



Tracking scissors using retro-reflective lines

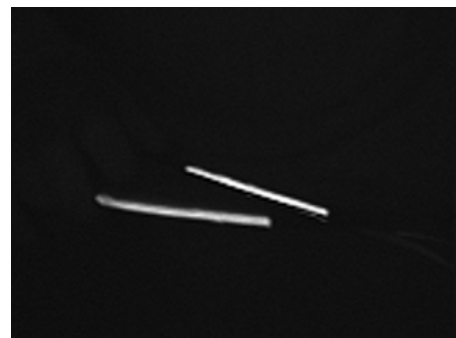
diploma thesis introducing talk
Katharina Pentenrieder



Introduction

■ Initial Situation

- Retro-reflective material
- Infrared images of two stereo cameras



■ Proceeding

- Finding the lines using Hough Transformation
- Tracking the lines in a series of images
- Determining the 3D-position of the instrument using images of two stereo cameras



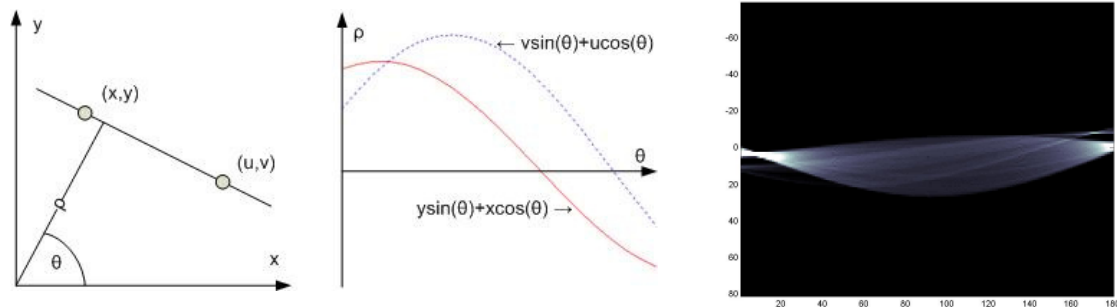
Hough Transformation

■ Theory

- Transformation into parameter plane

$$\rho = x \cos(\theta) + y \sin(\theta)$$

- Counting votes for each pair (ρ, θ) in an accumulator array \rightarrow finding maxima



Hough Transformation

■ Practical Problems

- Discretisation \rightarrow appropriate grid size
- Difficulties with noise \rightarrow phantom lines
- Different line intensities \rightarrow only one or too many lines are found

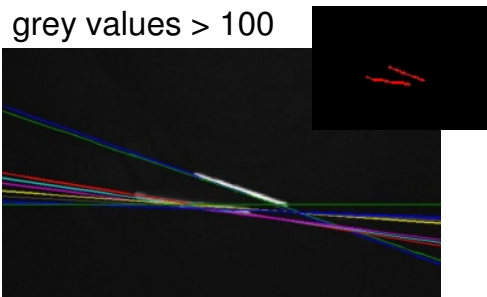
■ Approaches to solve these problems

- Variable cell size
- Variable grey value threshold
- Variable back transformation threshold
- Grouping of pairs (ρ, θ) with similar ρ -values

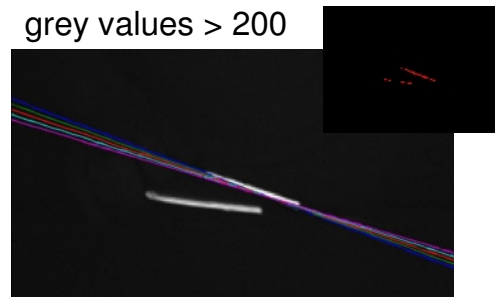
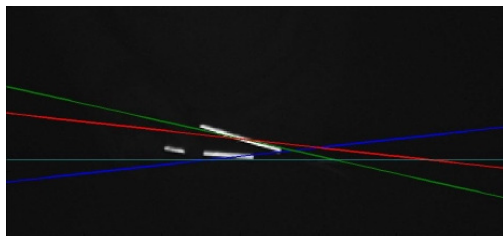


Hough Transformation

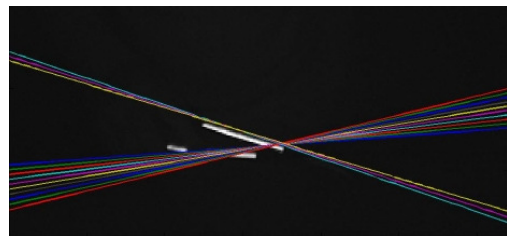
■ Results



$(\rho, \theta) = (80, 30)$, $btt = 0.6$



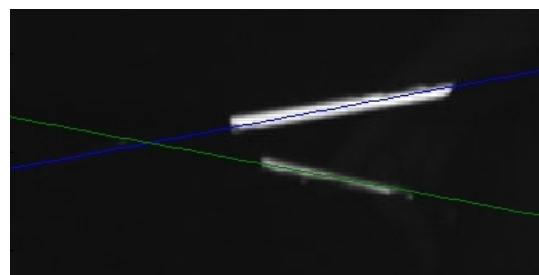
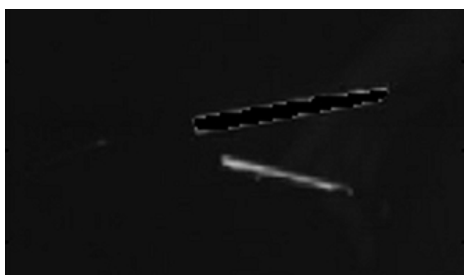
$(\rho, \theta) = (40, 180)$, $btt = 0.9$



Hough Transformation

■ Splitted Hough Transformation

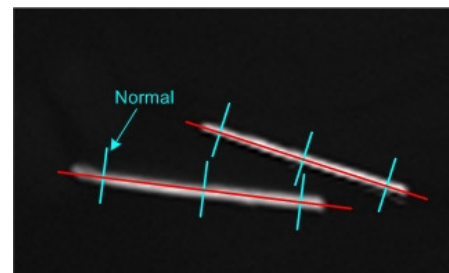
- maximum for original image at (ρ, θ)
- elimination along the corresponding line
- maximum for the new image at (ρ', θ')





Line Tracking

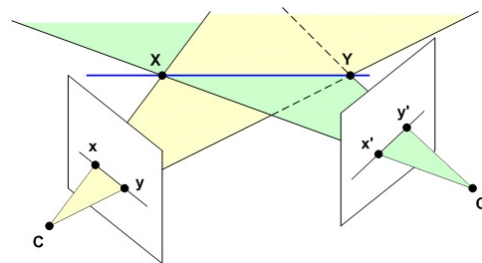
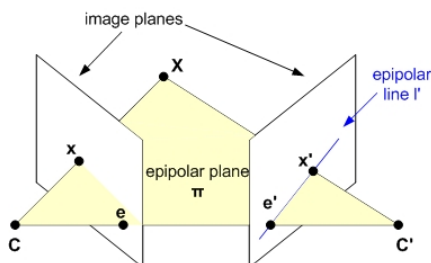
- When do it?
 - After Hough Transformation
 - After 3D-Positioning
- Correlation Matching
 - Grey value template vector \rightarrow line profile
 - Search for optimum of conformance



3D-Positioning

- Relationship: corresponding image points

- Fundamental matrix $F \rightarrow \mathbf{x}'^T F \mathbf{x} = 0$

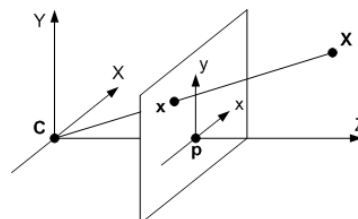


- Relationship: world point – image point

- Camera matrices P and P'

- Triangulation

- $\mathbf{x} = P\mathbf{X}$ and $\mathbf{x}' = P'\mathbf{X}'$





Further Steps

- Current topics
 - Hough Transformation with “noisy” images
 - Statistics on correctly determined lines
- Future topics
 - Tracking over a series of images
 - Creation of stereo image series
 - Computation of the 3D-Position
 - Tracking after 3D-Position is determined

Thank you for
your attention!

