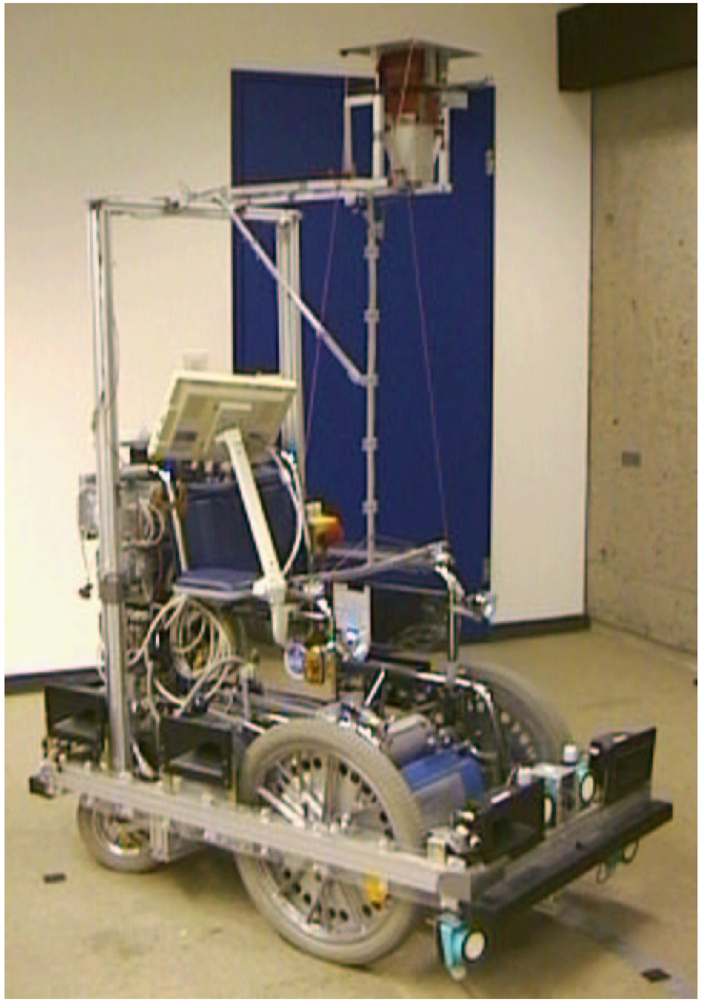
Controlling a Wheelchair with Image-based Homing

Thomas Röfer

Bremen Institute for Safe and Secure Systems

University of Bremen, Germany



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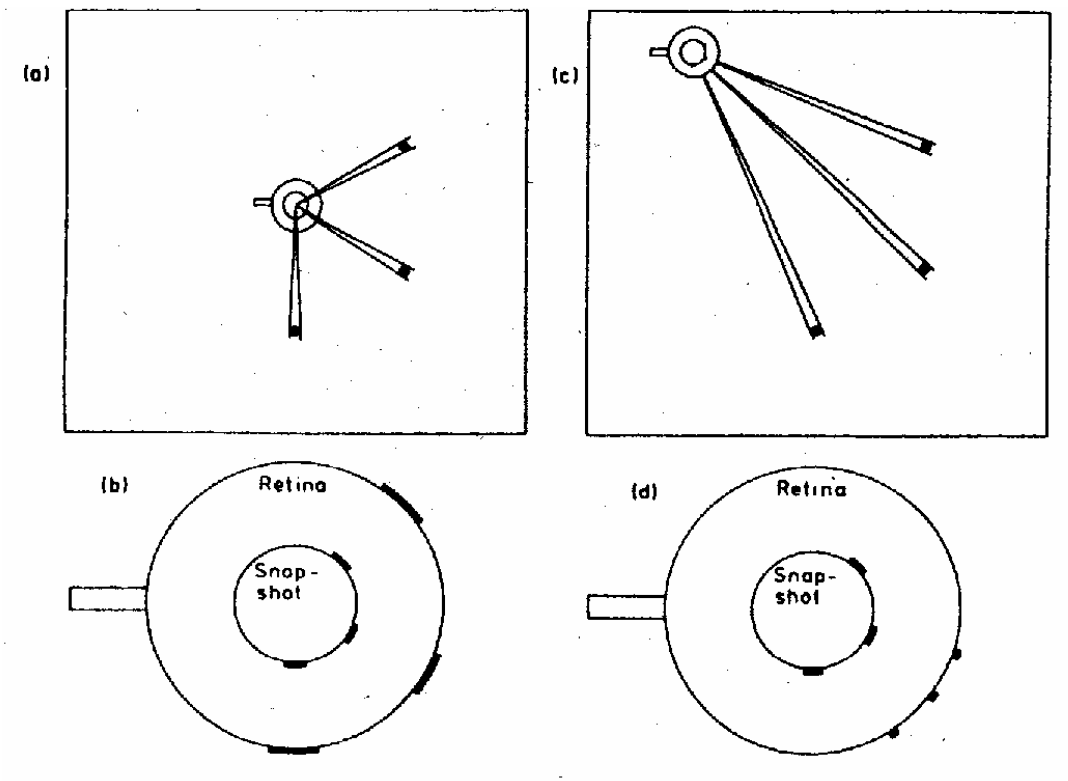
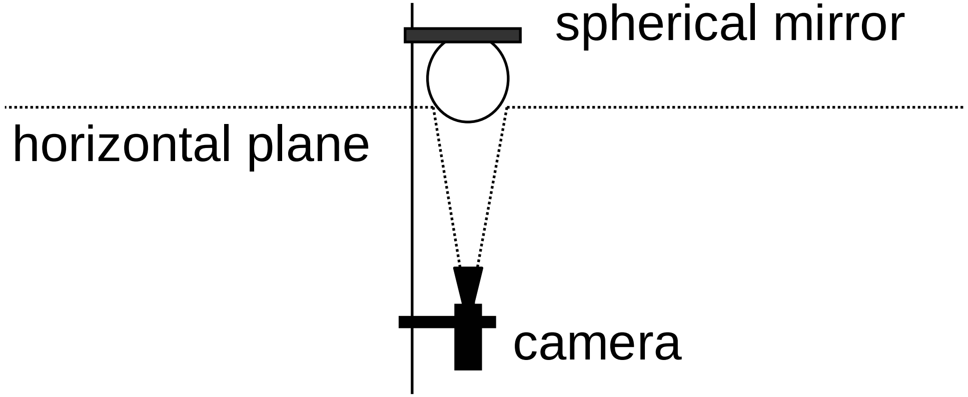
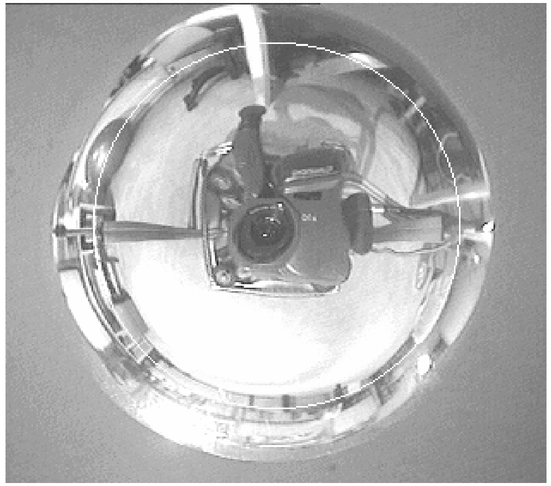
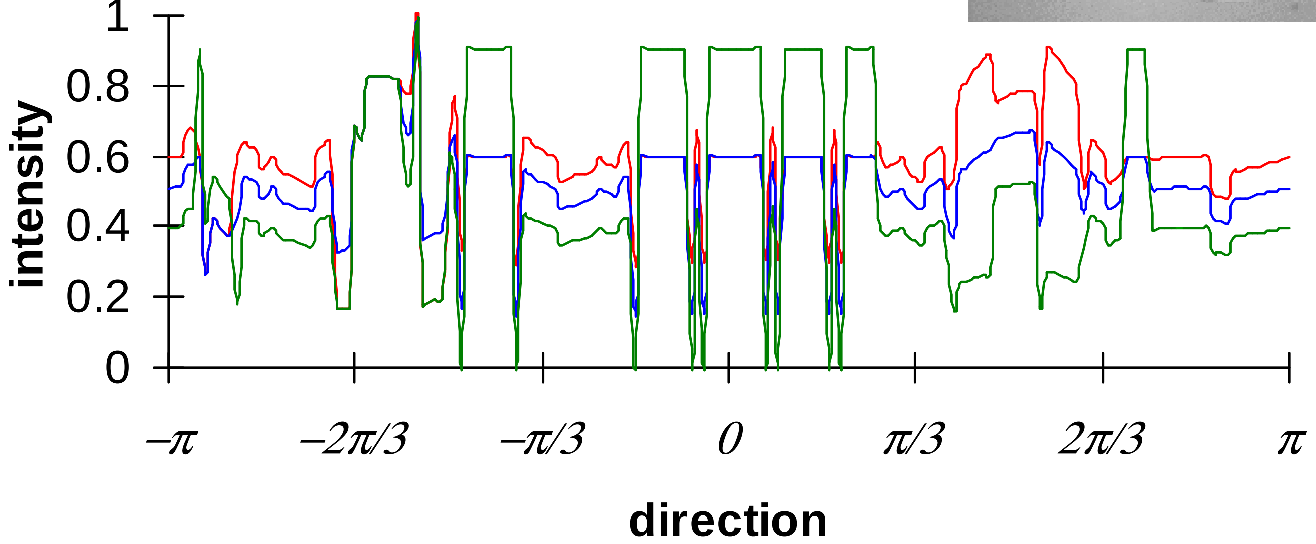


(Cartwright and Collett 1983)

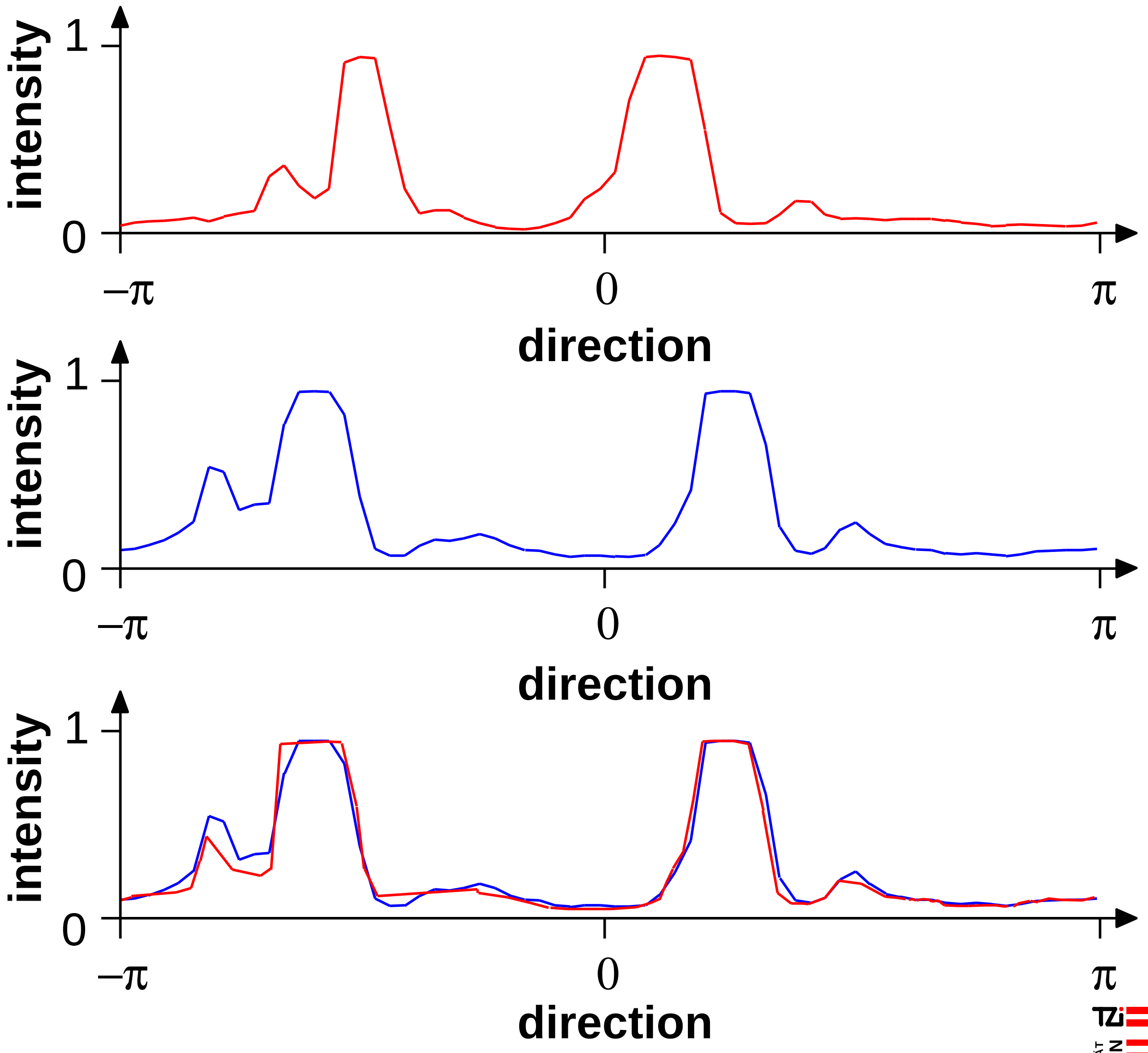
Sensor for Taking Panoramic Images







Matching Panoramic Images



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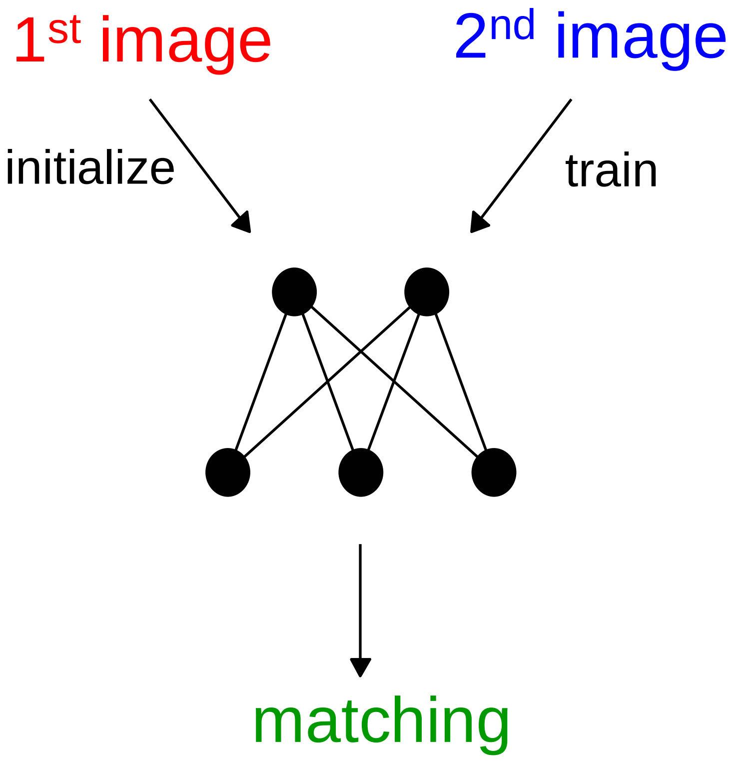
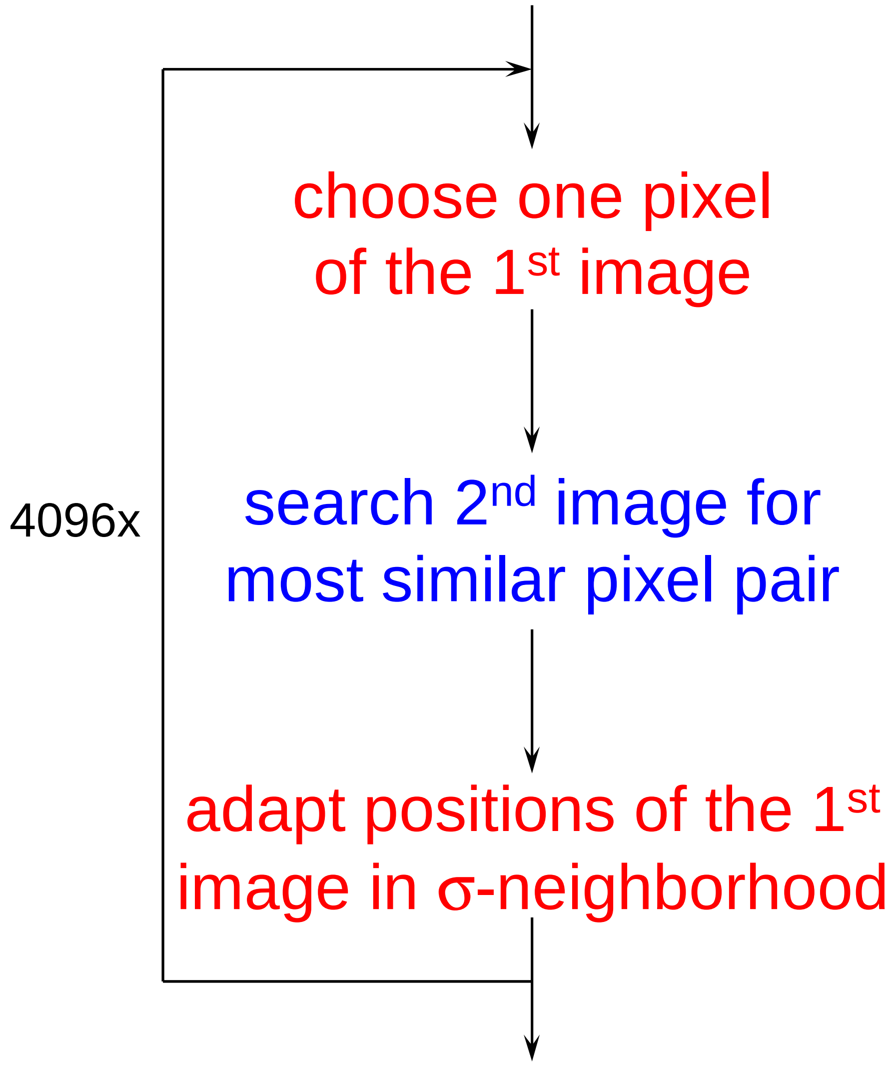
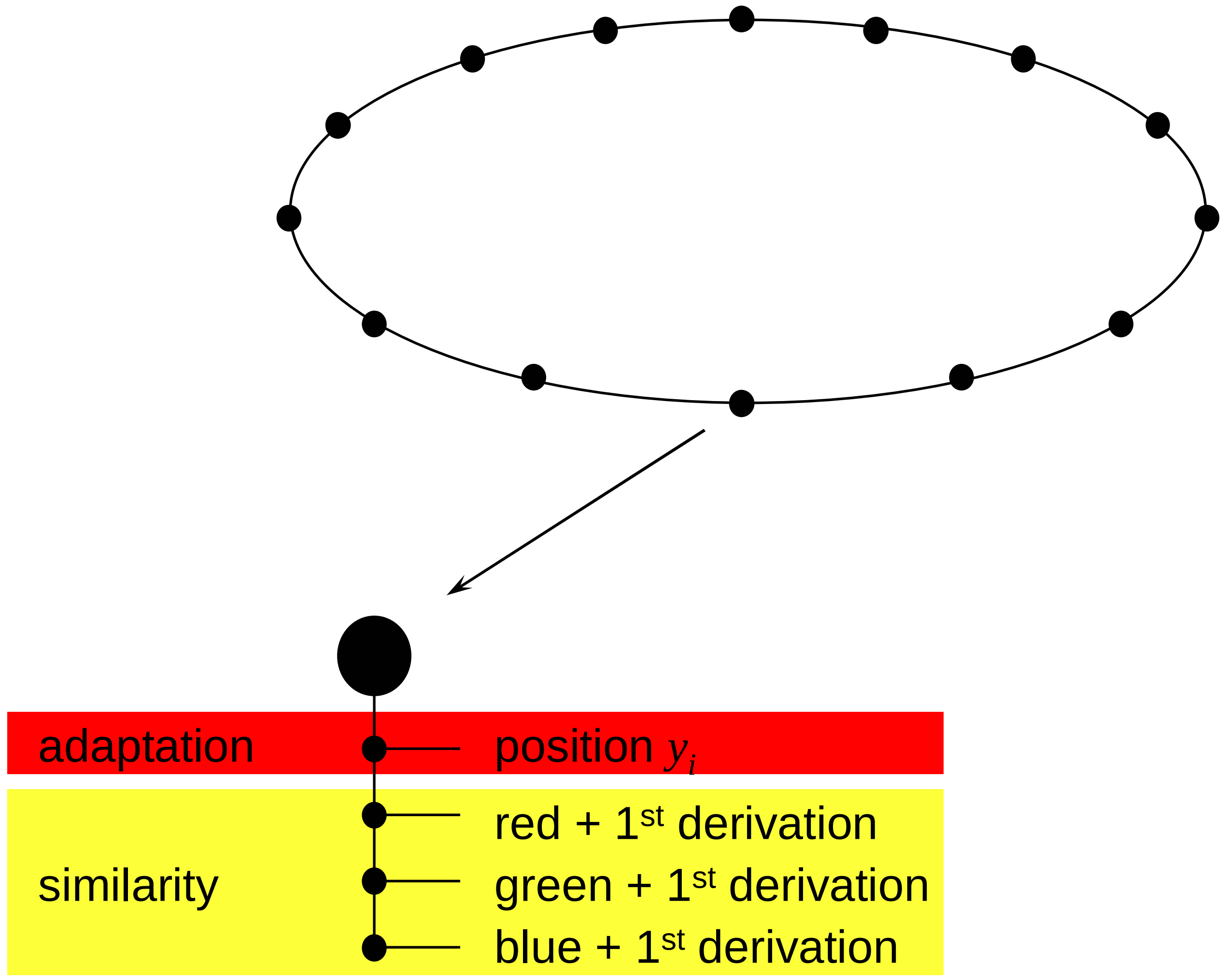
Basic Idea

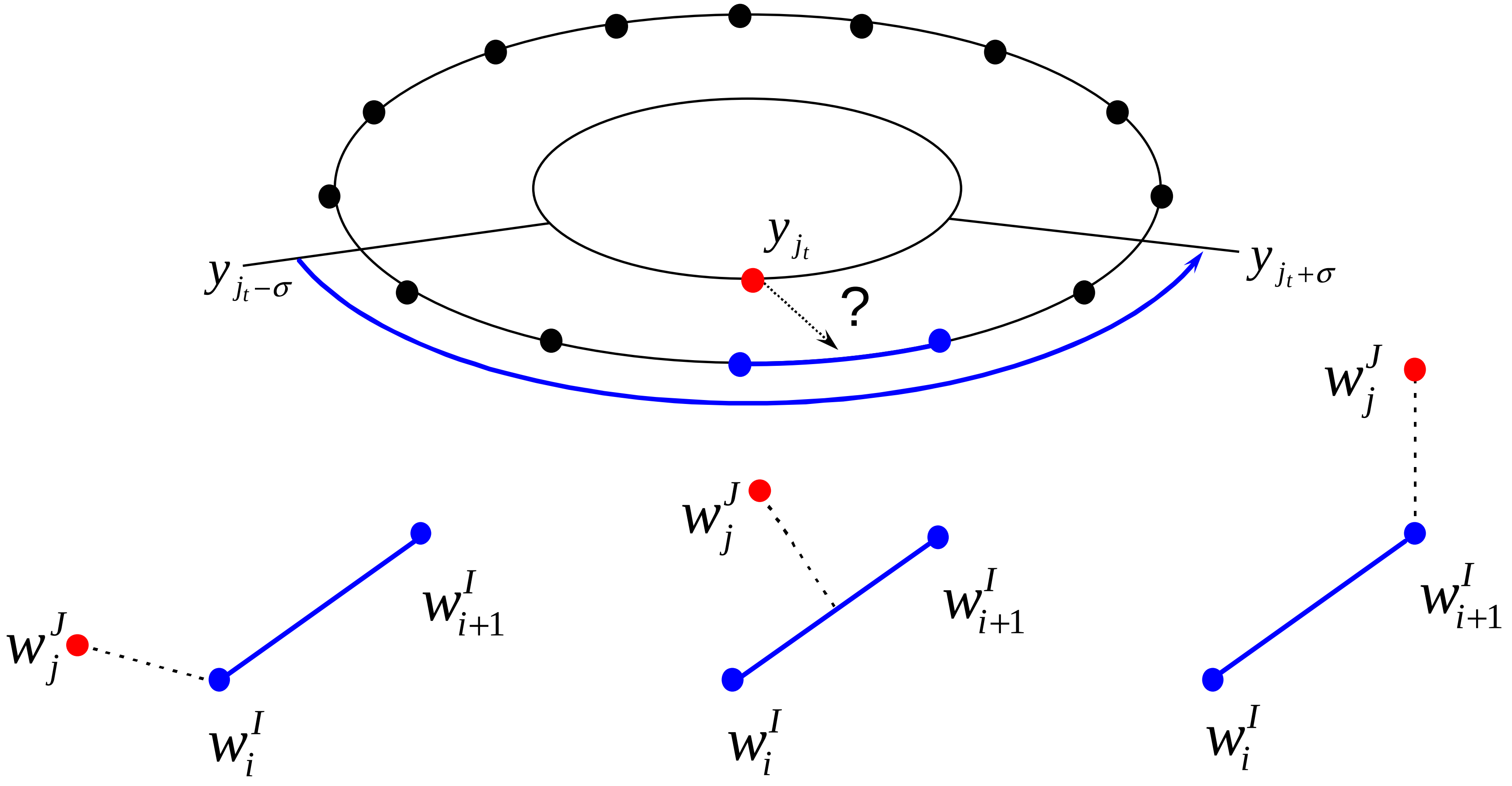

1st image
2nd image
initialize
train
matching


choose one pixel of the 1st image
search 2nd image for most similar pixel pair
adapt positions of the 1st image in σ-neighborhood
4096x

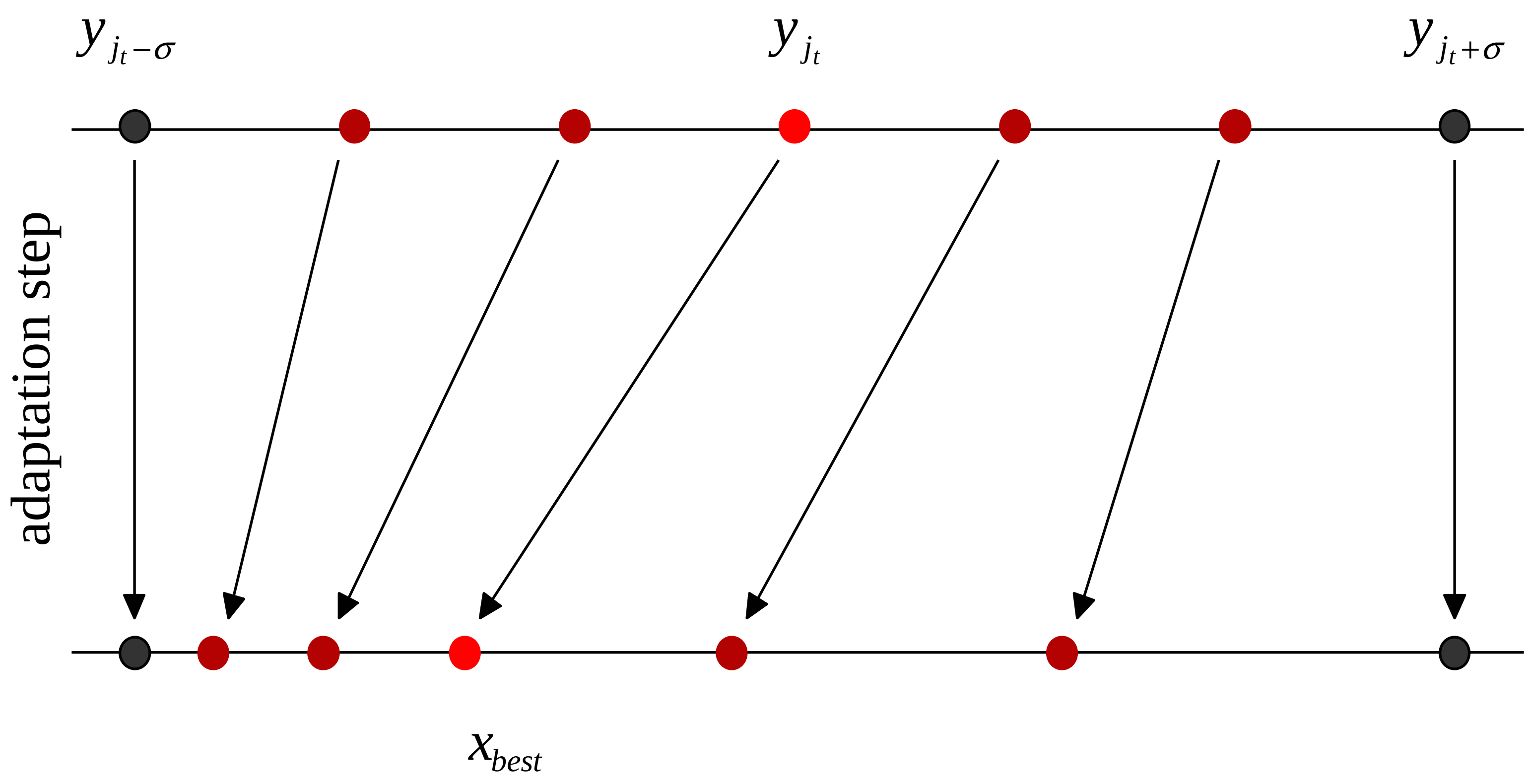
One-dimensional Feature Map



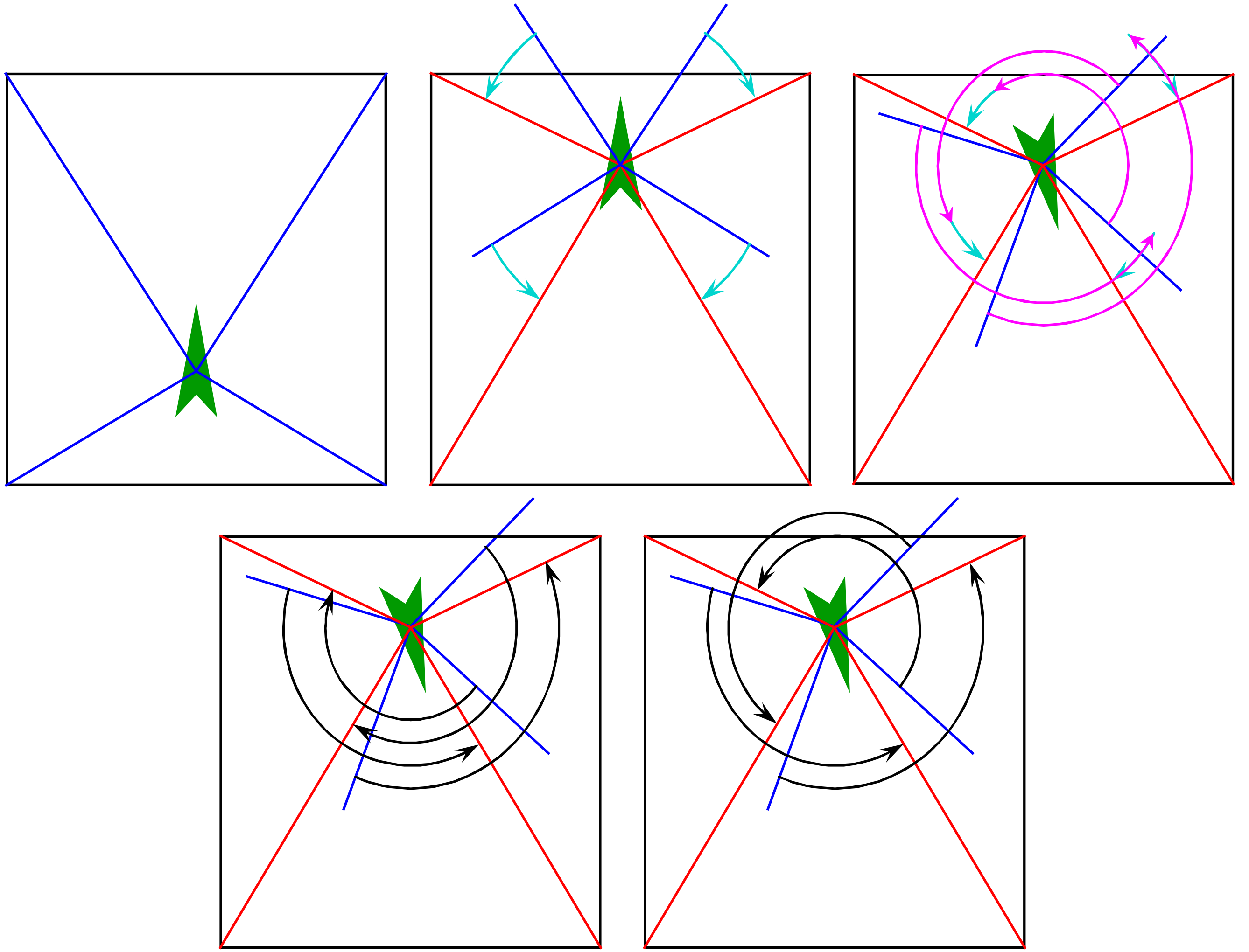
Similarity Search



Adaptation Step



Translational and Rotational Optical Flow



Dividing Optical Flow into Rotation and Translation

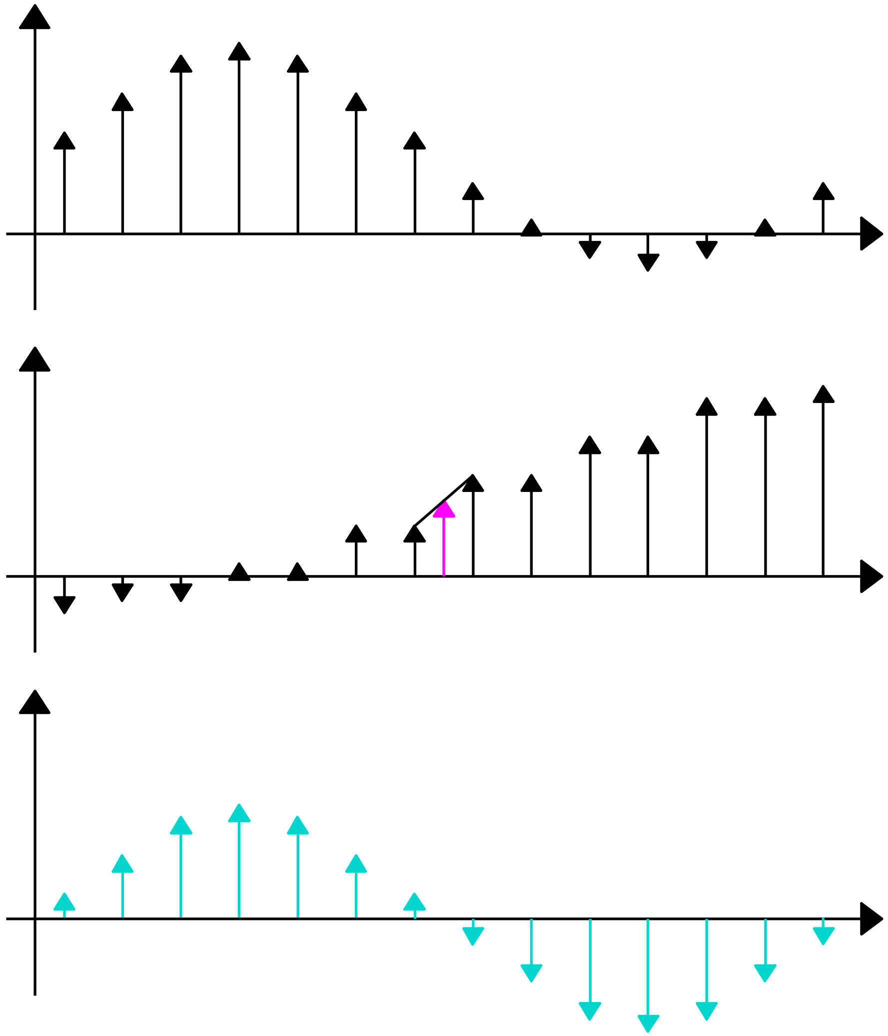
optical flow

↓

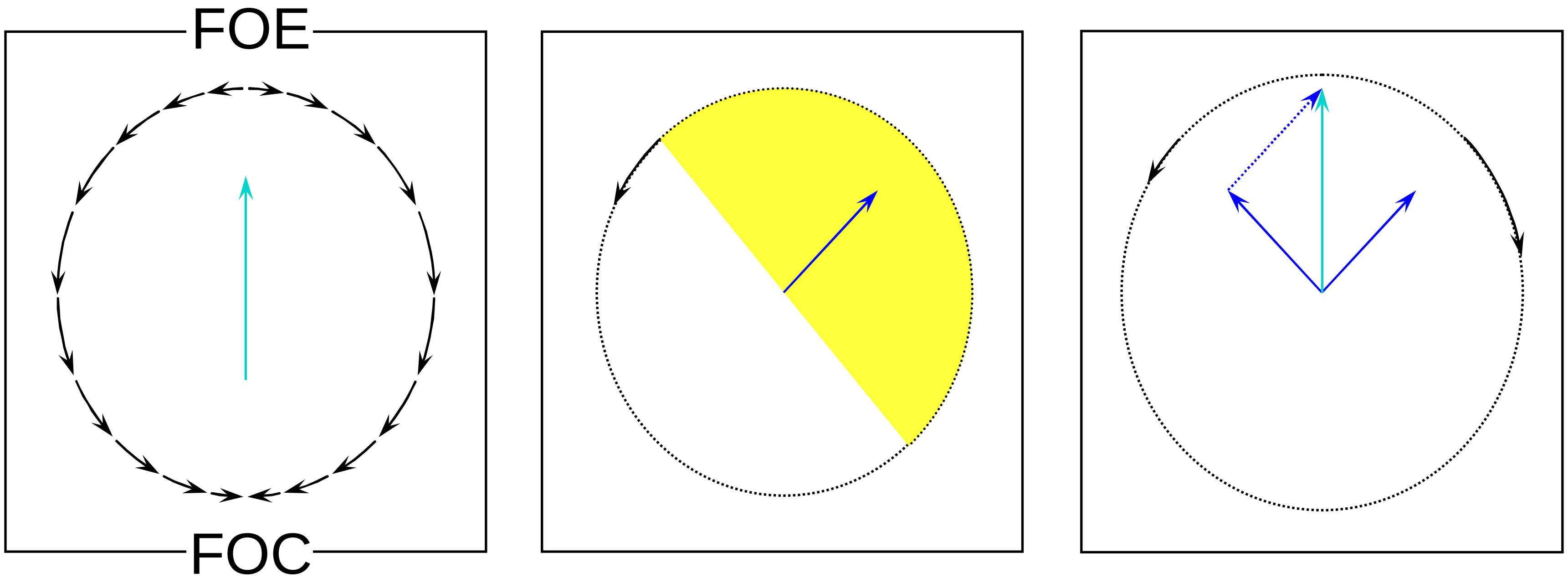
rotation

↓

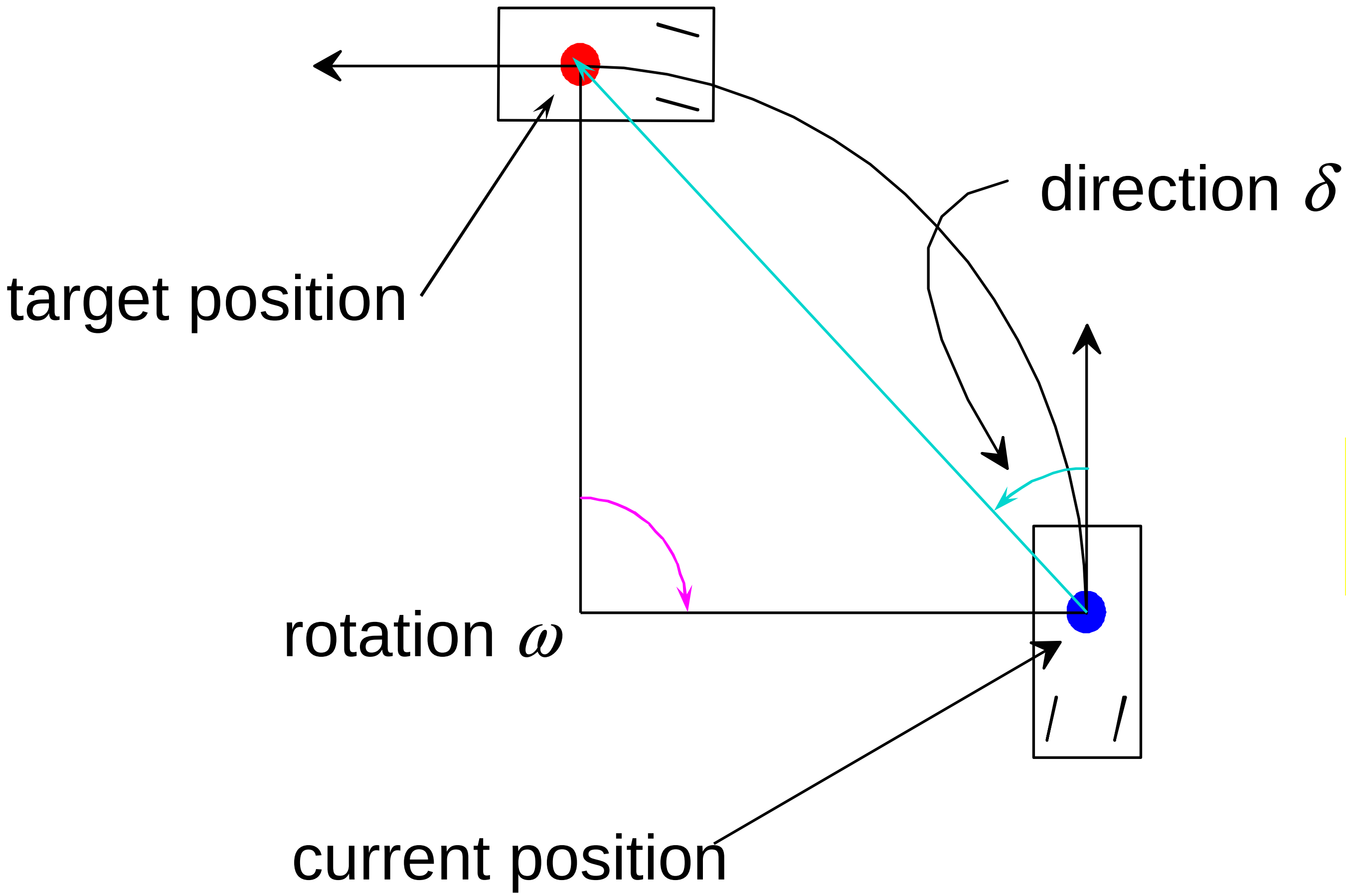
translational flow



Calculating the Translation Direction

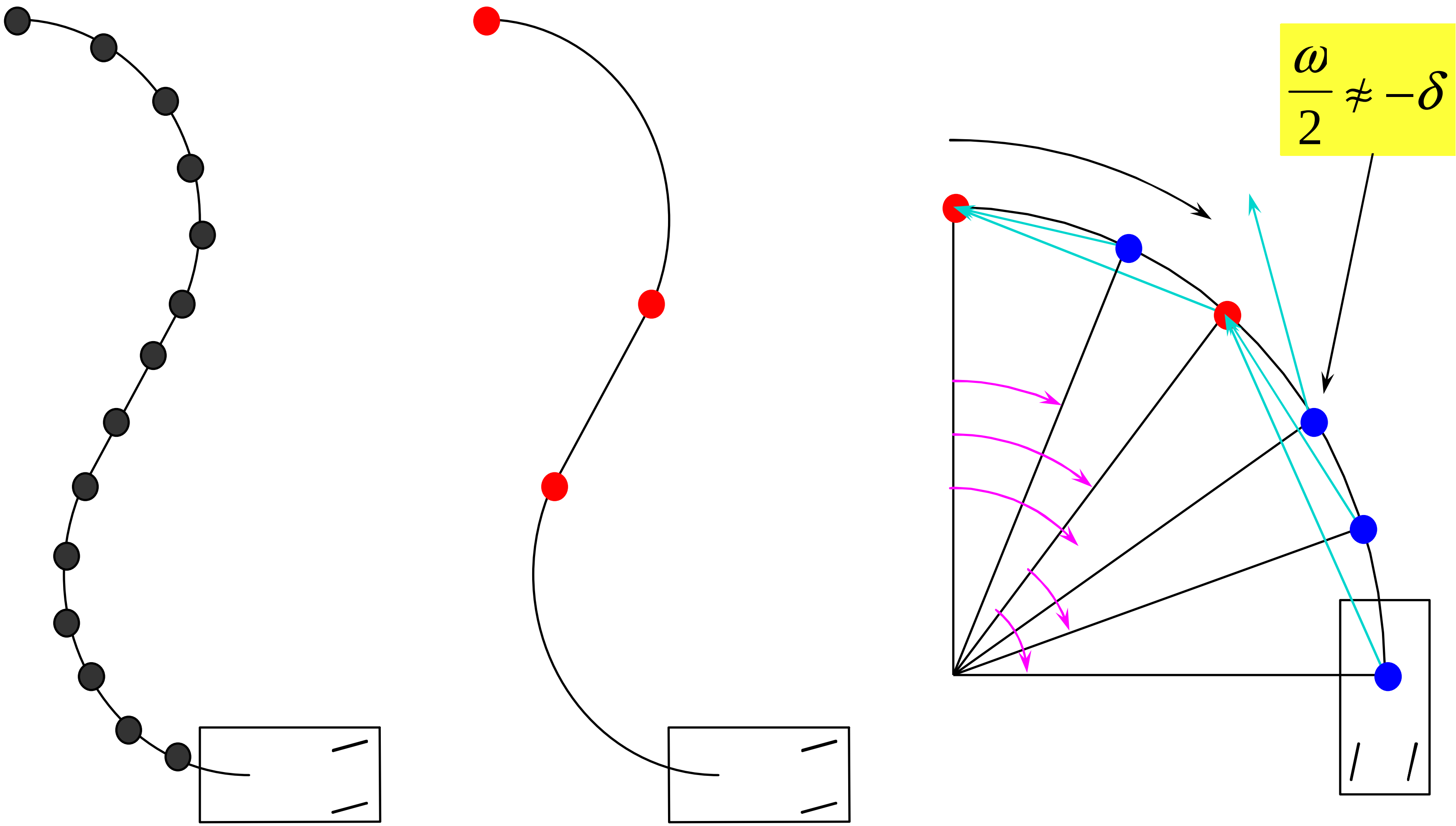


Relation between Rotation and Direction on a Wheelchair

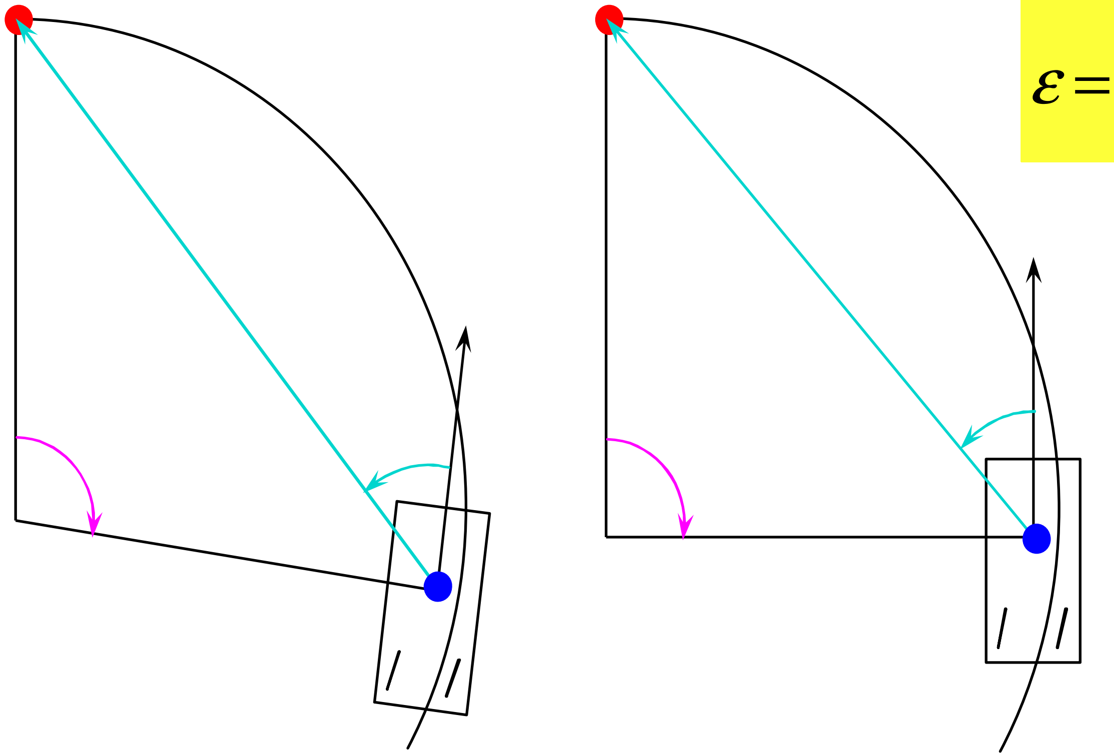


$$\frac{\omega}{2} = -\delta$$

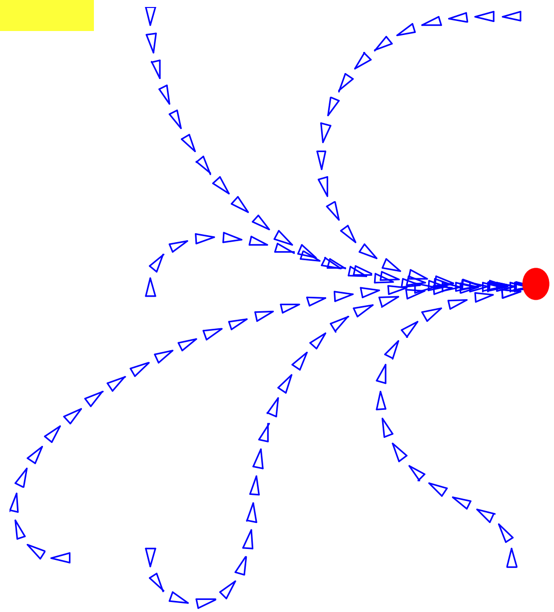
Representing Trajectories as Image Sequences



Autonomous Drive



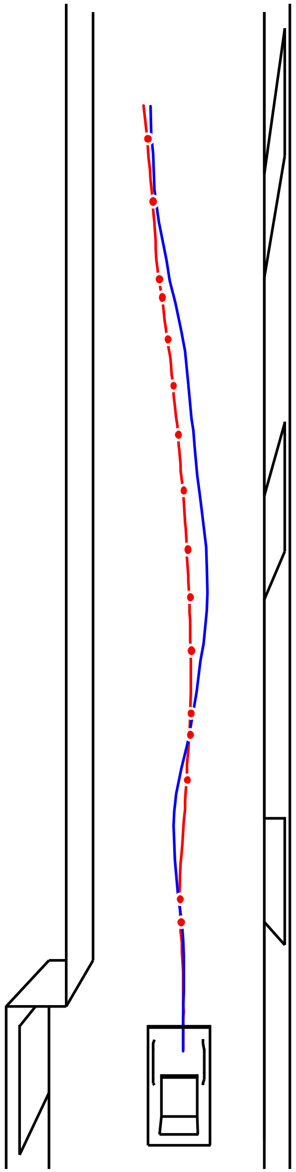
$$\varepsilon = \frac{\omega}{2} + \delta$$

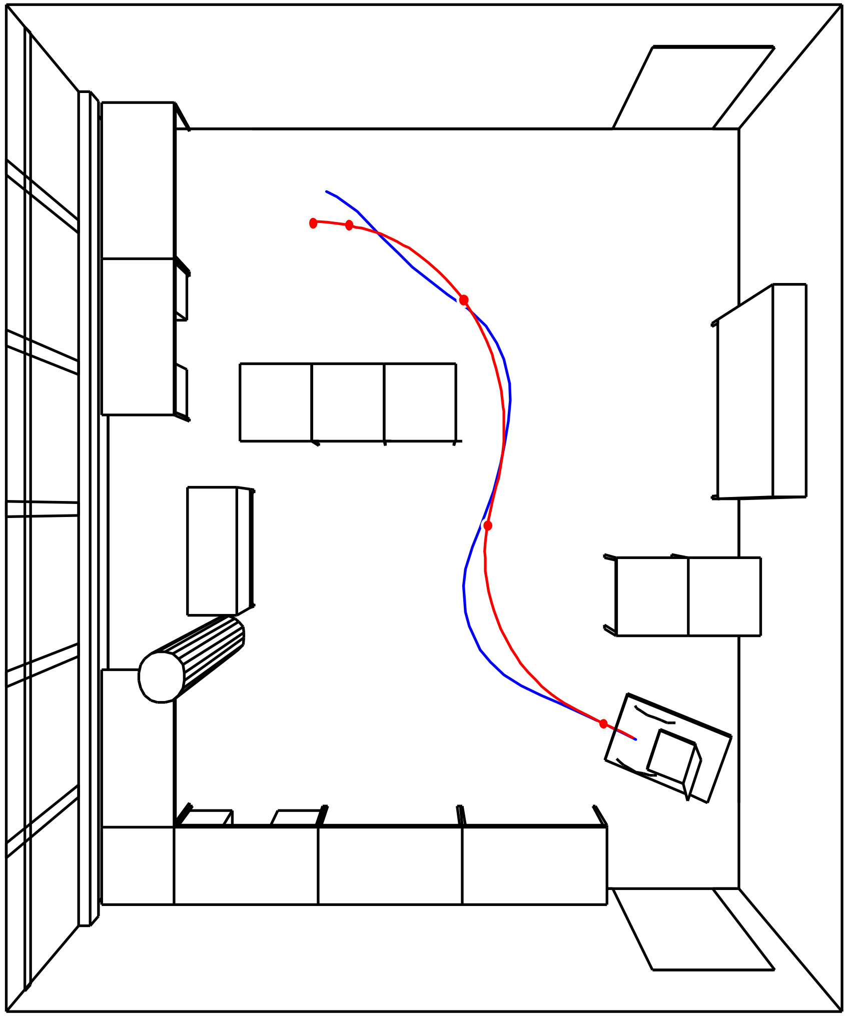


If the Translational Flow Is Large, Reduce ε.

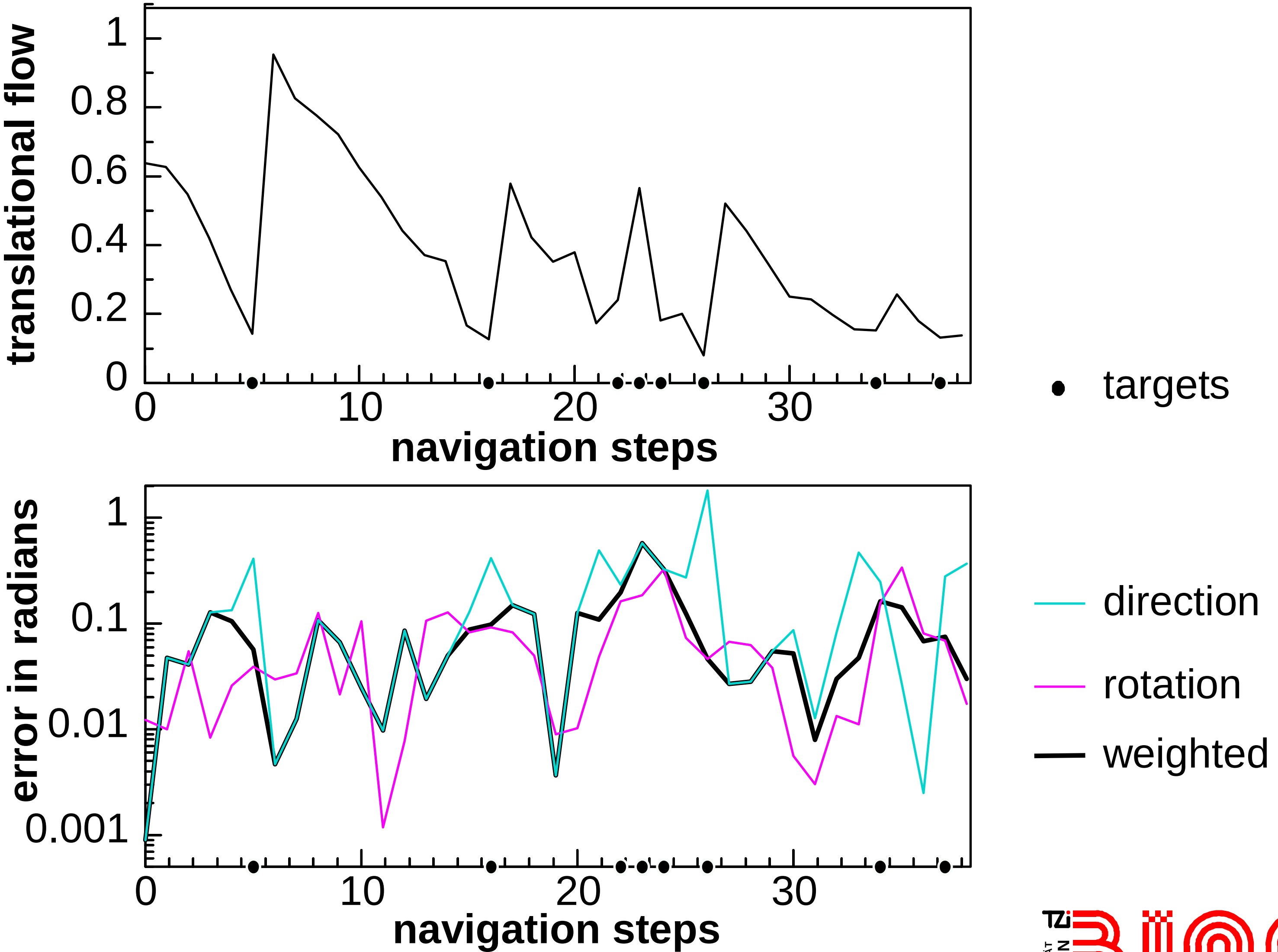
Otherwise, Reduce ω.

Experiments and Results





Analysis



translational flow
1
0.8
0.6
0.4
0.2
0
0
10
20
30
navigation steps
targets
error in radians
1
0.1
0.01
0.001
0
10
20
30
navigation steps
direction
rotation
weighted