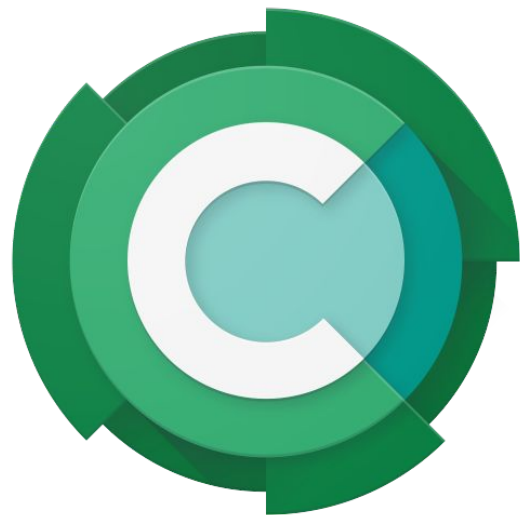


# 19th Cartographer Open House

2018-03-05  
(yyyy-dd-mm)



# What landed on master? • cartographer

- Task-based multithreading
  - Introduce Task (#1066)
  - Schedule Task in ThreadPool (#1113)
  - Pessimist ~Locker (#1125)
  - Use Task in ConstraintBuilder2D (#1118)
  - Use Task in ConstraintBuilder3D (#1119)
- Generic grids to support signed-distance fields
  - Introduce Grid2D as base class for 2D grids (#1046)
  - Replace Submap2D grid member by unique\_ptr (#1073)
  - Correspondence cost based probability grid (#1081)
  - Base ceres scan matcher on correspondence cost function (#1085)
  - Base ConstraintBuilder2D on correspondence cost function (#1088)
  - Replace ProbabilityGrid in Submap2D by Grid2D (#1097)
  - Introduce Grid and RangeDataInserter (#1108)
- Deserialize landmark poses. (#1064)
- Add sparse Eigen support to Bazel build. (#1074)

# What landed on master? • cartographer

- gRPC server
  - Update unfinished submap list on SLAM thread (#1061)
  - Add a gRPC version of SetLandmarkPose(). (#1068)
  - Switch to batch uploading for cloud based mapping and add retries (#1070)
  - Add error messages for gRPC connection failures (#1072)
  - Introduce option to enable SSL encryption for LocalTrajectoryUploader (...)
  - Add async\_grpc dependency to cartographer\_grpc (#1079)
  - Introduce metric to measure the length of the SLAM queue (#1117)
  - Register MapBuilderServer metrics (#1133)
- Lifelong mapping
  - Add overlapping trimmer params to TrajectoryBuilderOptions. (#1076)
  - Use area instead of cells count for overlapping trimmer options. (#1080)
  - Invoke trimmer only when there are enough added submaps. (#1095)
  - Return only optimized & finished submaps for trimmer. (#1104)
  - Transform submap cells to global frame correctly. (#1130)

# What landed on master? • cartographer

- Enhancements and tests

- Fix glog warning (#1082)
- ThreadPoolForTesting (#1098)
- Test ConstraintBuilder2D/3D (#1100)
- Suppress warnings for Bazel third\_party deps (#1054)
- add check (#1063)
- Speed up slow tests (#1077)
- Allow execution of Submap2D::ToResponseProto without a grid (#1078)
- Update Prometheus to avoid warning (#1058)
- Use references for constraints & nodes in TrimmingHandle. (#1091)
- Limit `bazel test` parallelism more precisely (#1094)
- Removed check for existence of first submap of first trajectory in po...
- Test GlobalSlam3D (#1114)
- Added a fake file writer (writes to string instead of file) (#1101)
- fixed that tests not getting linked against prometheus-cc (#1131)

# What landed on master? • cartographer

- Refactor
  - Move to testing/. (#1067)
  - Clean-up colliding 'SubmapData' names. (#1096)
  - Move files related to optimization to optimization/. (#1102)
  - Move constraint\_builders together. (#1103)
  - Added cartographer test library to CMake project (#1129)
- Rename metrics since slashes are not allowed in Prometheus (#1115)
- ...

# What landed on master? • `cartographer_ros`

- Enable rendering of submaps without a grid (#829)
- Extract assets writer class from static method (#827)
- [`cartographer_ros_msgs`] add run dependency on `message_runtime` (#800)
- Registration of external points processors in `AssetsWriter` (#830)
- Internal cleanup. (#821)
- Add a launch and configuration file for writing a ROS map (#577) (#721)
- Remove unused variable from `submaps_display.cc` (#840)
- Fix Clang thread safety guards in `drawable_submap.h` (#839)
- Follow up on `googlecartographer/cartographer#1108` (#838)

## What landed on master? • `point_cloud_viewer`

- Fix bug where old objects could get stuck and never updated. (#124)
- Upgrade THREE.js (#127)
- Refactor to enable more than one way of creating tiles from points. (#...
- Adds a strategy for creating colored images from the colors in the po...
- Add `dispose()` into the `xRayViewer` so that it clears out the THREE sce...

# What landed on master? • `async_grpc`

- Add CallCredentials for token files. (#13)
- Add package.xml for Catkin (#15)
- Update README.md page with documentation. (#17)
- Add unary RPC usage example (#18)



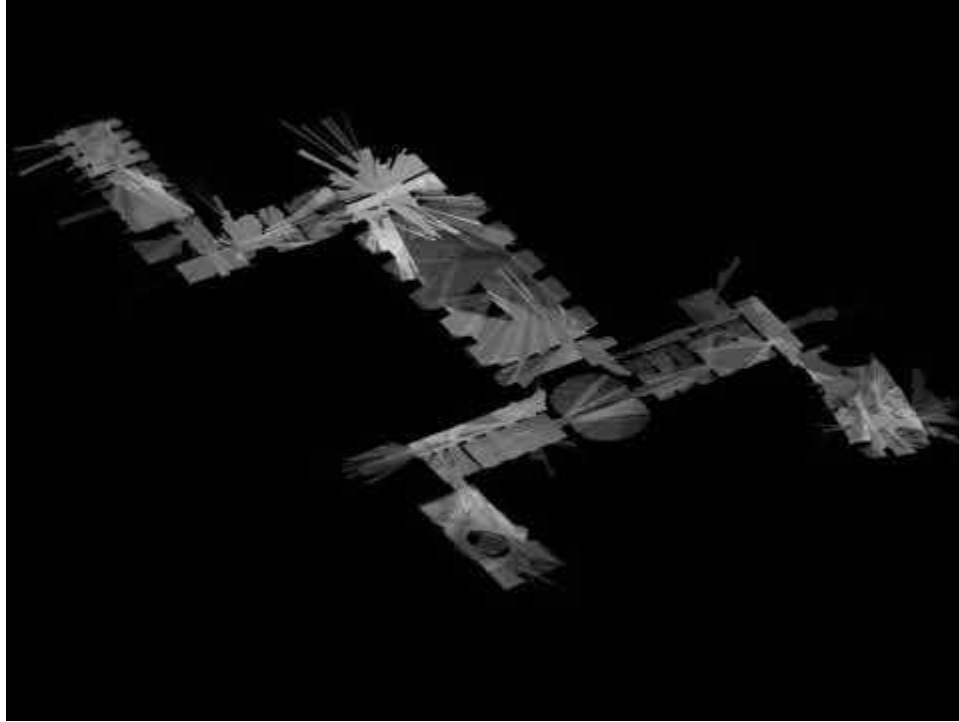
# What landed on master / pending PRs? • `rfcs`

- (no updates)

# Task-based Multithreading

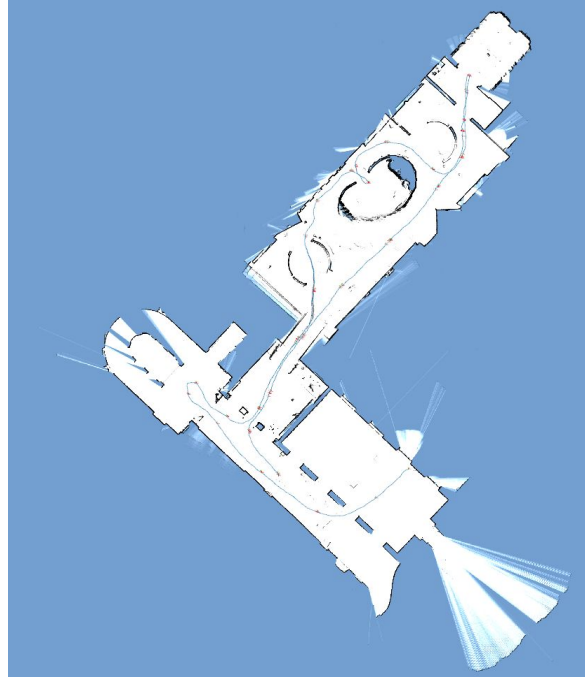
- ThreadPool receives `common::Task` (instead of `std::function`)
  - takes ownership
  - returns `weak_ptr` so callers can later add dependencies and get status
- Task may have dependencies to other tasks
- Background threads execute tasks that are not waiting for dependencies
- Status: merged
- Also tried to [integrate `absl::Mutex`](#) (1% shorter wall clock time), but no clear path for CMake support

# Overlapping trimmer



2 submaps per pixel, 1 sq. m. min covered area

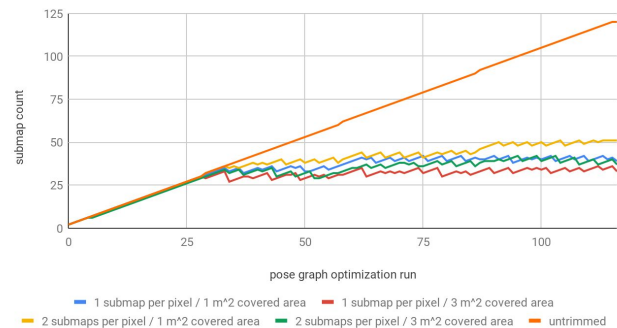
# Overlapping trimmer: cyclic run



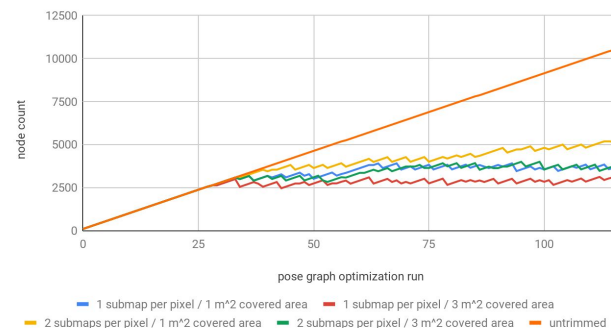
Rosbag: [b0-2014-07-11-10-58-16.bag](#) was run 4 times in a row, starting a new trajectory every time.

# Overlapping trimmer: performance

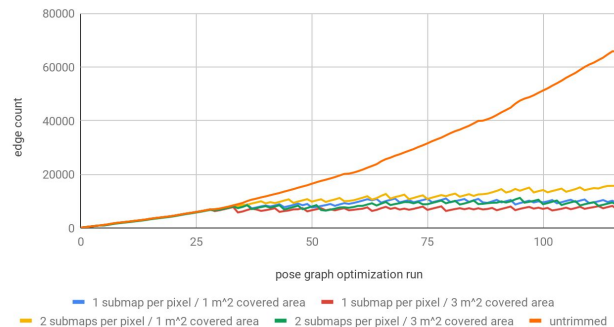
Submap count



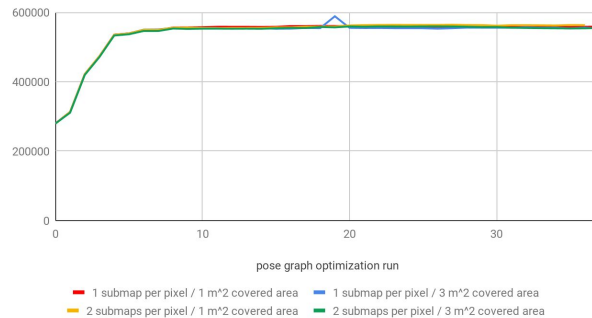
Node count



Pose graph edges (constraints)

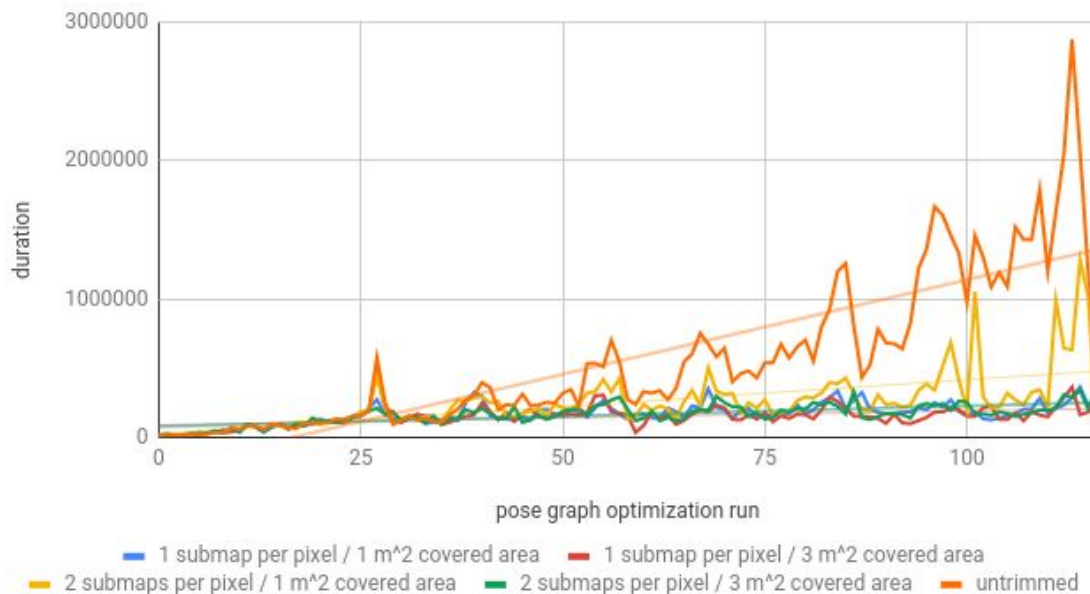


Area of the global map



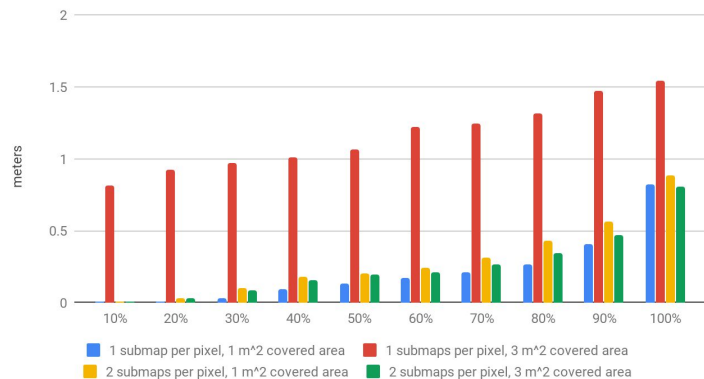
# Overlapping trimmer: performance

Duration of optimization run

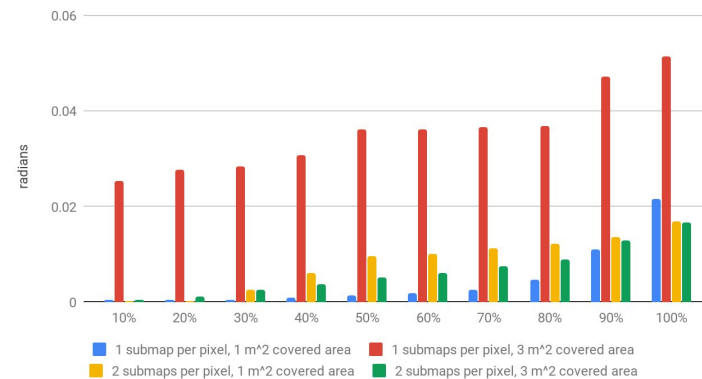


# Overlapping trimmer: quality

Distribution of translation difference

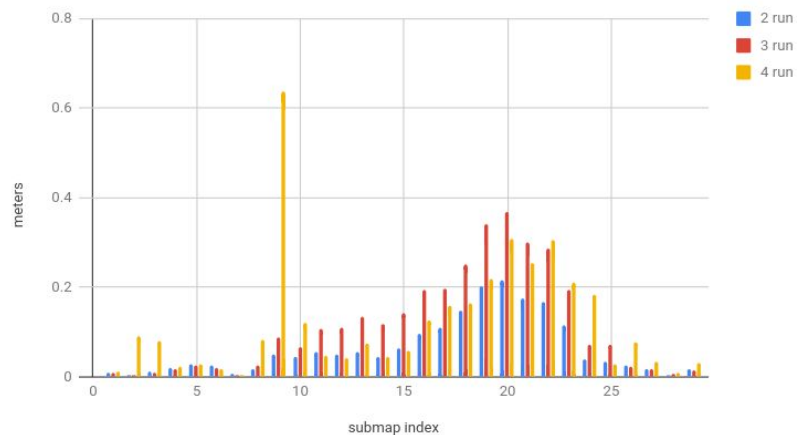


Distribution of rotation difference

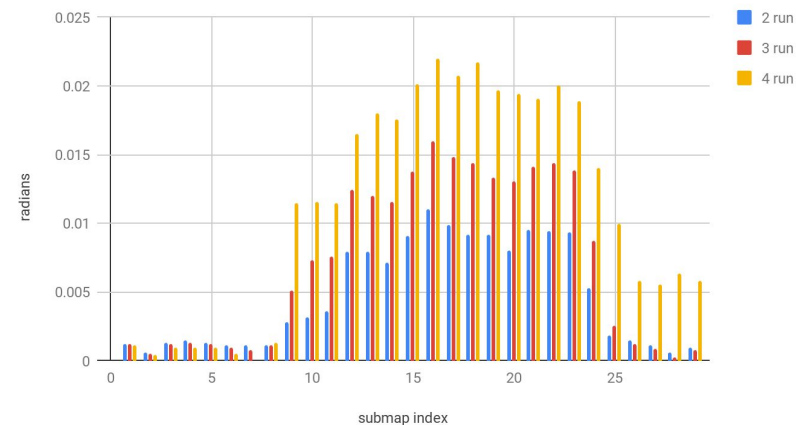


# Cyclic run w/o trimming

Translation difference



Rotation difference





# Overlapping trimmer: how to use

Add the following parameters to trajectory\_builder.lua.

```
include "trajectory_builder_2d.lua"  
include "trajectory_builder_3d.lua"
```

```
TRAJECTORY_BUILDER = {  
  trajectory_builder_2d = TRAJECTORY_BUILDER_2D,  
  trajectory_builder_3d = TRAJECTORY_BUILDER_3D,  
  pure_localization = false,  
  overlapping_submaps_trimmer_2d = {  
    fresh_submaps_count = 1,  
    min_covered_area = 2,  
    min_added_submaps_count = 5,  
  },  
}
```

# Current work

- Lifelong
  - Evaluation of OverlappingSubmapsTrimmer for localization (quality & latency)
- Cloud based mapping
- Code quality
  - Consider an option to ignore some failed checks to keep real-time systems running

Placeholder for other status reports

# Thanks!

Next Open House:  
**May 24th, 5pm CET**

If you would like to present anything next meeting, please reach out to  
[cschuet@google.com](mailto:cschuet@google.com)