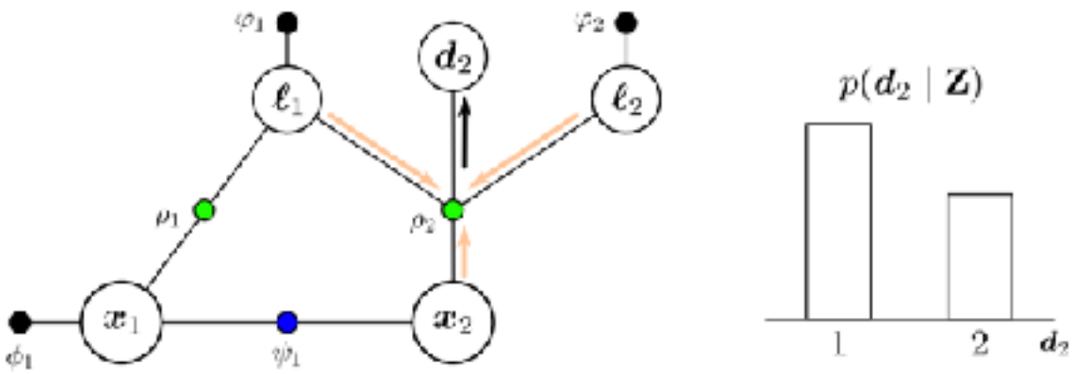
# ICRA 2020

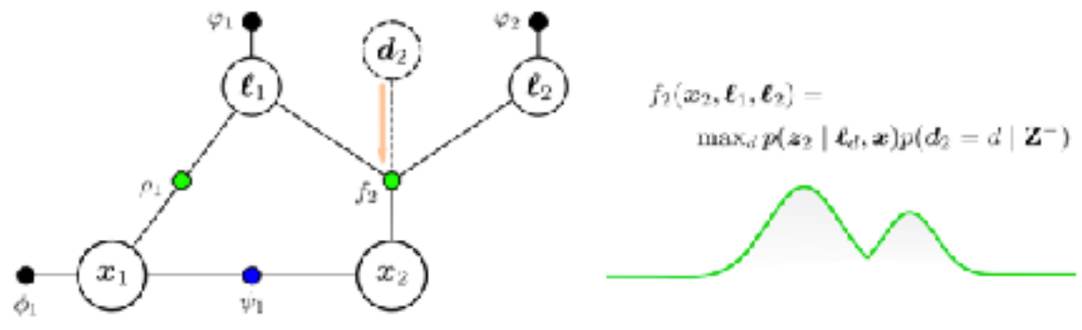
8th June 2020

# Probabilistic Data Association via Mixture Models for Robust Semantic SLAM [Video]

- Doesn’t explicitly represent hypo-tree, instead has semantic max-mixture factors
- Eliminates data-association variables through max-marginalization
- Incorporates null-hypothesis
- Current works for semantic data association




(a) Association probabilities computed by marginalizing out poses and landmarks.



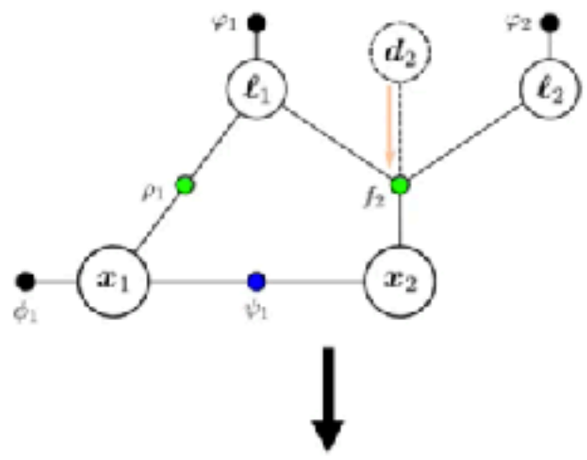

(b) Data association max-marginalization produces a mixture factor.

Doherty, Kevin, David Baxter, Edward Schneeweiss, and John Leonard. "Probabilistic Data Association via Mixture Models for Robust Semantic SLAM." arXiv preprint arXiv:1909.11213 (2019).

# Probabilistic Data Association via Mixture Models for Robust Semantic SLAM [Video]

## Probabilistic Data Association via Mixture Models for Robust Semantic SLAM

- Avoids exponential complexity typically associated with multi-hypothesis methods
- Permits efficient optimization using nonlinear least-squares methods
- Leverages the benefits of learned perception models, while offering improved robustness to their failures




$$f_2(x_2, \ell_1, \ell_2) = \max_d p(z_2 \mid \ell_d, x) p(d_2 = d \mid \mathbf{Z}^-)$$

Stay tuned at our project page on Github:

https://github.com/MarineRoboticsGroup/mixtures_semantic_slam

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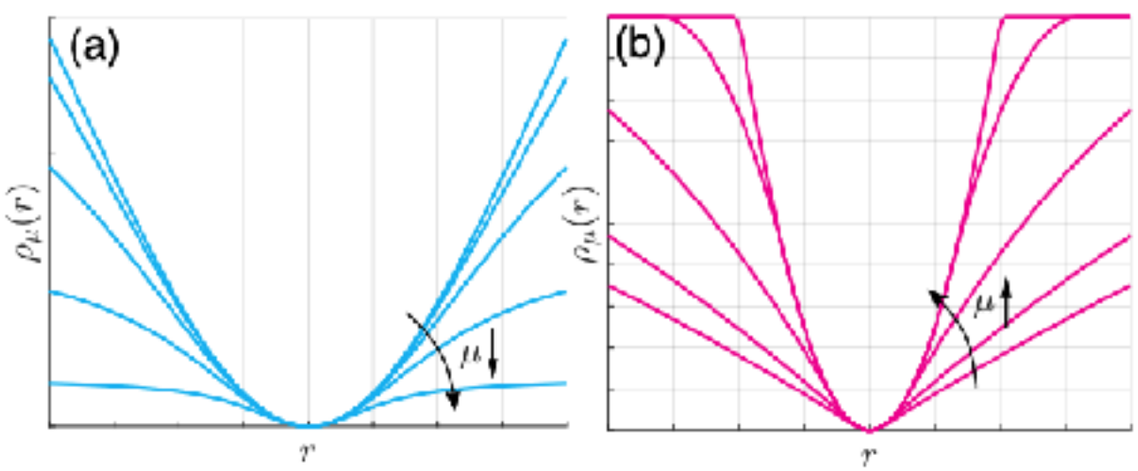
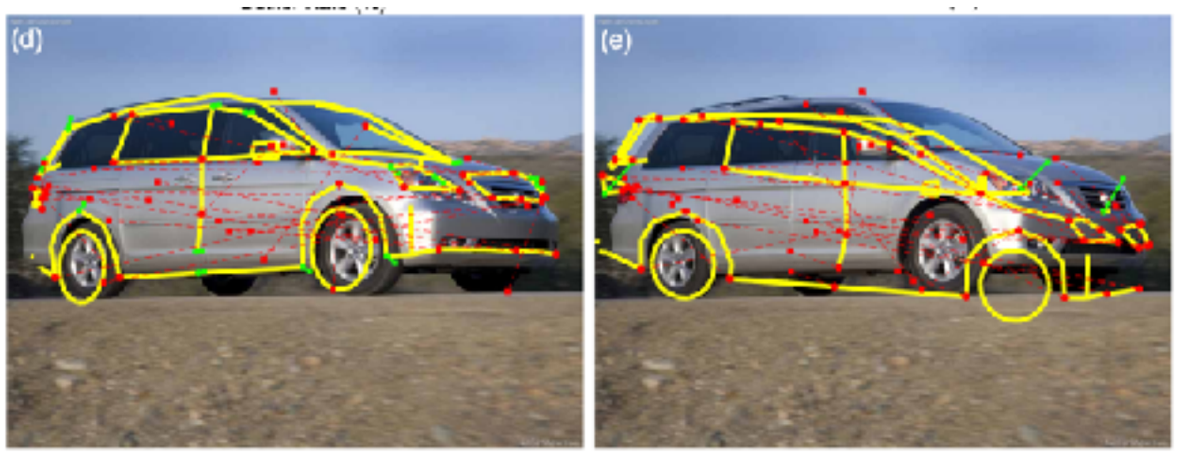
# Graduated Non-Convexity for Robust Spatial Perception: From Non-Minimal Solvers to Global Outlier Rejection [Video]

- Best robot vision paper
- **Applications**: mesh registration, shape alignment, PGO
- Non-minimal solver: solution + certificate of global optimality
- Optimize highly non-convex functions starting from a convex surrogate (TLS)




Yang, Heng, Pasquale Antonante, Vasileios Tzoumas, and Luca Carlone. "Graduated non-convexity for robust spatial perception: From non-minimal solvers to global outlier rejection." IEEE Robotics and Automation Letters 5, no. 2 (2020): 1127-1134.

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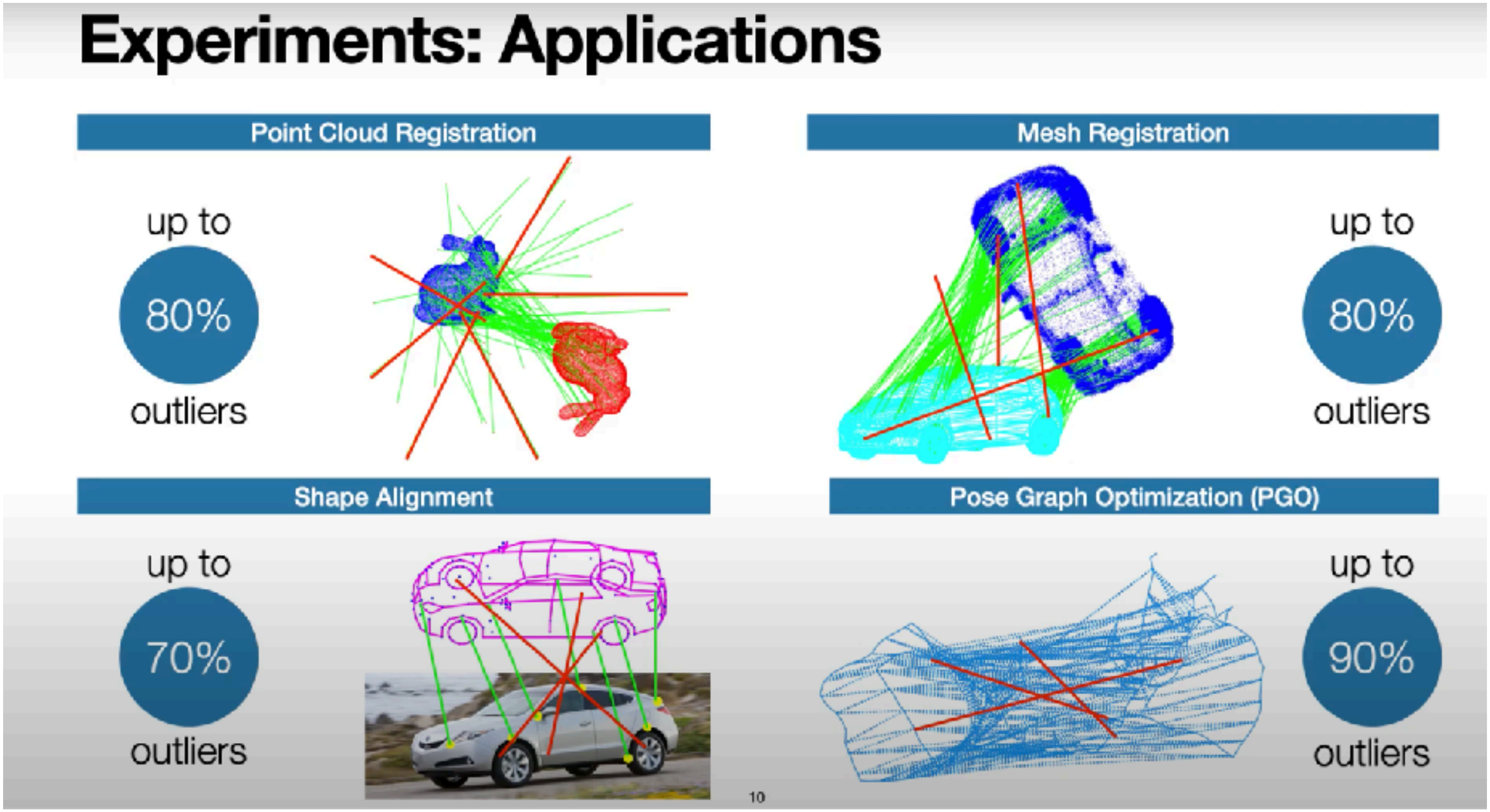


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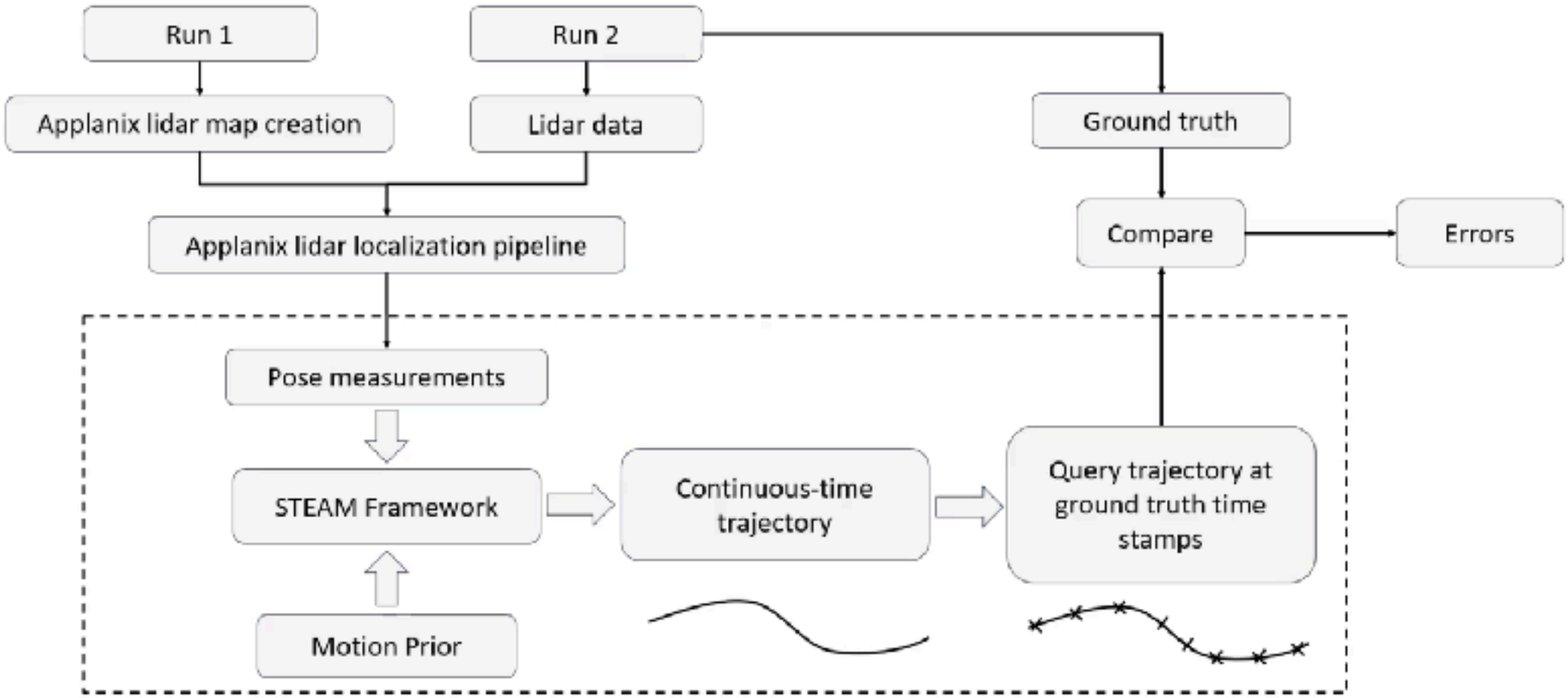
# A Data-Driven Motion Prior for Continuous-Time Trajectory Estimation on SE(3)

- Improving motion prior for STEAM problem
- Richer data-driven motion prior instead of white noise on acceleration or jerk
  - Generalized latent-force GP model




Wong, Jeremy N., David J. Yoon, Angela P. Schoellig, and Timothy D. Barfoot. "A Data-Driven Motion Prior for Continuous-Time Trajectory Estimation on SE (3)." IEEE Robotics and Automation Letters 5, no. 2 (2020): 1429-1436.

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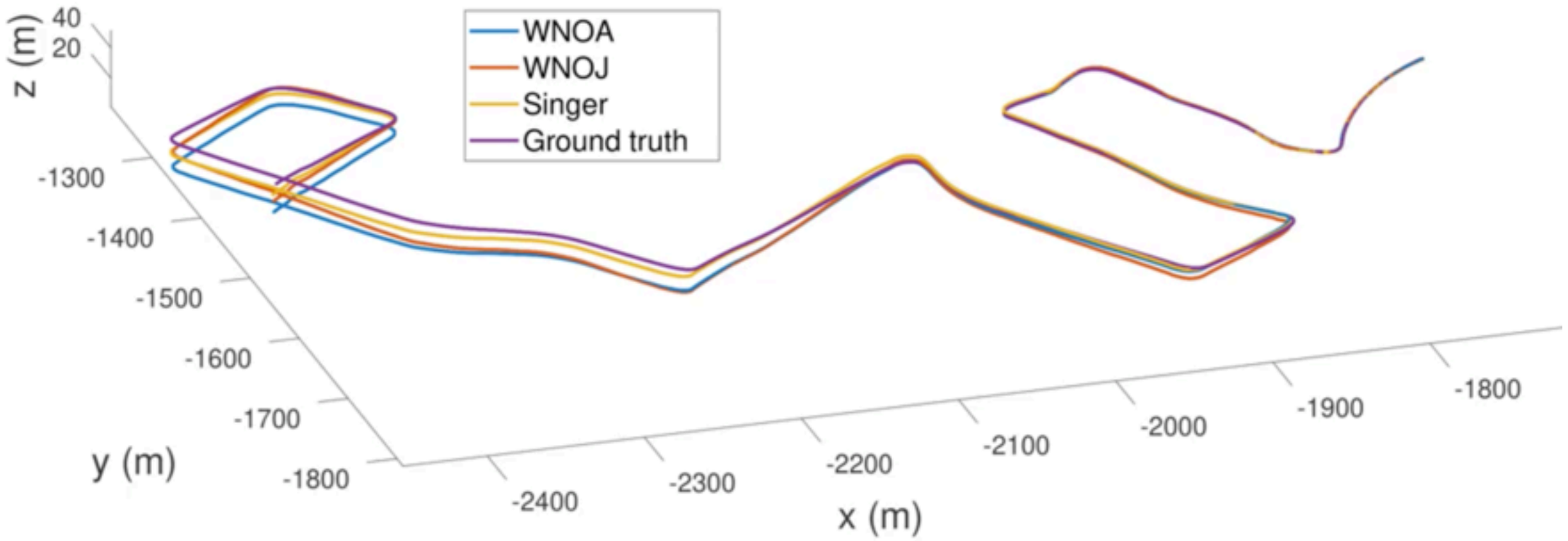


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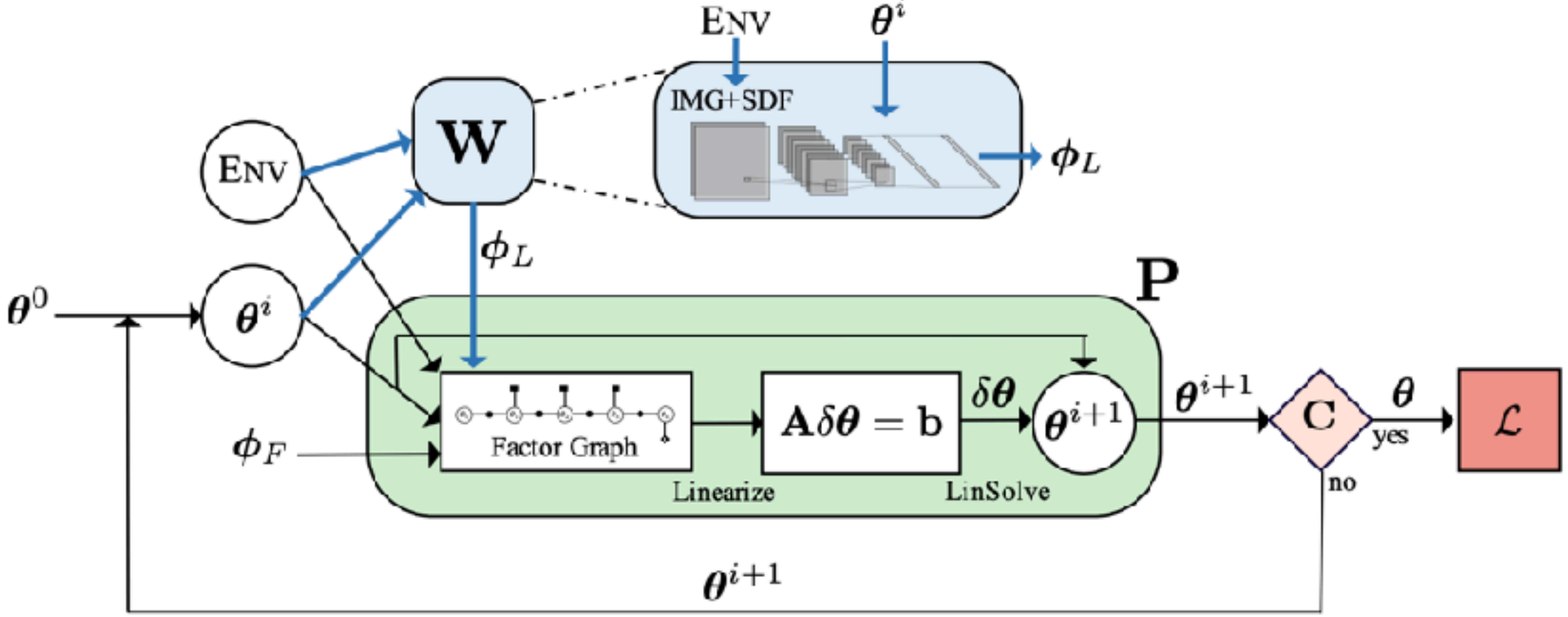
# Differentiable Gaussian Process Motion Planning

- Leverages past experience to adapt GPMP parameters
- Can now be trained end-to-end




Bhardwaj, Mohak, Byron Boots, and Mustafa Mukadam. "Differentiable Gaussian process motion planning." arXiv preprint arXiv:1907.09591 (2019).

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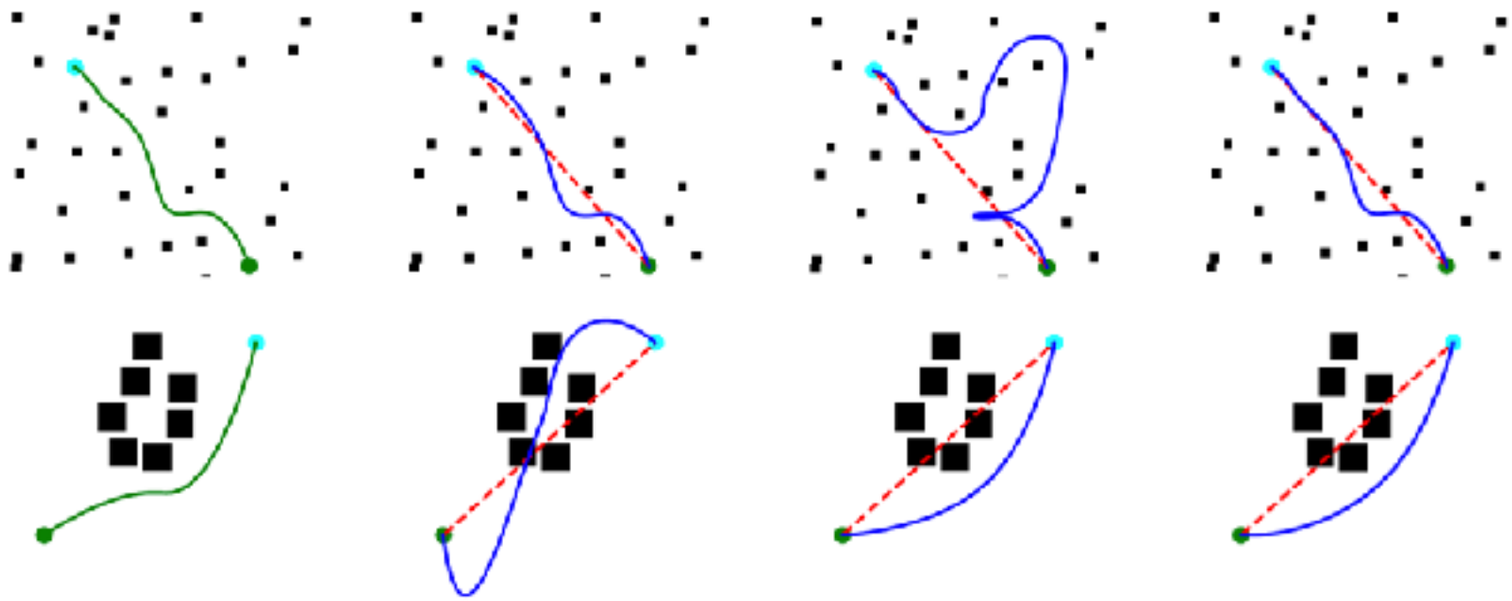

(a) Expert (b) GPMP2, $\sigma_{obs} = 0.15$ (c) GPMP2, $\sigma_{obs} = 0.01$ (d) dGPMP2

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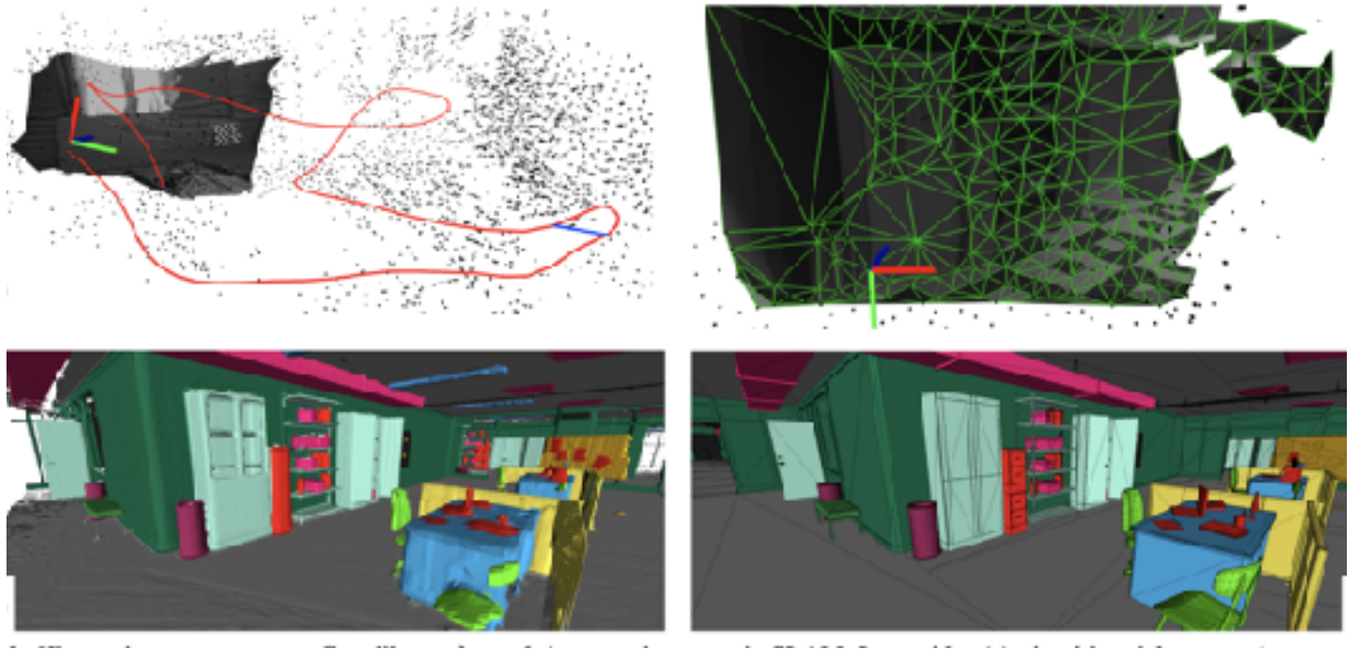
# Kimera: an Open-Source Library for Real-Time Metric-Semantic Localization and Mapping [Video]

- C++ library for realtime metric-semantic visual-inertial SLAM
- 4 components: **VIO, RPGO, Mesher, Semantics**

| Method | Sensors | Back-end | Geometry | Sema-ntics |
|---|---|---|---|---|
| ORB-SLAM [22] | mono | g2o | points | ✗ |
| DSO [23] | mono | g2o | points | ✗ |
| VINS-mono [24] | mono/IMU | Ceres | points | ✗ |
| VINS-Fusion [25] | mono/stereo/IMU | Ceres | points | ✗ |
| ROVIOLI [26] | stereo/IMU | EKF | points | ✗ |
| SVO-GTSAM [27] | mono/IMU | GTSAM | points | ✗ |
| ElasticFusion [18] | RGB-D | alternation | surfels | ✗ |
| Voxblox [28] | RGB-D | [26] | TSDF | ✗ |
| SLAM++ [16] | RGB-D | alternation | objects | ✓ |
| SemanticFusion [17] | RGB-D | [18] | surfels | ✓ |
| Mask-fusion [29] | RGB-D | [30] | surfels | ✓ |
| SegMap [31] | lidar | GTSAM | points/segments | ✓ |
| XIVO [32] | mono/IMU | EKF | objects | ✓ |
| Voxblox++ [14] | RGB-D | [26] | TSDF | ✓ |
| **Kimera** | **mono/stereo/IMU** | **GTSAM** | **mesh/TSDF** | ✓ |



Rosinol, Antoni, Marcus Abate, Yun Chang, and Luca Carlone. "Kimera: an Open-Source Library for Real-Time Metric-Semantic Localization and Mapping." arXiv preprint arXiv:1910.02490 (2019).