

4/14: SLAM (cont'd), sysID

Announcements:

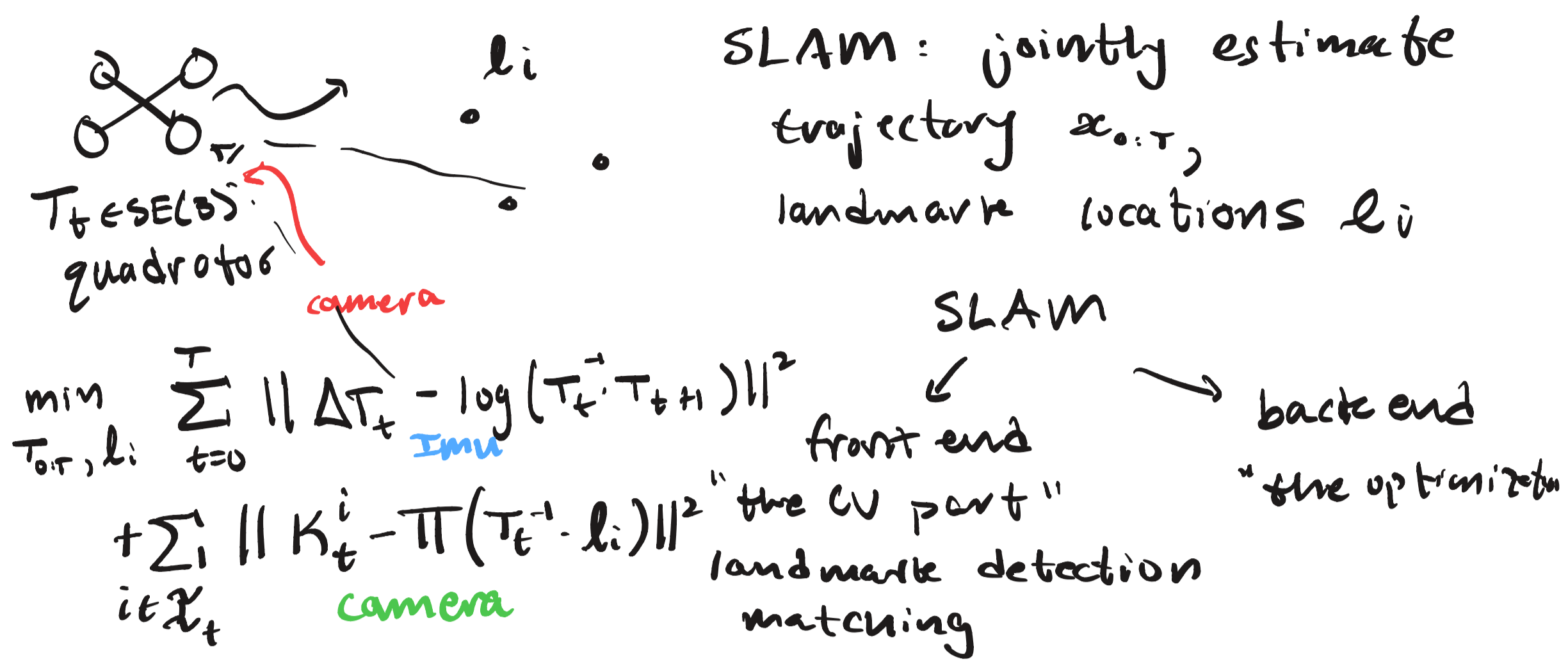
- HW4 out, due next Thurs (4/23)

Last time:

- SLAM/VID (frontend vs. backend)

Today:

- SLAM wrap-up
- system identification (sysID)



Two subtleties: optimize over $SE(3)$, robustness

1) $T_t \in SE(3) \neq \mathbb{R}^6$

idea: use $\exp: \mathbb{R}^6 \rightarrow SE(3)$ to create pseudo-cartesian geometry

For each iteration:

- introduce some $\delta T_t \in \mathbb{R}^6$, $T_t = T_t^{(k)} \cdot \exp(\delta T_t)$
- can compute the Jacobians @ $\delta T_t = 0$

$$\min_{\delta T_t, l_i} (\dots)$$

- compute updates via GN

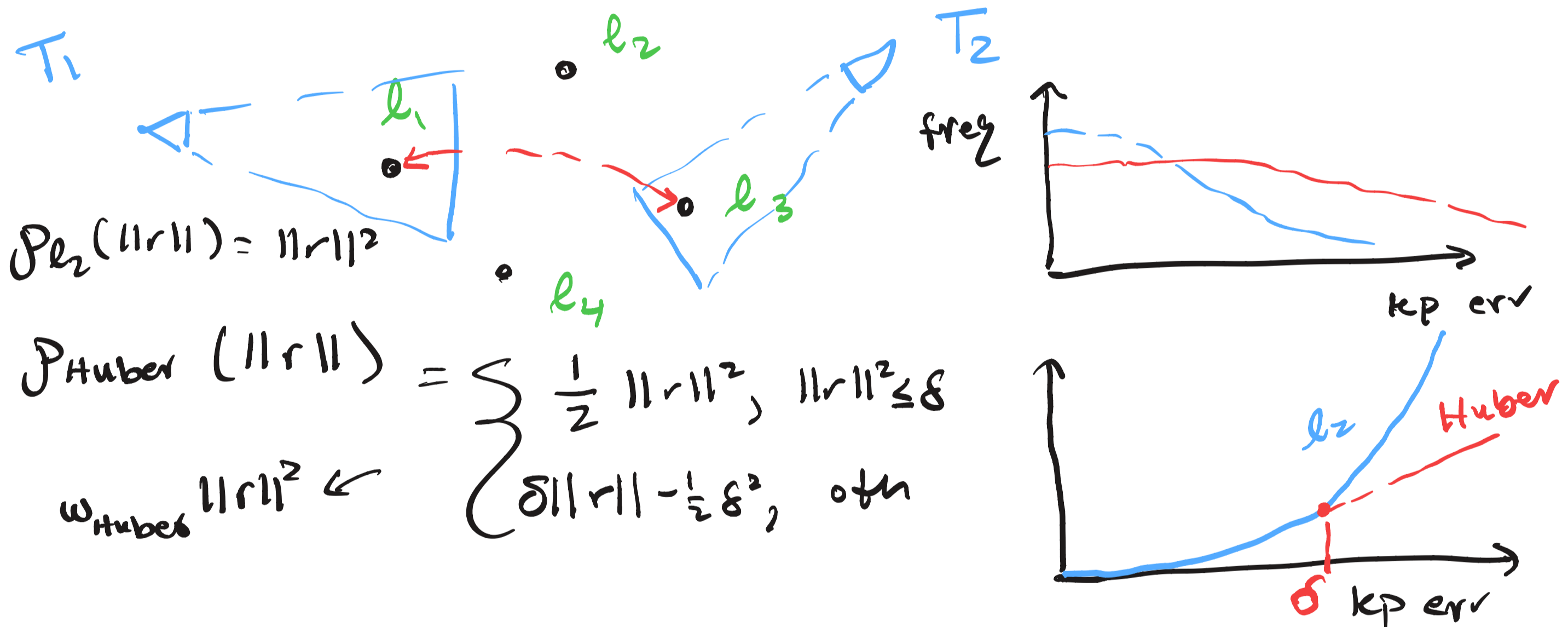
$$T_t^{(k+1)} = T_t^{(k)} \cdot \exp(\delta T_t^*)$$

2) Robustness to outliers

SLAM frontends match incorrectly all the time

- ↳ reflections
- ↳ repeated structure

suppose we get a bad match



Packages/software:

NLLS: GTSAM, Ceres

SLAM: ORBSLAM3, Luca Carlone

Module 5: model uncertainty / robustness

A throughline of this class



Traj. opt: $f(x_t, u_t) \rightarrow u_{0:T-1}^*$
dynamics controls

state est: $f(x_t, u_t) \rightarrow x_{0:T}^*$
 $h(x_t)$ trajectories

Benefits: + sample efficiency (differentiable)
+ generalizable
+ correctness

Drawback: - brittle (w/r/t modeling error)

↳ How can we address modeling errors?

can we build better models? system ID

safety (constraints) CBFs