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

spherical mirror

horizontal plane

camera

direction

intensity

$-\pi$ $-2\pi/3$ $-\pi/3$ $0$ $\pi/3$ $2\pi/3$ $\pi$
Matching Panoramic Images

![Graphs showing intensity vs. direction](image)
Basic Idea

1\textsuperscript{st} image \hspace{2cm} 2\textsuperscript{nd} image

- initialize
- train
- matching
- choose one pixel of the 1\textsuperscript{st} image
- search 2\textsuperscript{nd} image for most similar pixel pair
- adapt positions of the 1\textsuperscript{st} image in $\sigma$-neighborhood

$4096 \times 4096$
One-dimensional Feature Map

adaptation

position $y_i$

similarity

red + 1$^{st}$ derivation

green + 1$^{st}$ derivation

blue + 1$^{st}$ derivation
Similarity Search

\[ y_{ji} - \sigma \]

\[ y_{ji} \]

\[ y_{ji} + \sigma \]

\[ w_j \]

\[ w_{i+1} \]
Adaptation Step

\[ y_{j_{i-\sigma}} \rightarrow y_{j_i} \rightarrow y_{j_{i+\sigma}} \]

adaption step
Translational and Rotational Optical Flow
Dividing Optical Flow into Rotation and Translation

- Optical flow
  - Rotation
  - Translational flow
Calculating the Translation Direction

FOE

FOC
Relation between Rotation and Direction on a Wheelchair

Rotation $\omega$

Target position

Direction $\delta$

Current position

$\frac{\omega}{2} = -\delta$
Representing Trajectories as Image Sequences

\[ \frac{\omega}{2} \neq -\delta \]
If the Translational Flow Is Large, Reduce $\varepsilon$. Otherwise, Reduce $\omega$. 

\[ \varepsilon = \frac{\omega}{2} + \delta \]
Experiments and Results
Analysis

- targets
- direction
- rotation
- weighted