Applied Computer Vision for Robotics

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GitHub

- Find together in groups of 3 people
- Everyone needs to create a GitHub account
  [http://github.com](http://github.com)
- Write a mail to [kloses@in.tum.de](mailto:kloses@in.tum.de) containing:
  - team name (be creative here)
  - real name, GitHub account name and e-mail address for each team member
Syllabus

- New sheet every 2 weeks
- **Mandatory** meeting every week
- Short presentation of the sheet results by the teams
- Everyone will be registered to a RVC mailing list - ask questions here
- You can also ask us questions or write mails
We are going to use ROS - Robot Operating System (www.ros.org)

We’ll introduce it on the fly and give hints which packages you might need

Check out the tutorials and wiki on ros.org for more details
Cameras

- If you don’t have an own camera working in ROS, you can borrow one from us
- PSEye Camera - 640x480 @60Hz
- Deposit: 10 €
- Detect image corners
- Calculate structure tensor

\[ M = \sum_{u,v} w(u, v) \begin{pmatrix} \nabla_x I & \nabla_x I \nabla_y I \\ \nabla_y I 
\end{pmatrix} \]

- Be careful about the image data types
- Use the eigenvalues \( \lambda_1, \lambda_2 \) to calculate the “corneress”
Use the Harris-Stephens formula to avoid the exact computation of the eigenvalues

\[ M_c = \lambda_1 \lambda_2 - \kappa (\lambda_1 + \lambda_2)^2 \]

\[ = \text{det}(M) - \kappa \text{trace}^2(M) \]

- Kappa is a parameter and can be tuned to get reasonable results
- Threshold to get corners and perform non-maximum suppression
Scale Space

- Perform Harris corner detection on different scales
  - Create an image pyramid with a scale factor (<1) and a fixed number of octaves
  - Detect the corners in each octave
Find the orientation of each corner

Compute the angle using

\[ \theta = \text{atan2} \left( \sum_{u,v} w(u, v) \left( \begin{array}{c} \nabla_x I \\ \nabla_y I \end{array} \right) \right) \]
- Very often the detected features are not well distributed over the image.
- Instead of using a fixed threshold, ANMS uses only non-maximum suppression within a certain radius.