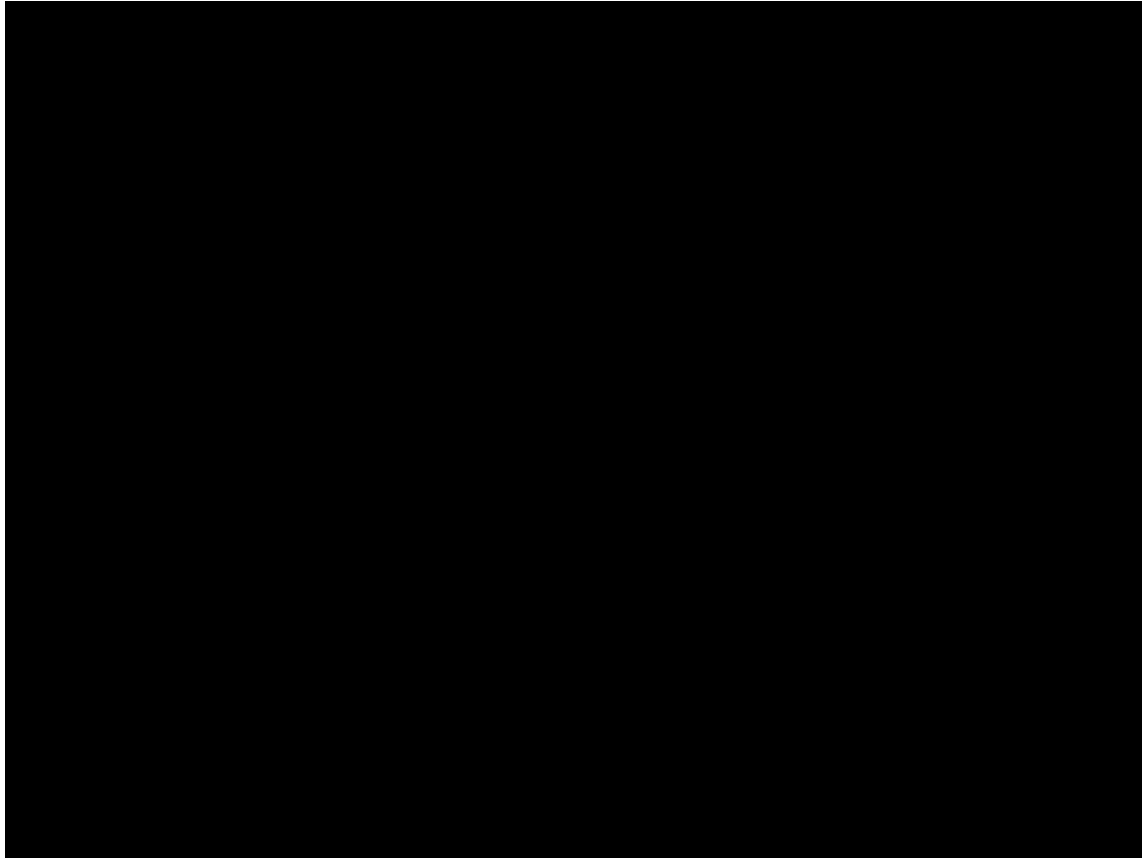


# Example 2: Data Visualization





## Example 2: Find Robot Congestion



# Example 3: Analyze Non-Spatial Data



# Example 3: Analyze Non-Spatial Data

wireless\_msgs/Connection

/p3\_153/connection :: Features Total: 144, Filtered: 144, Selected: 0

	bitrate	signal_level	sigTimestamp	frequency	stamp	nk_quality_rai
1	6	-55	153686183...	5.21999999...	153686183...	55/70
2	6	-53	153686184...	5.21999999...	153686184...	57/70
3	6	-57	153686184...	5.21999999...	153686184...	53/70
4	6	-45	153686185...	5.21999999...	153686185...	65/70
5	6	-55	153686185...	5.21999999...	153686185...	55/70
6	6	-60	153686194...	5.21999999...	153686194...	50/70
7	6	-60	153686194...	5.21999999...	153686194...	50/70
8	6	-56	153686195...	5.21999999...	153686195...	54/70
9	6	-59	153686195...	5.21999999...	153686195...	51/70
10	6	-65	153686196...	5.21999999...	153686196...	45/70
11	6	-60	153686196...	5.21999999...	153686196...	50/70

Show All Features

geometry\_msgs/Pose2d(ish)

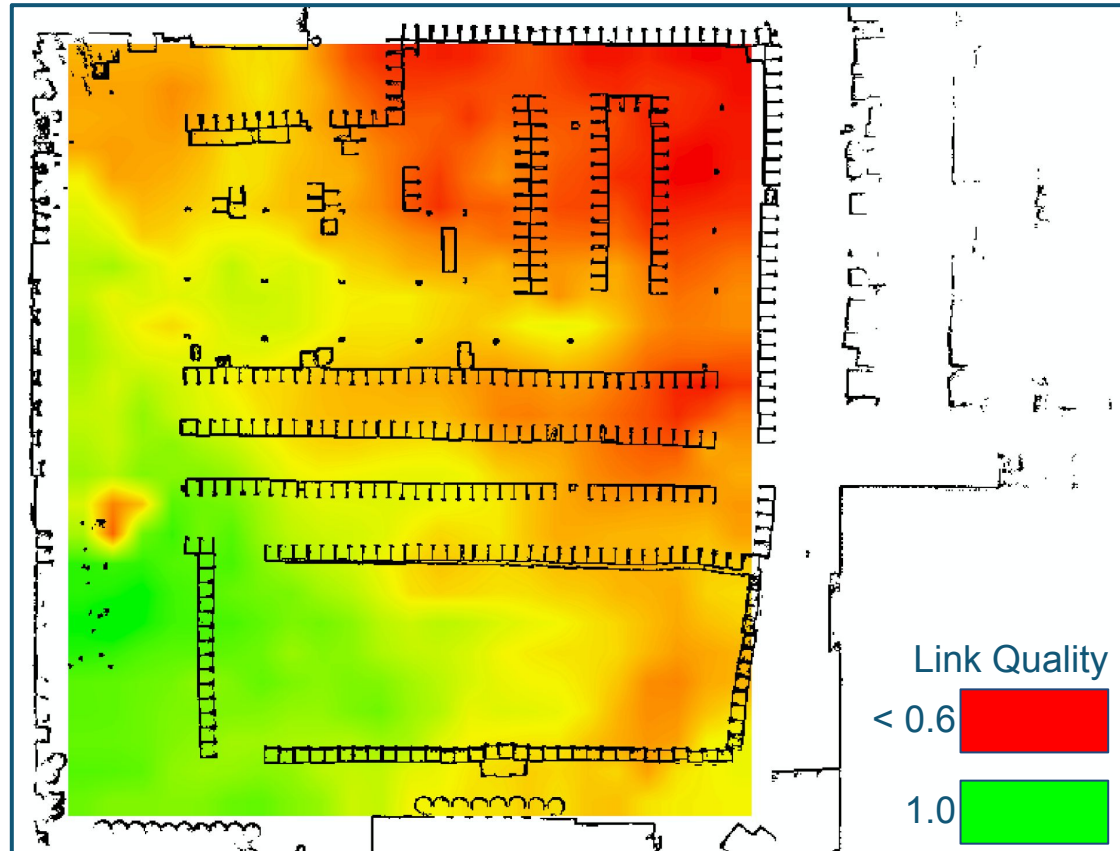
/p3\_153/global\_state :: Features Total: 362, Filtered: 362, Selected: 0

	velocity_y	sigTimestamp	stamp	velocity_x	velocity_theta	robot_name
1	0.89310044...	153686184...	153686184...	-0.2518345...	-0.2302937...	p3_153
2	0.32104092...	153686184...	153686184...	-0.0518803...	-0.0815087...	p3_153
3	1.06470930...	153686184...	153686184...	-0.2291792...	0.05059212...	p3_153
4	1.01489245...	153686185...	153686185...	0.35876235...	-0.3497394...	p3_153
5	-0.8499709...	153686182...	153686182...	-0.6924911...	0.3462204...	p3_153
6	-0.6718613...	153686182...	153686182...	-0.1472423...	0.11027581...	p3_153
7	-1.0808378...	153686182...	153686182...	-0.0539792...	0.06466072...	p3_153
8	-1.0099521...	153686182...	153686182...	-0.0214446...	0.11576318...	p3_153
9	-0.0767068...	153686182...	153686182...	-0.0375956...	-1.8675255...	p3_153
10	0.04625532...	153686183...	153686183...	-1.0066308...	0.15224081...	p3_153
11	-0.2571779...	153686183...	153686183...	-0.9934945...	0.27282738...	p3_153
12	0.44119548...	153686183...	153686183...	-0.1118251...	-0.5005379...	p3_153

Show All Features



# Example 3: Analyze Non-Spatial Data



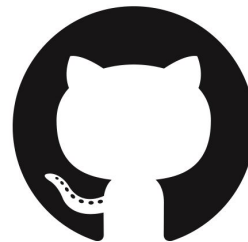
# Future Work...

- Better documentation, examples, sample data
- Map Frame -> World Frame using map projections
- Publish data into ROS environment
- Performance improvements for high volume data
- ROS2 support

...Collaboration Welcome!



# Thank you.



`github.com/locusrobotics/qgis_ros`



`ablakey@gmail.com`



`@LocusRobotics`



LOCUS

`LocusRobotics.com/careers`

