Point sets, Maps and Navigation - III

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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?

\[ \mathcal{T}_{D \rightarrow A} = \mathcal{T}_{B \rightarrow A} \circ \mathcal{T}_{C \rightarrow B} \circ \mathcal{T}_{D \rightarrow C} \]

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

\[ \tau_{D \to A} = \tau_{B \to A} \circ \tau_{C \to B} \circ \tau_{D \to C} \]
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