Point sets, Maps and Navigation - III

D.A. Forsyth

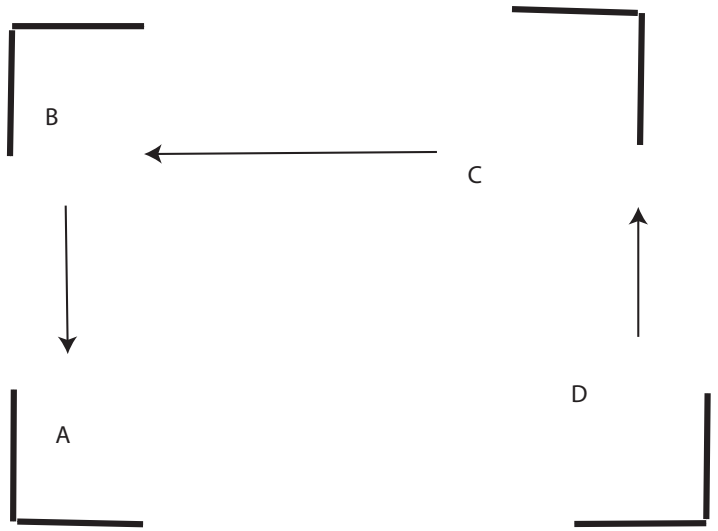
Localization

- We can now robustly register a point set to a point set
  - This is localization
    - Look at LIDAR
    - register to map
    - I know where I am
- Q:
  - how to make the map?
    - registration + bundle adjustment
  - how to incorporate movement estimates and model uncertainty?
    - next big topic

Bundle adjustment

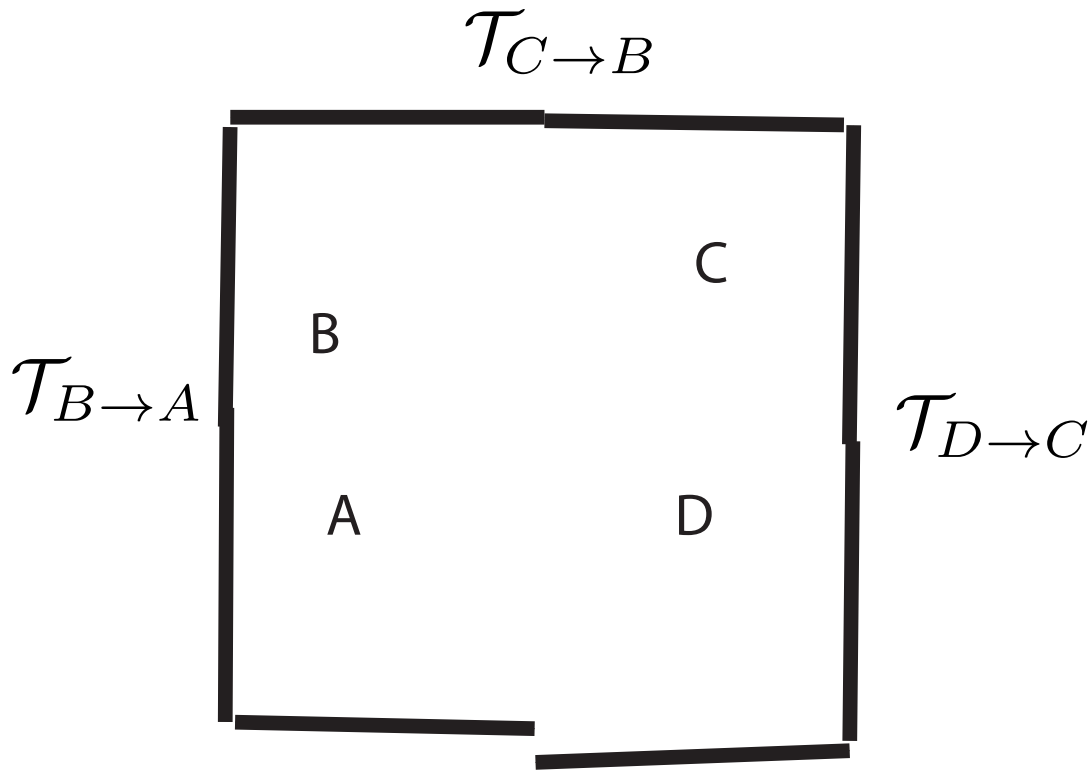
- The problem:
  - Register B to A, C to B, D to C
    - -> then you know D->A, but it isn't very good…

Q: Why not C->A?



Bundle adjustment

- Loop closure problems
  - Why is this happening?



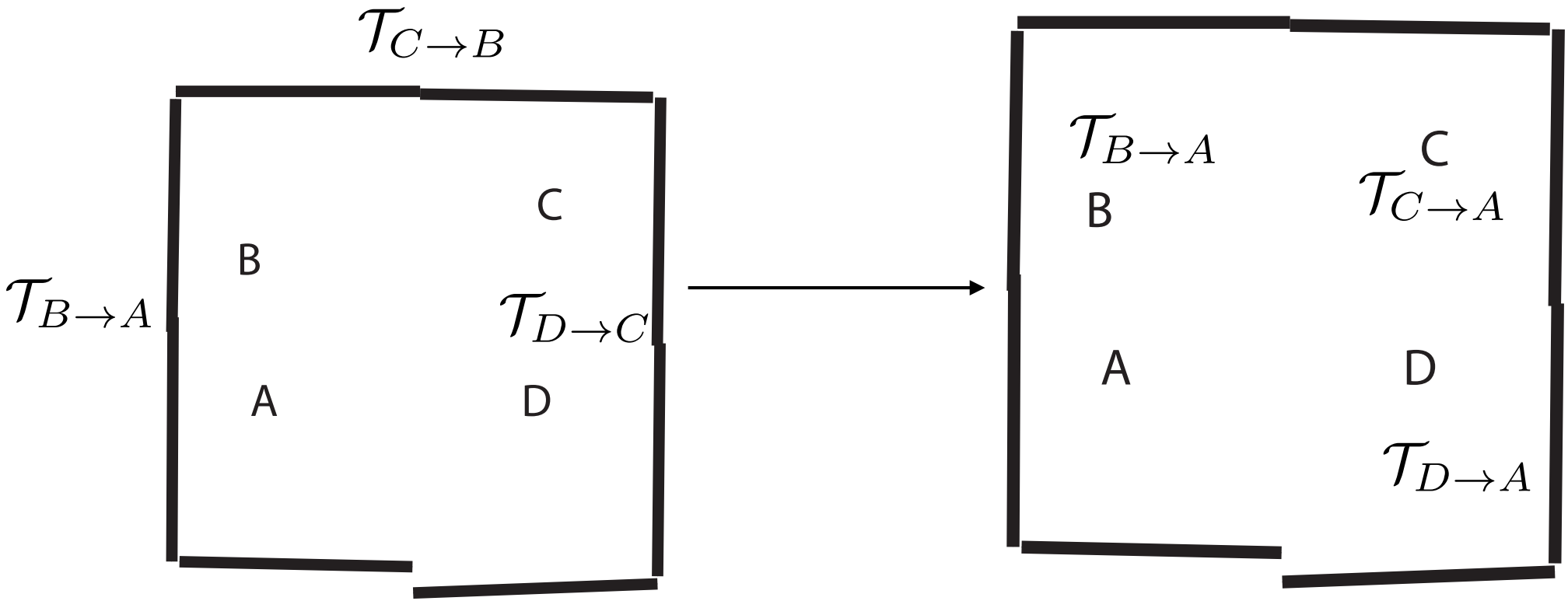
$$\mathcal{T}_{D\to A} = \mathcal{T}_{B\to A} \circ \mathcal{T}_{C\to B} \circ \mathcal{T}_{D\to C}$$

But this isn't the one that minimizes the D, A overlap errors!

Strategies

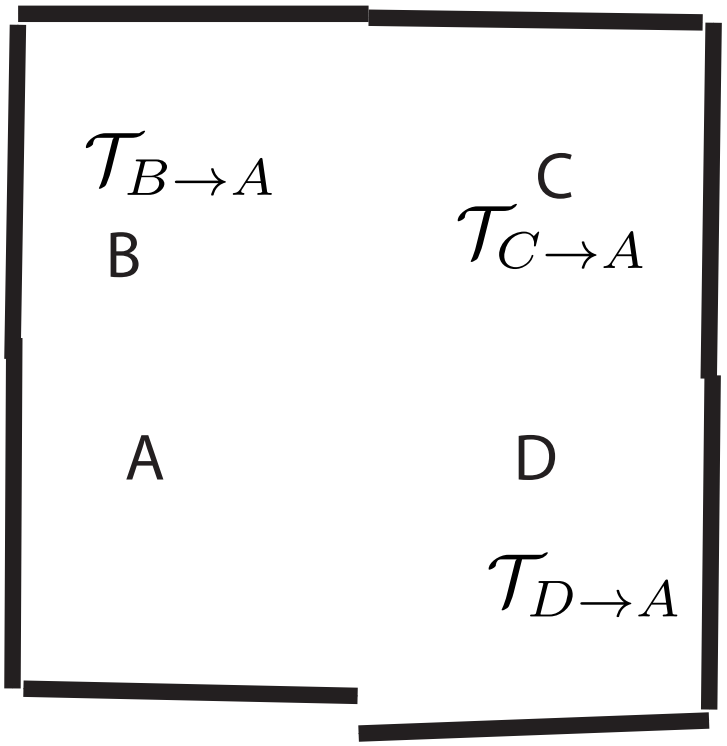
- (Pretty much always)
  - Fix one set of points
  - Register in sequence
    - usually defined by (say) time
  - Now fix the resulting estimates
    - these are a start point

Fixing the maps - I



$$\mathcal{T}_{D\to A} = \mathcal{T}_{B\to A} \circ \mathcal{T}_{C\to B} \circ \mathcal{T}_{D\to C}$$

Fixing the maps - II



- Simplest
  - Repeat:
    - Fix N-1, use ICP/IRLS to est. last
  - + Closed form solutions
  - - Convergence issues
  - - Inefficient
- Cleaner
  - One least squares optimization problem
    - in all maps
    - Newton's method
  - + Efficient
  - - Local minima
  - - Can be very large optimization