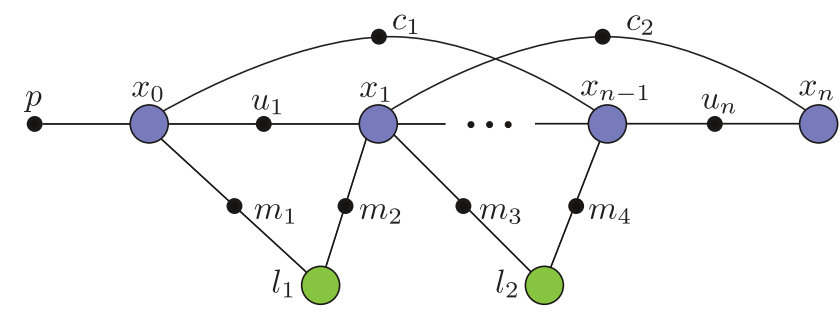
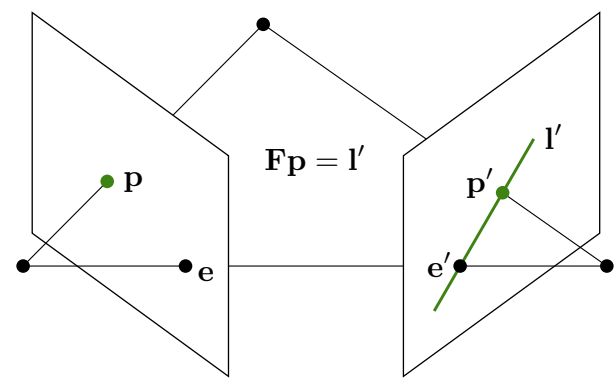


Ego-motion estimation (SLAM)

Geometric constraints & Probabilistic inference

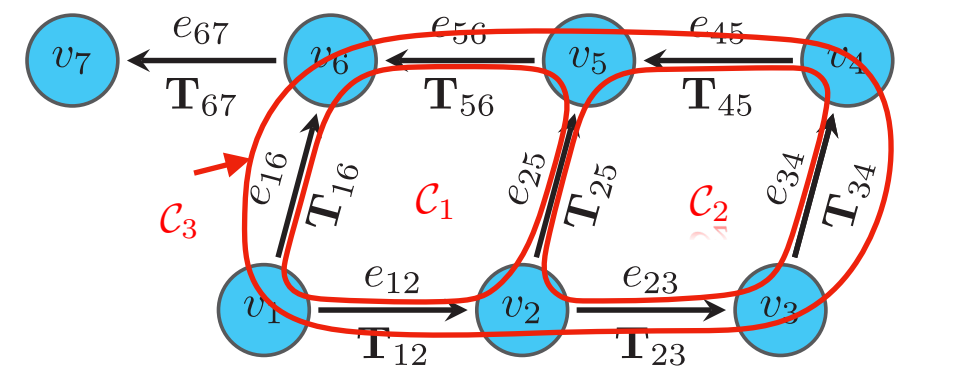
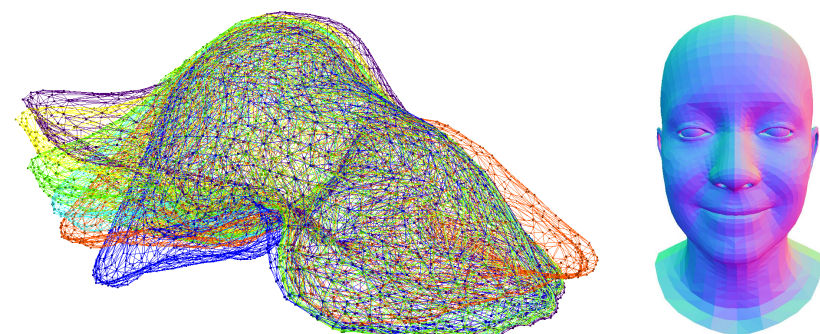
Optimization techniques



SLAM (Reliability & Accuracy)

Perception in surgical robotics requires:

- SLAM in nonrigid scenes (unsolved yet)
- substantial reliability and accuracy
- theoretical sound and explainable solution

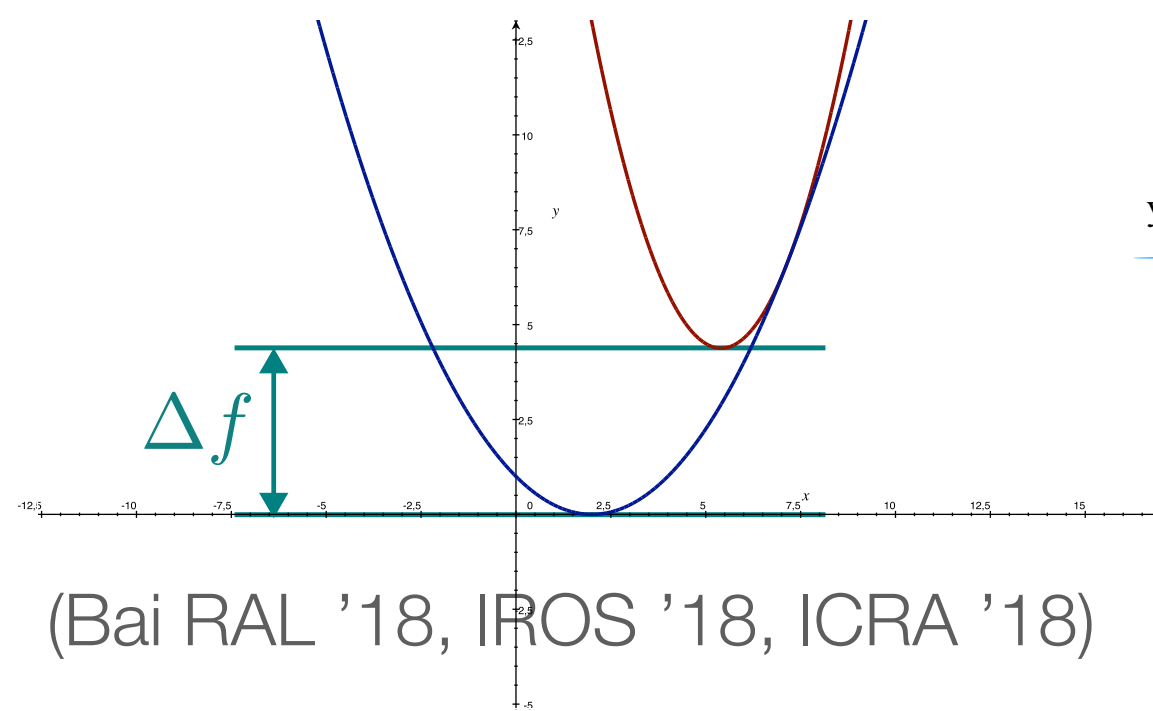


Each iteration:

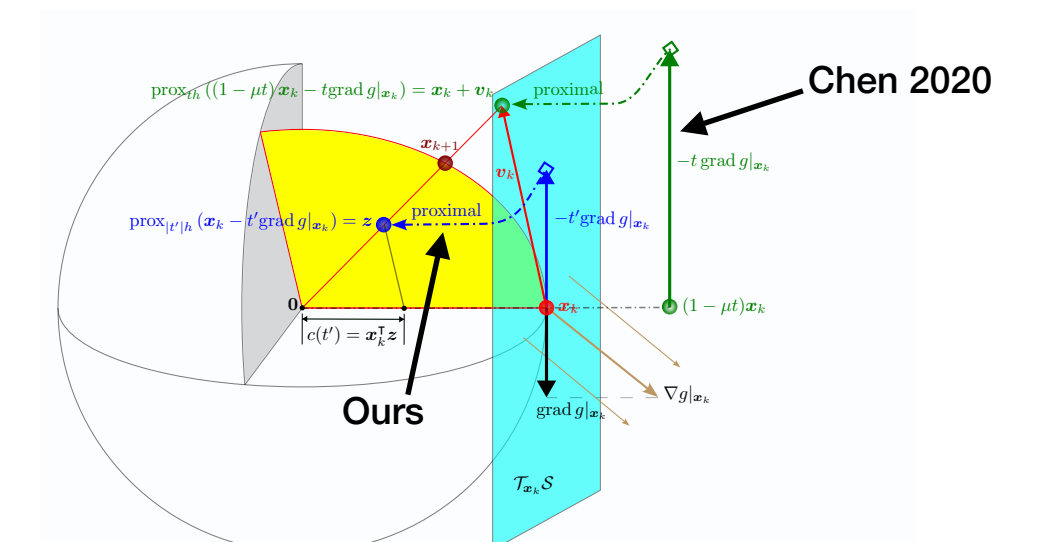
$$\Delta x = \bar{B}^\dagger \bar{b} = \bar{B}^\top (\bar{B} \bar{B}^\top)^{-1} \bar{b}$$

	c_1	c_2
c_1	4	1
c_2	1	4

(Bai TRO '21)

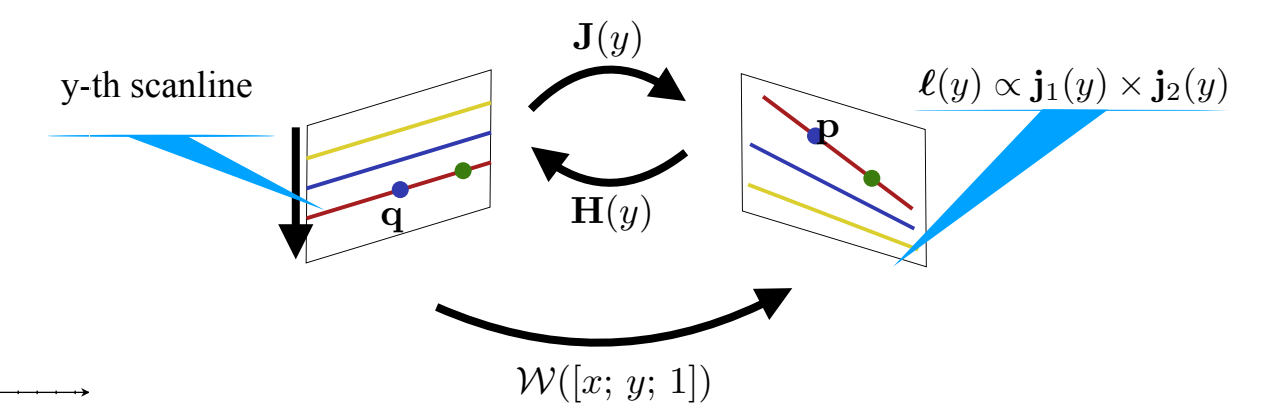


(Bai RAL '18, IROS '18, ICRA '18)

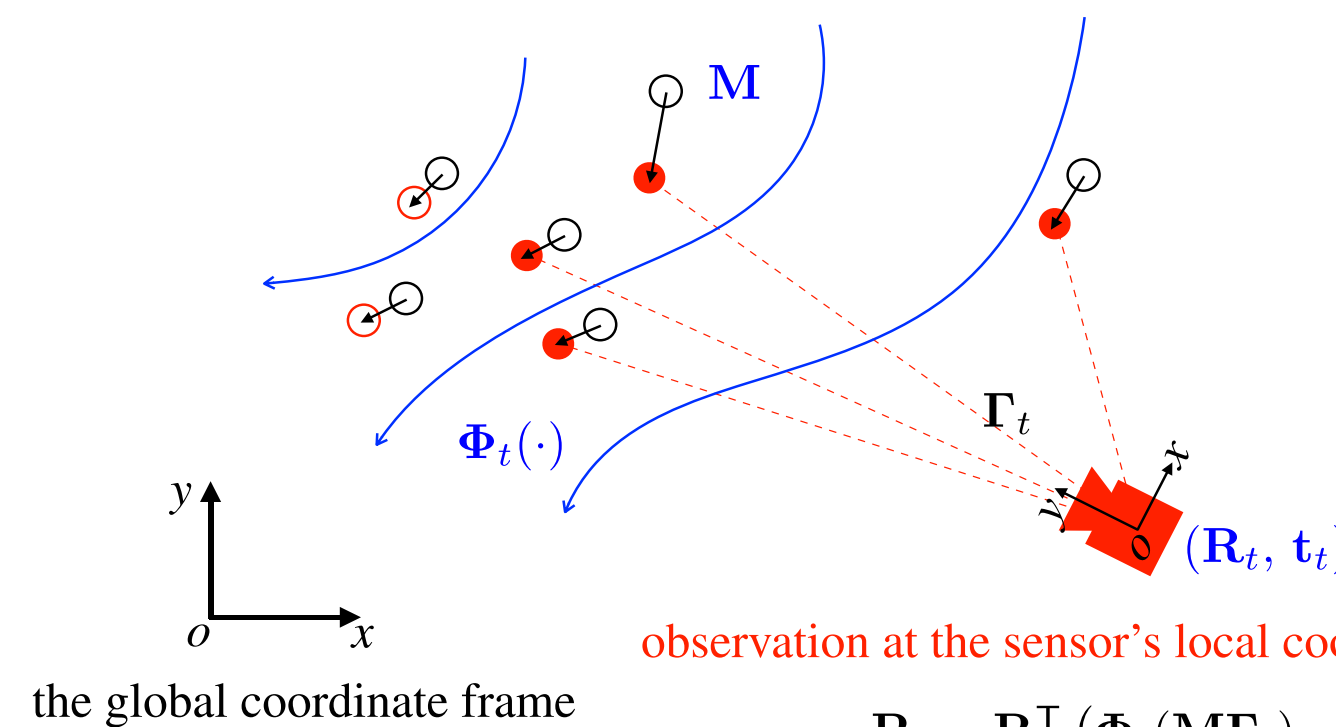


$$\min_x g(x) + h(x) \quad \text{s.t. } \|x\|_2 = 1$$

(Bai TPAMI '23)



(Bai CVPR '22)



Deformable transformation:

$$y_t(\mathbf{P}_t) \stackrel{\text{def}}{=} \Phi_t^{-1}(\mathbf{R}_t \mathbf{P}_t + \mathbf{t}_t \mathbf{1}^\top) \rightarrow \mathbf{M}\Gamma_t$$

The pose and deformation are entangled, which means both are ambiguous.

(Bai IJCV '21, IJRR '23, RSS '22)