CVVisual

Andreas Clara Erich Florian Johannes Nikolai Raphael

20. Juni 2014

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0.1 Gliederung

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1 Einführung in OpenCV

1.1 Überblick

- Bildverarbeitung
- weite Verbreitung
- Matrizen als Grundlage

- Filter + Matches

1.2 Matrizen

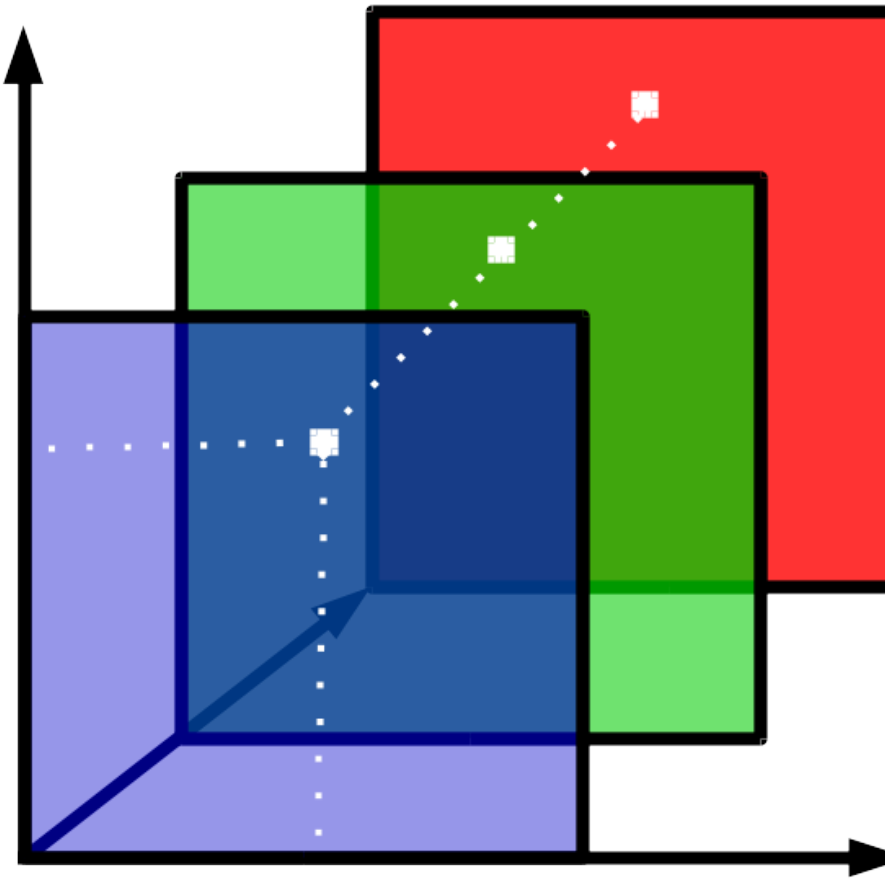


Bild = mehrdimensionale Matrix

Bsp. BGR-Bild: 1. Channel blau, 2. Channel grün usw.

1.3 Filter

Berechnung auf Umgebung jedes Pixels

1.4 Filter

Beispiel dilate: helle Flächen werden größer

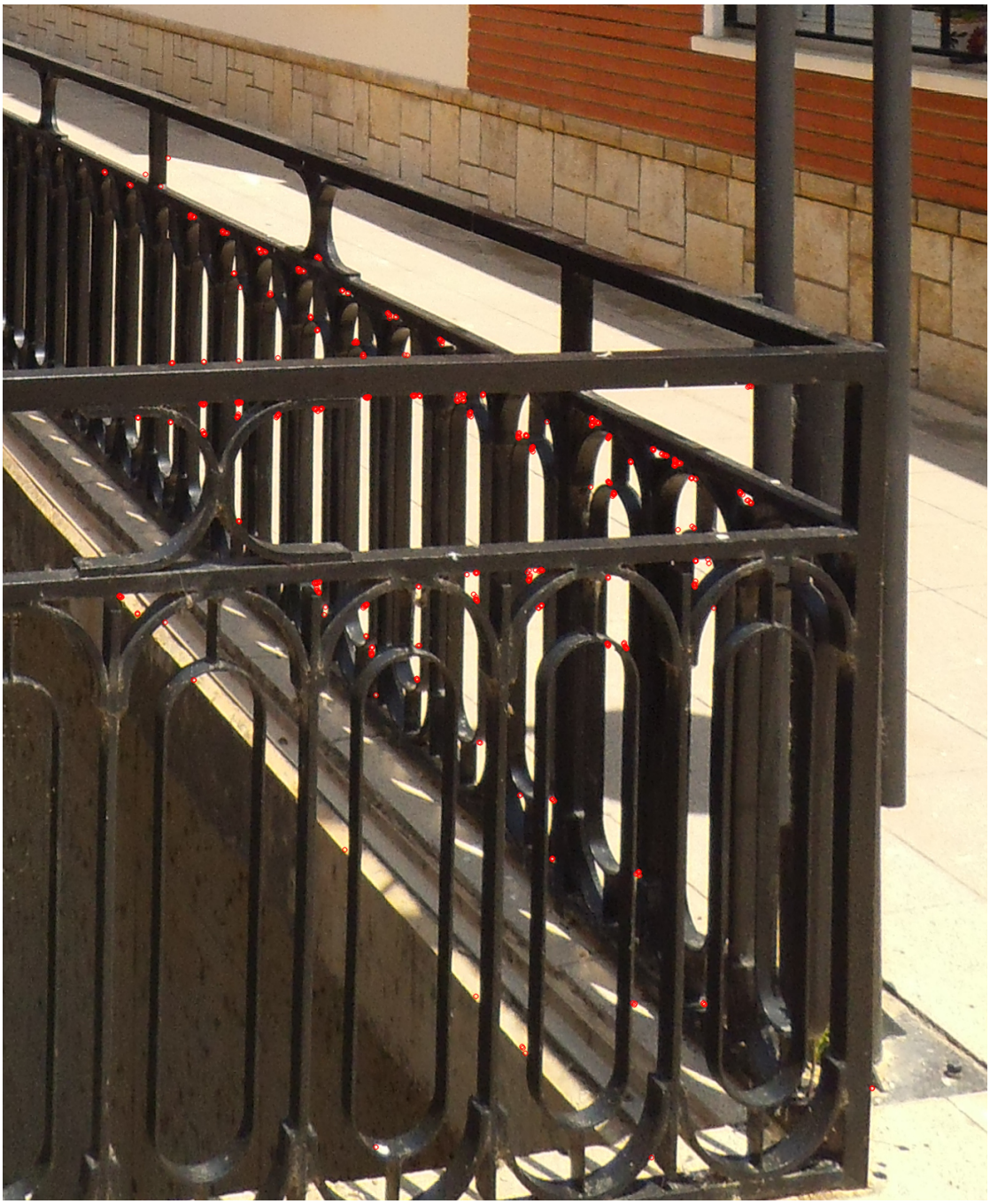
5	7	3	5	5	5
3	2	6	7	6	5
2	3	2	4	6	6
3	3	5	6	4	5
1	4	6	2	2	4
3	4	7	5	6	5

1.5 Filter

Beispiel dilate: helle Flächen werden größer 

1.6 Matches

Keypoints = charakteristische Punkte



1.7 Matches

Match = Paar aus Keypoints

2 Motivation

2.1 Debuggen von OpenCV

```
#ifdef DEBUG
        Mat img_matches;
        drawMatches( img_1, keypoints_1, img_2, keypoi
                     good_matches, img_matches, Scalar:
                     vector<char>(), DrawMatchesFlags::
        imshow("good matches", img_matches);
#endif
```

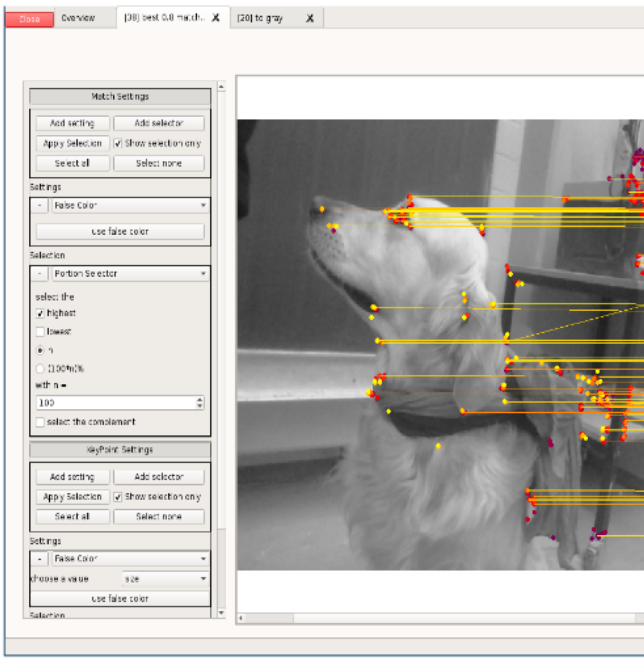
versus

```
cvv::debugMatches(img1, img2, keypoints_1, key
```

Systematisches Debugging statt „Random Code“

Hinweis auf showMatches/showKeypoints

2.2 Ziele



Visualisierung von Matritzen, Filtereffekten und Matches

3 Anwenderfeatures

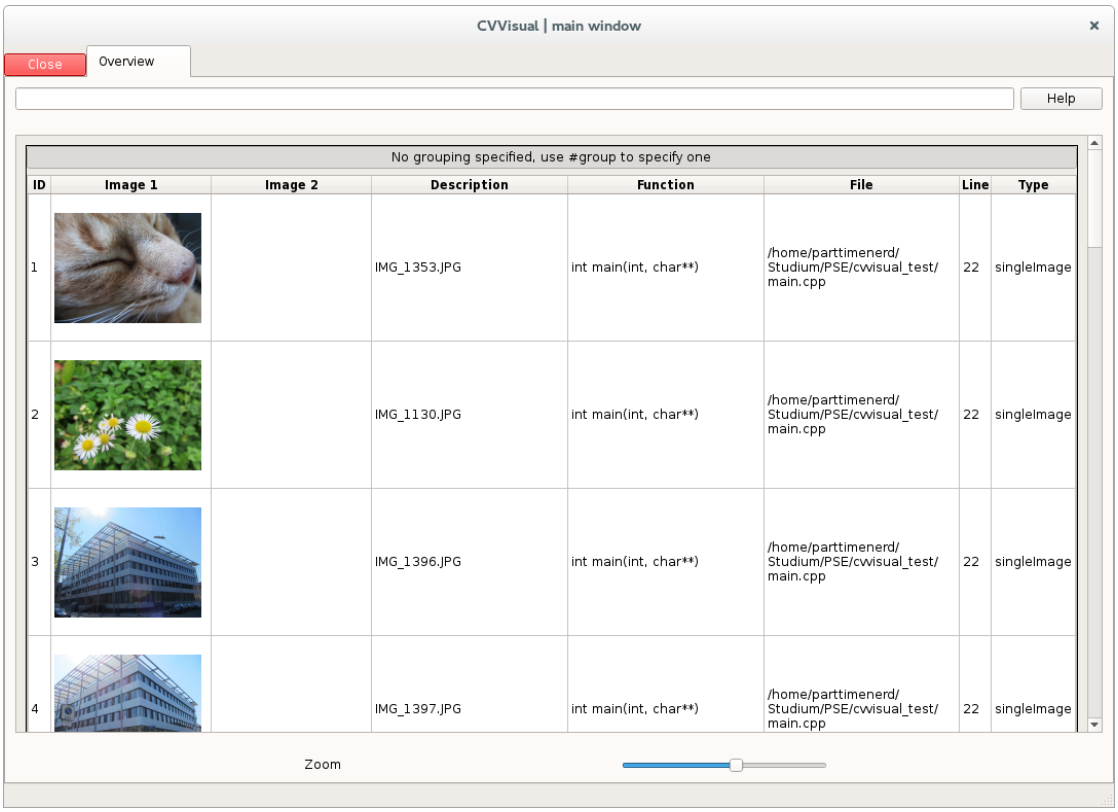
3.1 Verwendung

```
std::string imgIdString{"imgRead"};
imgIDString += toString(imgId);
cvv::showImage(imgRead, CVVISUAL_LOCATION, imgIdString);

// convert to grayscale:
cv::Mat imgGray;
cv::cvtColor(imgRead, imgGray, CV_BGR2GRAY);
cvv::debugFilter(imgRead, imgGray, CVVISUAL_LOCATION,
                 "to gray", "SingleFilterView");
```

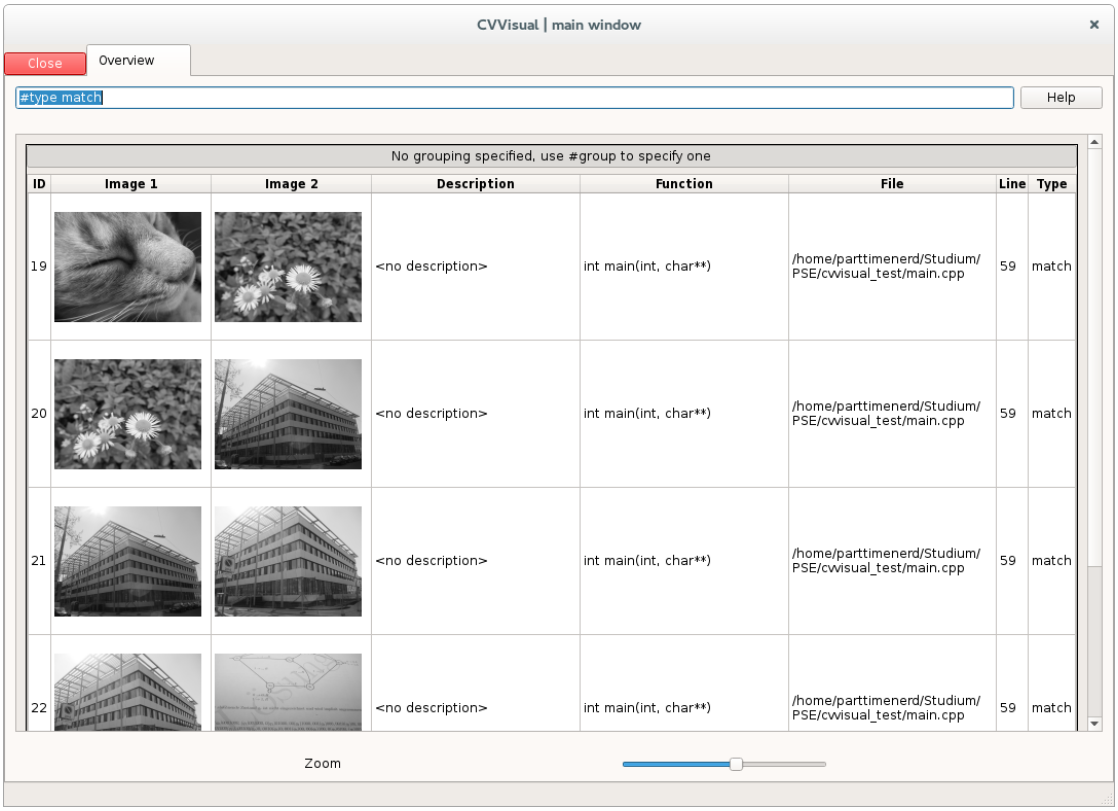
3.2 Übersicht

Übersicht über alle Aufrufe


CVVisual | main window
Close
Overview
Help
No grouping specified, use #group to specify one
ID
Image 1
Image 2
Description
Function
File
Line
Type
1
IMG_1353.JPG
int main(int, char**)
/home/parttimenerd/Studium/PSE/cvvisual_test/main.cpp
22
singleImage
2
IMG_1130.JPG
int main(int, char**)
/home/parttimenerd/Studium/PSE/cvvisual_test/main.cpp
22
singleImage
3
IMG_1396.JPG
int main(int, char**)
/home/parttimenerd/Studium/PSE/cvvisual_test/main.cpp
22
singleImage
4
IMG_1397.JPG
int main(int, char**)
/home/parttimenerd/Studium/PSE/cvvisual_test/main.cpp
22
singleImage
Zoom

3.3 Übersicht

Filterbar



3.4 Übersicht

Sortierbar

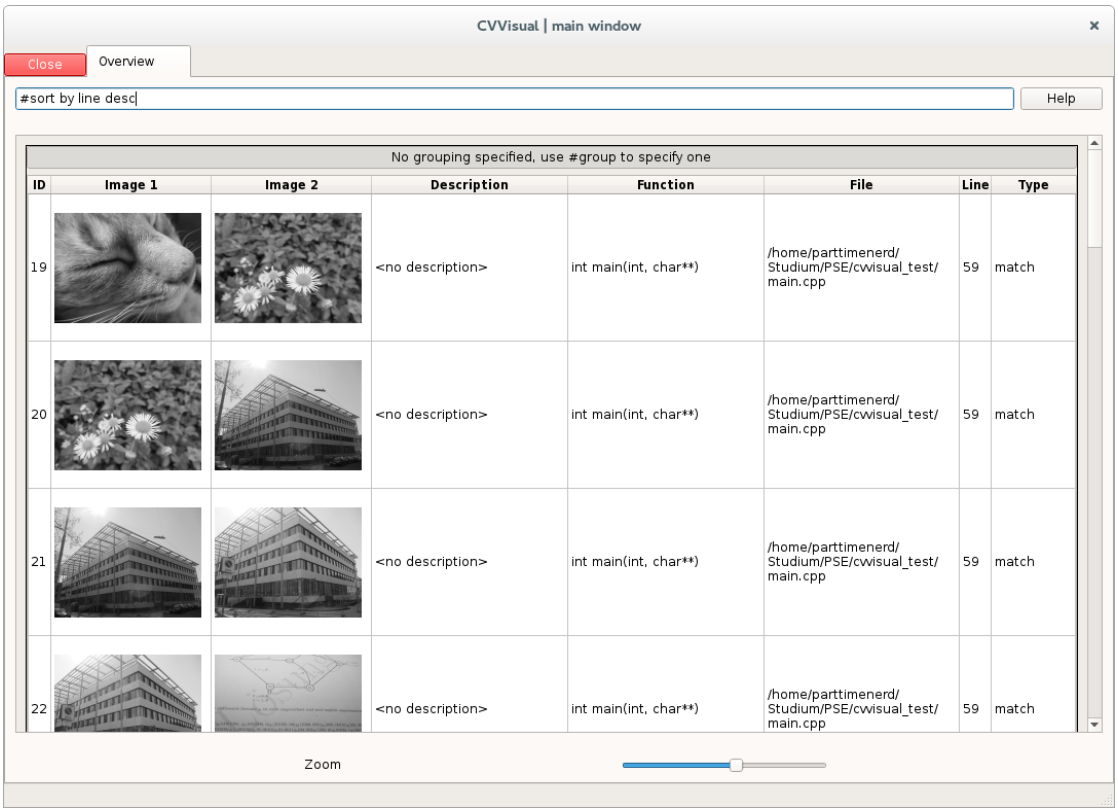
3.5 Übersicht

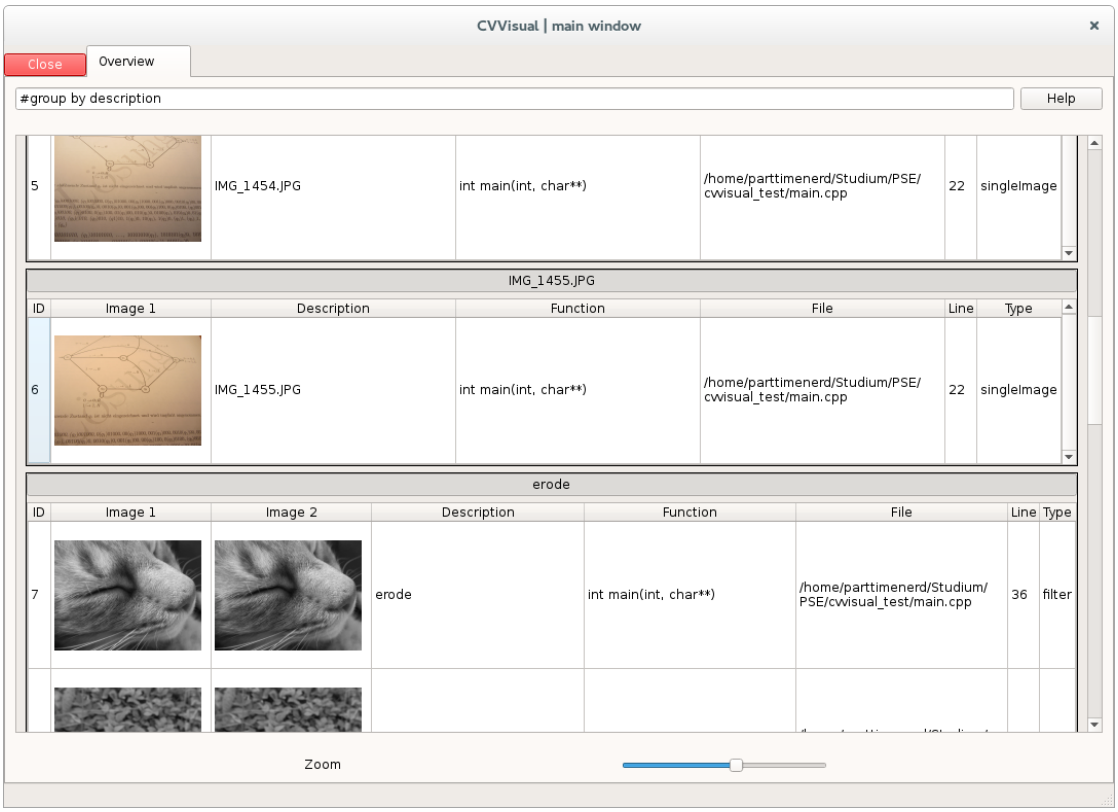
Gruppierbar

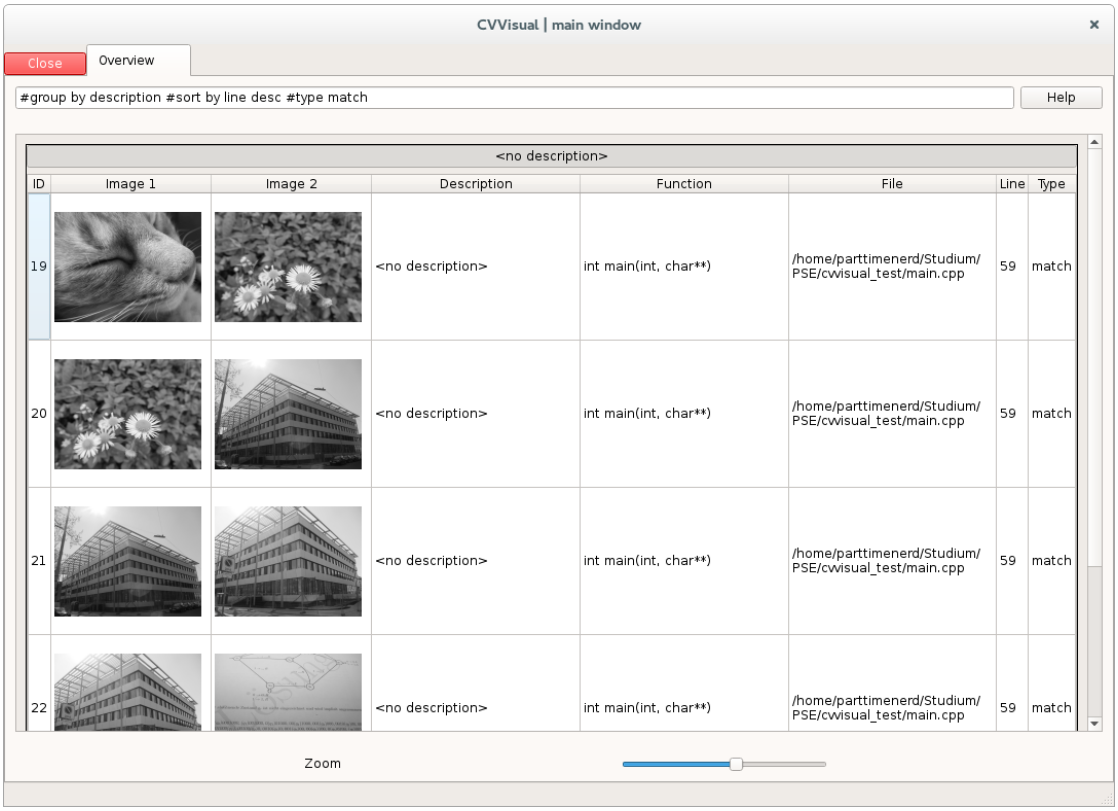
3.6 Übersicht

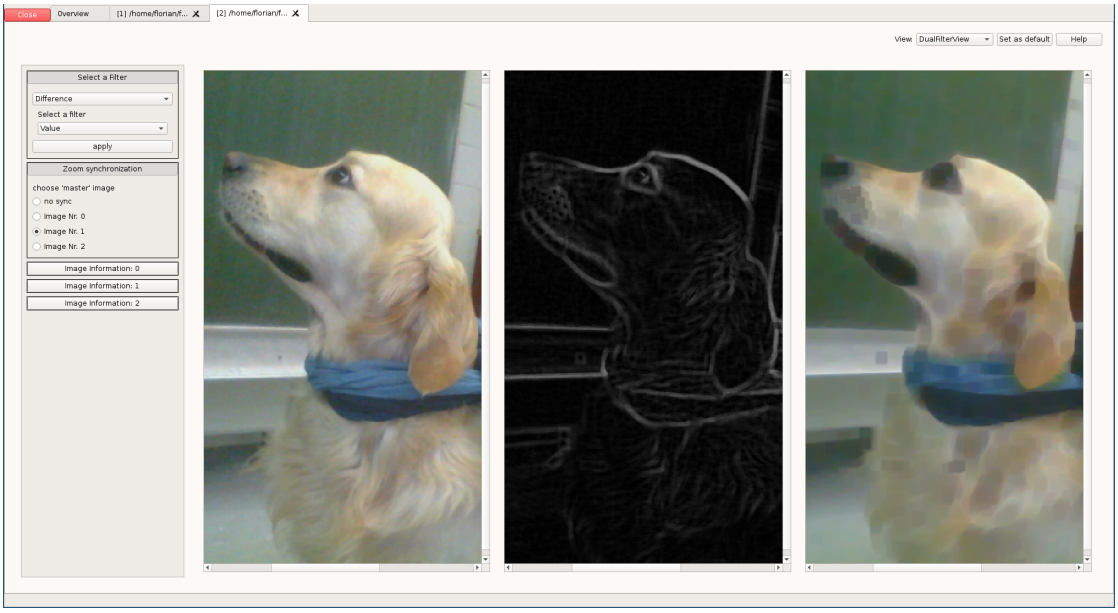
3.7 Filter

- 2 Bilder → 1 Bild
- Differenzbilder, Overlay, geänderte Pixel für Filter


CVVisual | main window
Close
Overview
#sort by line desc
Help
No grouping specified, use #group to specify one
ID
Image 1
Image 2
Description
Function
File
Line
Type
19
<no description>
int main(int, char**)
/home/parttimenerd/Studium/PSE/cvvisual_test/main.cpp
59
match
20
<no description>
int main(int, char**)
/home/parttimenerd/Studium/PSE/cvvisual_test/main.cpp
59
match
21
<no description>
int main(int, char**)
/home/parttimenerd/Studium/PSE/cvvisual_test/main.cpp
59
match
22
<no description>
int main(int, char**)
/home/parttimenerd/Studium/PSE/cvvisual_test/main.cpp
59
match
Zoom

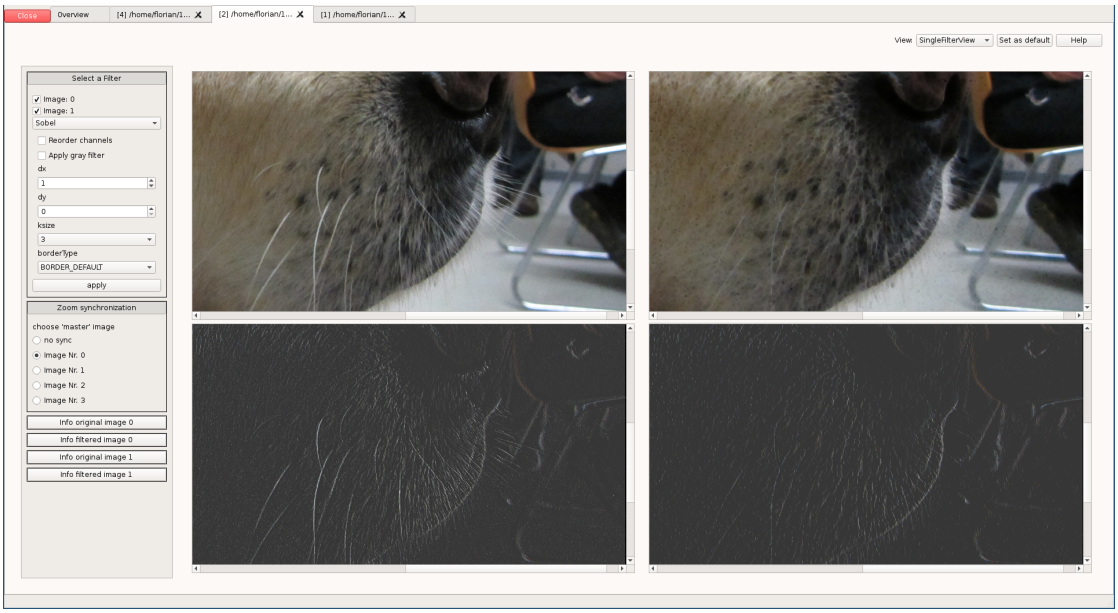

CVVisual | main window
Close
Overview
#group by description
Help
5
IMG_1454.JPG
int main(int, char**)
/home/parttimenerd/Studium/PSE/cvvisual_test/main.cpp
22
singleImage
IMG_1455.JPG
ID
Image 1
Description
Function
File
Line
Type
6
IMG_1455.JPG
int main(int, char**)
/home/parttimenerd/Studium/PSE/cvvisual_test/main.cpp
22
singleImage
erode
ID
Image 1
Image 2
Description
Function
File
Line
Type
7
erode
int main(int, char**)
/home/parttimenerd/Studium/PSE/cvvisual_test/main.cpp
36
filter
Zoom


CVVisual | main window
Close
Overview
#group by description #sort by line desc #type match
Help
<no description>
ID
Image 1
Image 2
Description
Function
File
Line
Type
19
<no description>
int main(int, char**)
/home/parttimenerd/Studium/PSE/cvvisual_test/main.cpp
59
match
20
<no description>
int main(int, char**)
/home/parttimenerd/Studium/PSE/cvvisual_test/main.cpp
59
match
21
<no description>
int main(int, char**)
/home/parttimenerd/Studium/PSE/cvvisual_test/main.cpp
59
match
22
<no description>
int main(int, char**)
/home/parttimenerd/Studium/PSE/cvvisual_test/main.cpp
59
match
Zoom


Close
Overview
View
DualFilterView
Set as default
Help
Select a Filter
Difference
Select a filter
Value
apply
Zoom synchronization
choose 'master' image
no sync
Image Nr. 0
Image Nr. 1
Image Nr. 2
Image Information: 0
Image Information: 1
Image Information: 2

3.8 Filter

- 1 Bild → 1 Bild
- Nachträgliche Anwendung weiterer Filter

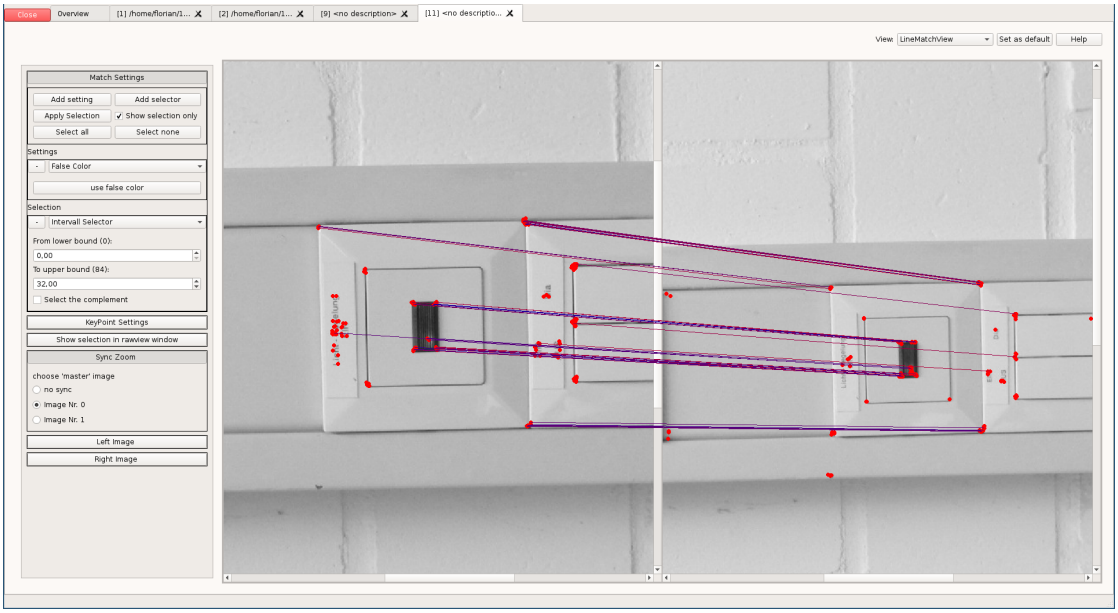


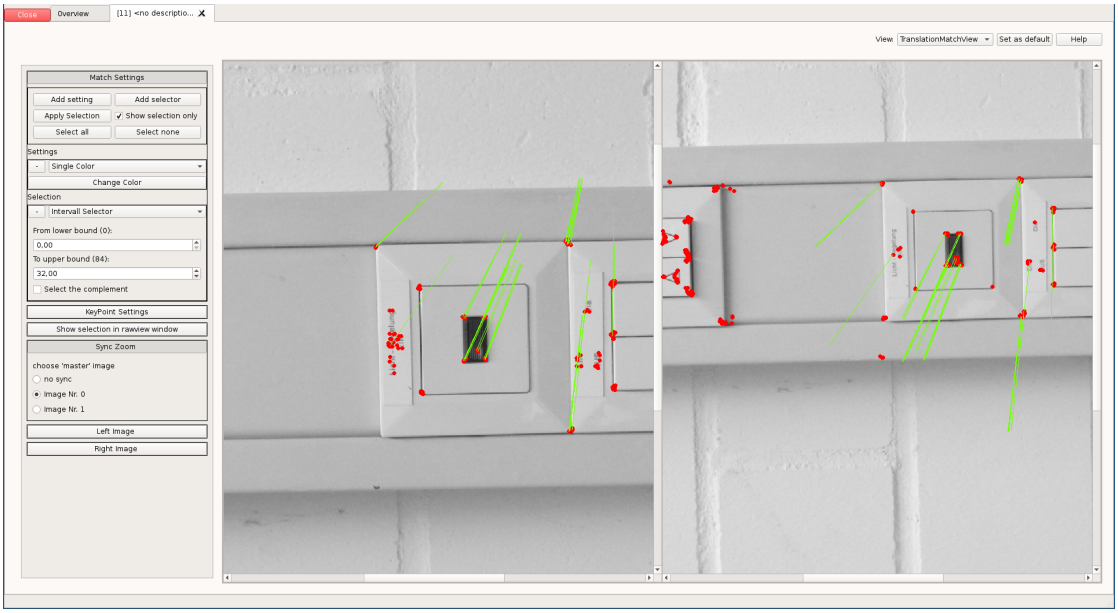
3.9 Matches

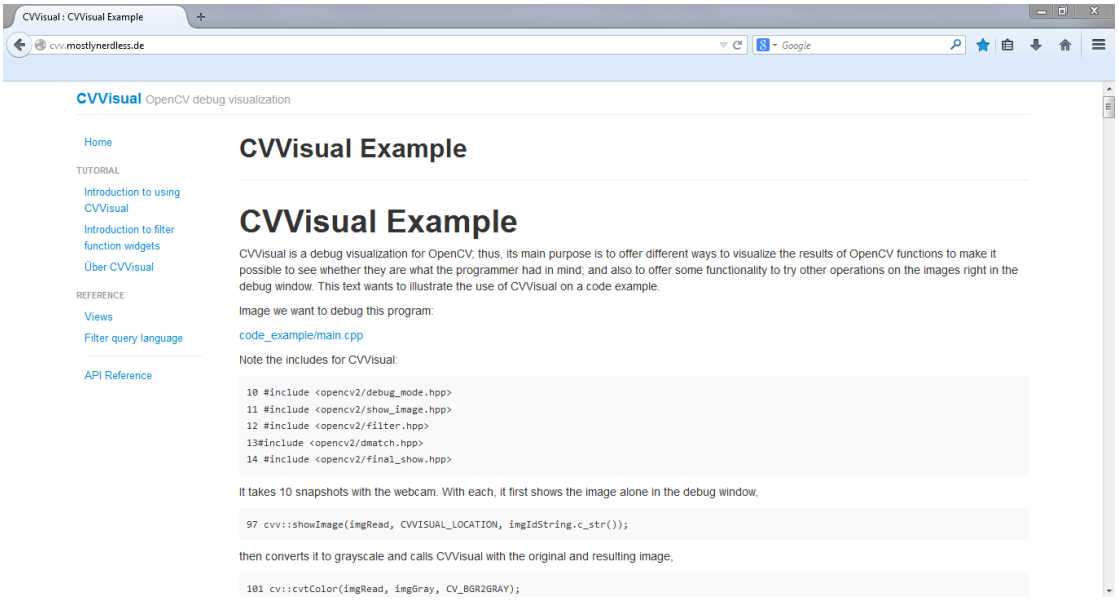
- Anzeigen / Filtern von Keypoints / Matches
- Anzeige der Verbindungen von Keypoints

3.10 Matches

- Anzeigen / Filtern von Keypoints / Matches
- Anzeige der Translation von Keypoints


Close
Overview
[1] /home/florian/1...
[2] /home/florian/1...
[9] <no description>
[11] <no descriptio...
View: LineMatchView
Set as default
Help
Match Settings
Add setting
Add selector
Apply Selection
Show selection only
Select all
Select none
Settings
False Color
use false color
Selection
Intervall Selector
From lower bound (0):
0,00
To upper bound (84):
32,00
Select the complement
KeyPoint Settings
Show selection in rawview window
Sync Zoom
choose 'master' image
no sync
Image Nr. 0
Image Nr. 1
Left Image
Right Image


Close
Overview
[11] <no descriptio...
View: TranslationMatchView
Set as default
Help
Match Settings
Add setting
Add selector
Apply Selection
Show selection only
Select all
Select none
Settings
Single Color
Change Color
Selection
Intervall Selector
From lower bound (0):
0,00
To upper bound (84):
32,00
Select the complement
KeyPoint Settings
Show selection in rawview window
Sync Zoom
choose 'master' image
no sync
Image Nr. 0
Image Nr. 1
Left Image
Right Image



4 GUI-Demo

5 Dokumentation

5.1 Tutorials, Beispiele

5.2 Kurzdokumentation

Wird von der Hilfefunktion des Programms benutzt.

5.3 Referenz:

- Mit Hilfe von Doxygen

6 Architektur

6.1 Entwurf

- Trennung in API, Datenhaltung, Visualisierung

6.2 Signals/Slots & Templates

- Qt erlaubt keine Templateklassen mit Q_OBJECT

CVVisual OpenCV debug visualization

Home

TUTORIAL

Introduction to using CVVisual

Introduction to filter function widgets

Über CVVisual

REFERENCE

Views

Filter query language

API Reference

Views

General information:

Most views offer an `ImageInformation` collapsable in their accordion menus.
The zoom can be found here.
`Ctrl` + `Mouse wheel` is also zoom; `Ctrl` + `Shift` + `Mouse wheel` is a slower zoom.
If the zoom is deeper than 60%, the image's pixels will be overlaid with their channel values; usually, the order is BGR[+alpha] from the top.

Single Image View:

Associated with the `debugSingleImage()` function.
Shows one single image with no features other than `Image Information`.

Filter Views:

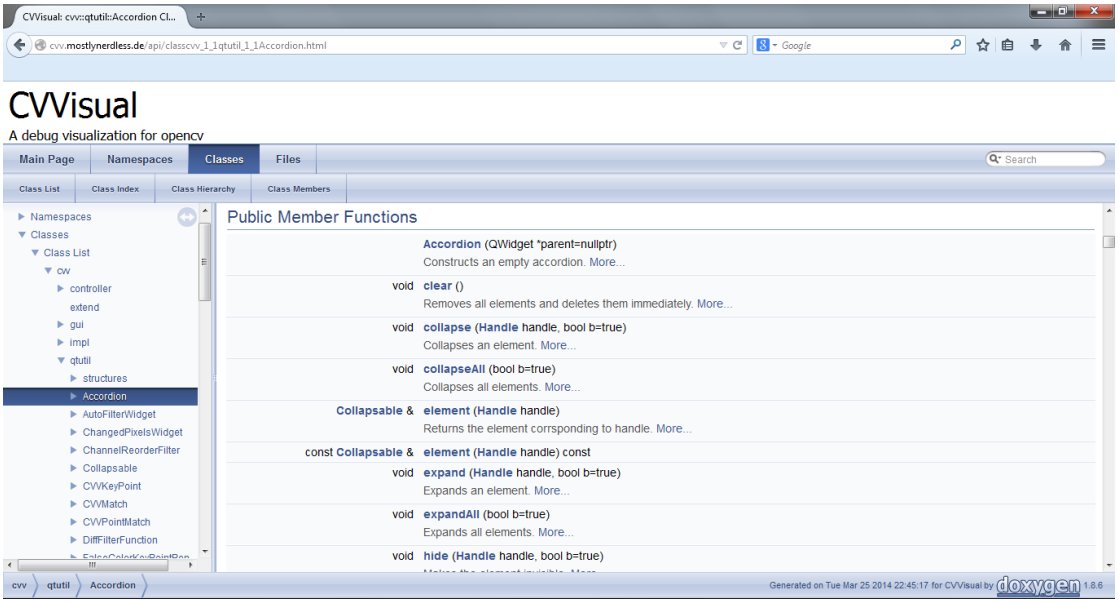
Associated with the `debugFilter()` function.

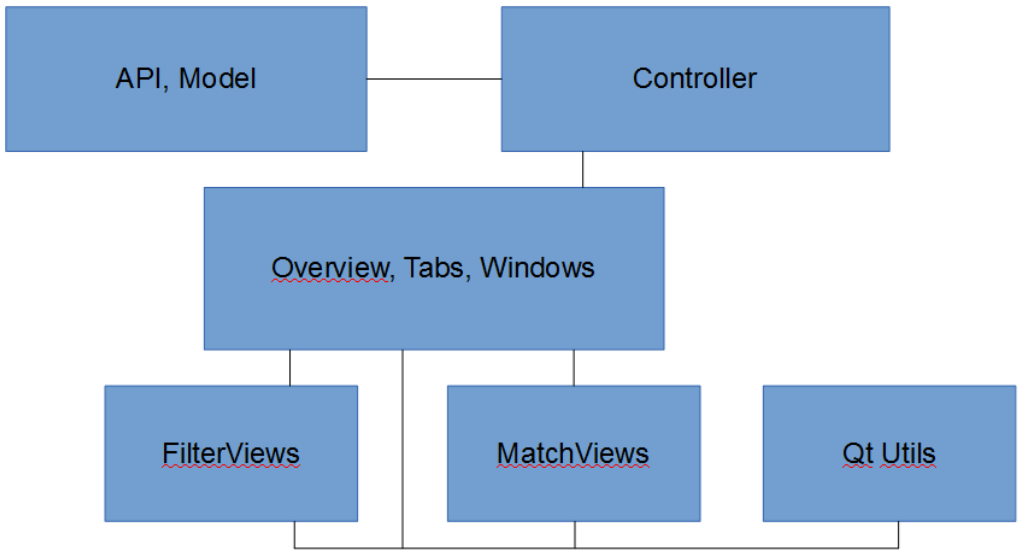
DefaultFilterView:

Shows two images with only the basic features of `ImageInformation`, synchronized zoom and `Histogram`.

DualFilterView:

Shows the two images given to the CVVisual function and *Result Image* inbetween which represents the result of a filter that was applied to the others via the `Filter selection` collapsable, like a difference image between the two.





- Signals/Slots in Objekte ausgelagert

```
class SlotQString : public QObject
{    Q_OBJECT
  public:
    SlotQString(const std::function<void(QString)> &f,
                QObject *parent = nullptr)
    : QObject{ parent }, function_{ f }
    {    if (!f)
             throw std::invalid_argument{ "invalide function" };
    }
public slots:
    void slot(QString t) const
         {function_(t);}
  private:
    std::function<void(QString)> function_;
};
```

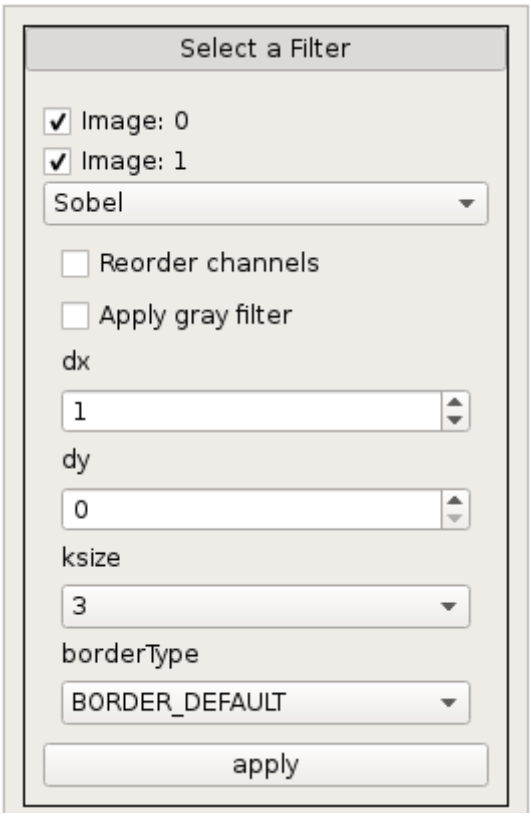
6.3 RegisterHelper

- Ermöglicht die Auswahl von Funktionen über eine Combobox
- Funktionen werden über eine API Funktione registriert

6.4 (Auto-)FilterWidget

- Unterklasse von RegisterHelper
- Ermöglicht Auswahl von Filtern

- Gibt Ergebnise per Signal weiter (z.B. an ein ZoomableImage)



6.5 ZoomableImage

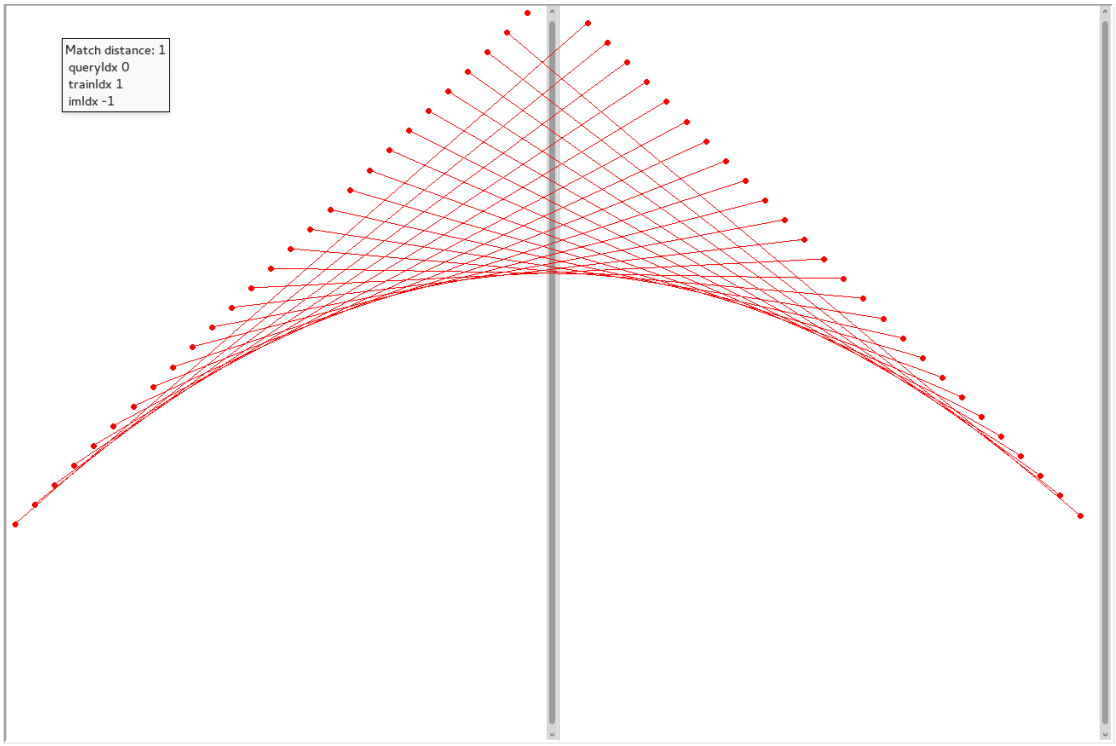
- Umwandlung von cv::Mat in Qt Format
- Signal & Slot für Zoom Events
- Slot zum Bild wechseln
- SyncZoomWidget erlaubt syncronen Zoom
- ZoomableImageOptionPanel zeigt weiter Informationen/Optinen an

6.6 MatchScene

- Enthält 2 ZoomableImages
- Enthält die KeyPoints/Matches als QGraphicsObjects

6.7 Match/KeyPointSetting

- Keine Auslagerung von Singals/Slots möglich



- Daher parallele Entwicklung von KeyPoint und MatchSetting
- Nur Selektierte KeyPoints/Matches werden angezeigt

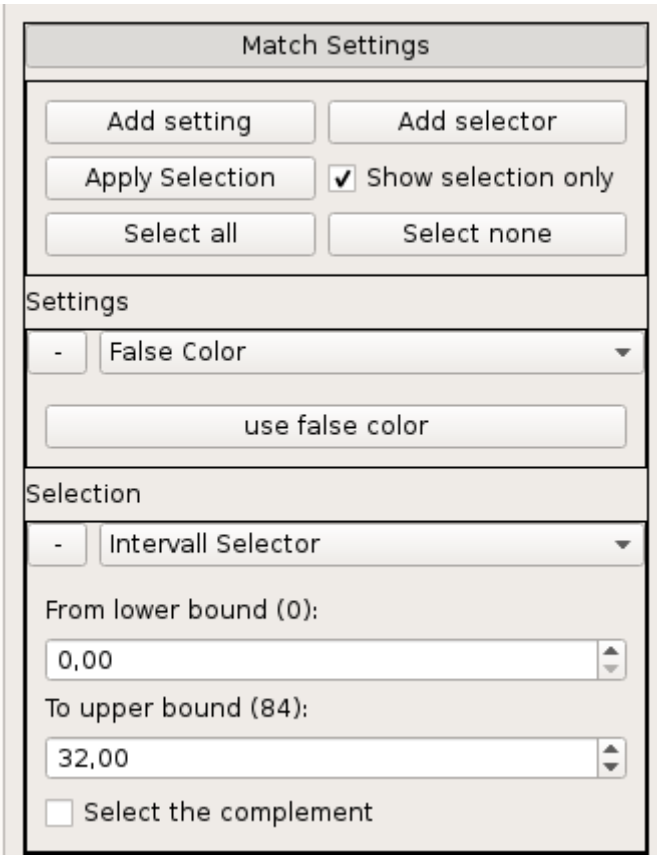
6.8 Views

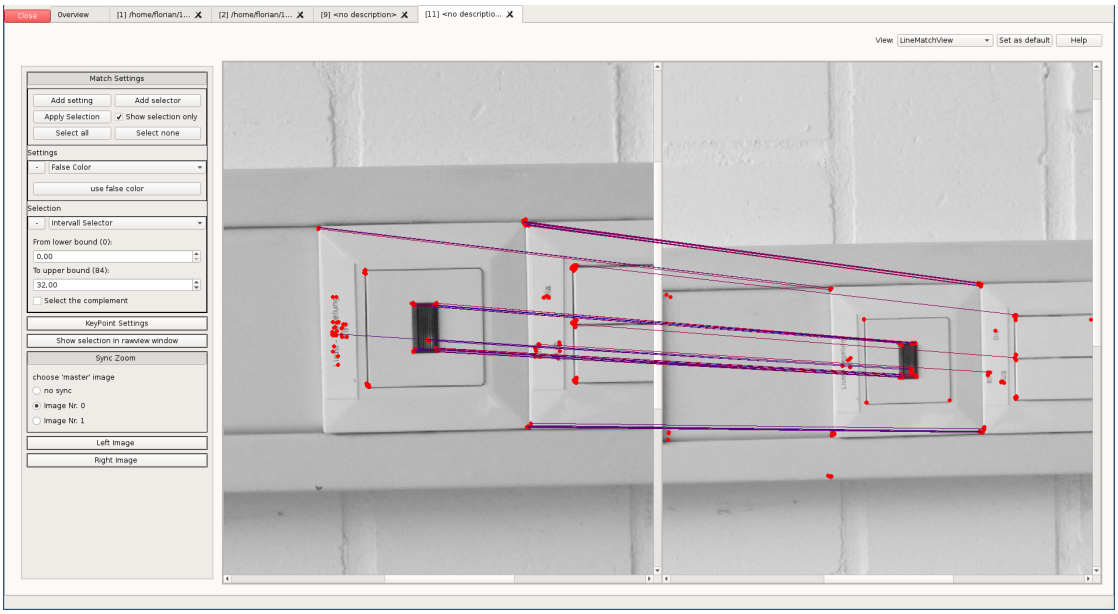
- Visualisierung der unterschiedlichen Aufrufe
- Unterscheiden sich meist in unterschidlichen Nutzen von QT Util Klassen
- Einzige Aufgabe Weiterleitung und Annahme der Selektion (beim Wechsel der Views)

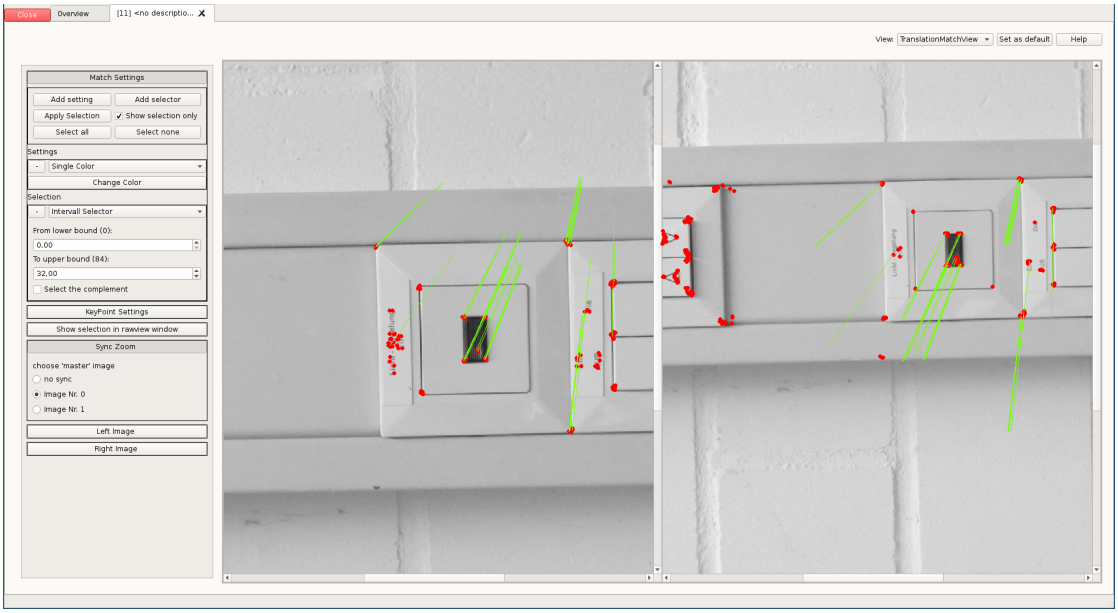
7 API

7.1 Anwender API

- Triviale Benutzung auch in C++98
- Sehr klein und übersichtlich


Match Settings
Add setting
Add selector
Apply Selection
Show selection only
Select all
Select none
Settings
-
False Color
use false color
Selection
-
Intervall Selector
From lower bound (0):
0,00
To upper bound (84):
32,00
Select the complement


Close
Overview
[1] /home/florian/1...
[2] /home/florian/1...
[9] <no description>
[11] <no descriptio...
View:
LineMatchView
Set as default
Help
Match Settings
Add setting
Add selector
Apply Selection
Show selection only
Select all
Select none
Settings
False Color
use false color
Selection
Intervall Selector
From lower bound (0):
0,00
To upper bound (84):
32,00
Select the complement
KeyPoint Settings
Show selection in rawview window
Sync Zoom
choose 'master' image
no sync
Image Nr. 0
Image Nr. 1
Left Image
Right Image



7.2 Interne API

- Erweiterung über Funktionen in `cvv::extend`
- Leichtes, zentralisiertes Hinzufügen von Visualisierungen, Filtern, Views,...

8 Ausblick

8.1 Rezeption

Projekt schien von der OpenCV-Community wohlwollend aufgenommen zu werden

8.2 Rezeption

Nach aktuellem Stand aber aufgrund C++11 und Qt5 keine Aufnahme ins Haupt-Repo

8.3 Links

- Github: https://github.com/CVVisualPSETeam/CVVisual
- Dokumentation: https://cvv.mostlynerdless.de/
- Doxygen: https://cvv.mostlynerdless.de/api/

snosov1 commented 2 days ago Collaborator

Hi, Andreas!

First of all, thank you for a really valuable contribution. I've been dreaming about such functionality since the day 1 I started using OpenCV.

As **@apavlenko** suggests, this module should probably go to the opencv_contrib repository. Due to limited resources we've created it, so we could easily accept such big PRs - almost "No questions asked". Then it boils there for a bit of time, and if it turns out to be solid and well received by the community, we would merge it into the mainstream (this) repo.

It's a default path for such major contributions and if you're ok with it - let's do it this way.

Personally, I would like such module to be in the mainstream repo as soon as possible. So, I'll try to review it shortly and give some feedback.

snosov1 commented on 19. Apr.

Sorry for delay. I've looked through it right away, and they're a couple of issues. Mainly, we don't plan to enable C++11 for builds of this repository, since the support is not yet ubiquitous. Also, the usage of Qt5 is rather limiting.

This makes it a great tool for development and research on Desktops with latest sw, but is unusable on other platforms.

My thinking is that in its current form it doesn't belong to the mainstream repo because of these dependencies. But, I think, it can be merged to the contrib repo after a few minor fixes.

Let's also ask **@kirill-kornyakov** on that.