CVVisual

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1 Einführung in OpenCV

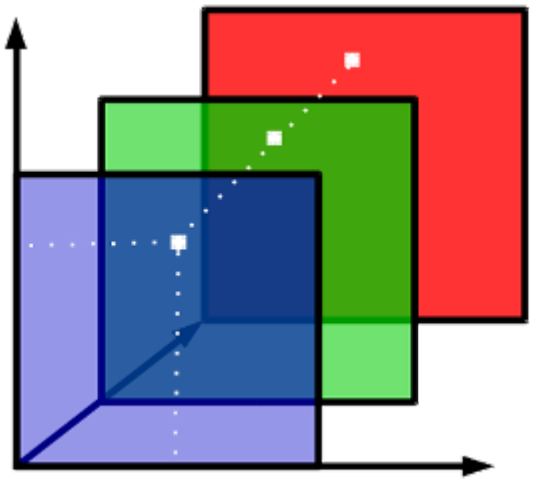
1.1 Überblick

- 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

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

1.4 Filter

Beispiel dilate: helle Flächen werden größer

1.5 Filter

Beispiel dilate: helle Flächen werden größer

1.6 Filter

Beispiel dilate: helle Flächen werden größer

1.7 Matches

Keypoints = charakteristische Punkte

1.8 Matches

Match = Paar aus Keypoints

2 Motivation

2.1 Debuggen von OpenCV

Systematisches Debugging statt „Random Code“

```
#ifdef DEBUG
        Mat img_matches;
        drawMatches( img_1, keypoints_1, img_2, keypoints_2,
                     good_matches, img_matches, Scalar::all(-1), Scalar::all(-1),
                     vector<char>(), DrawMatchesFlags::NOT_DRAW_SINGLE_POINTS );
        imshow("good matches", img_matches);
#endif
```

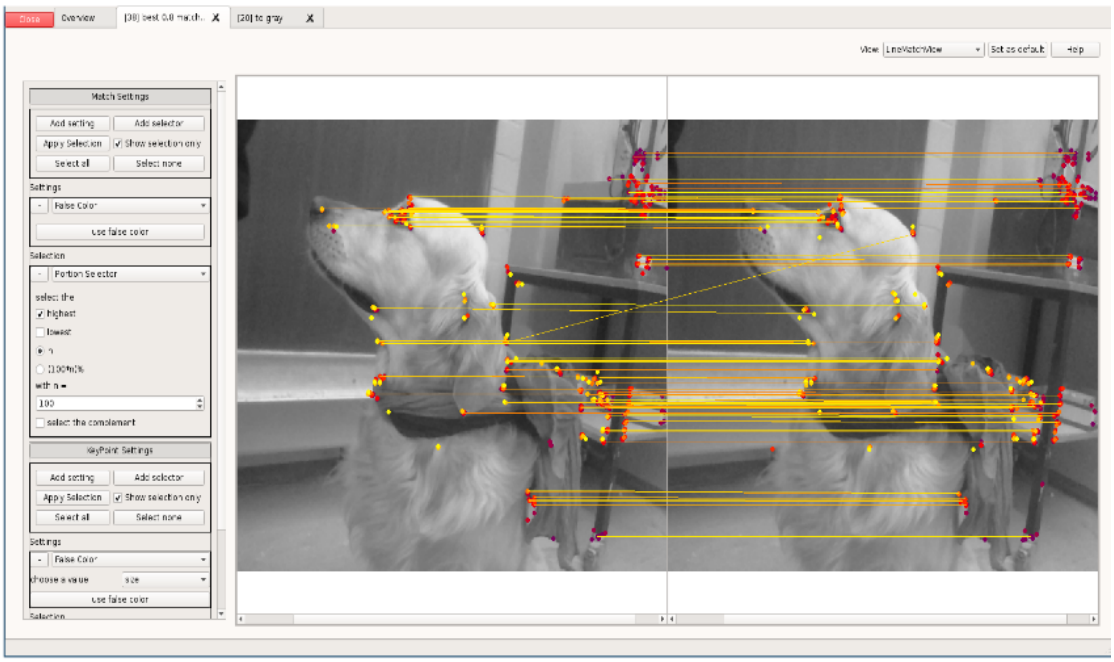
versus

```
        cvv::debugMatches(img1, img2, keypoints_1, keypoints_2, good_matches);
```

Hinweis auf showMatches/showKeypoints

2.2 Ziele

Visualisierung von Matritzen, Filtereffekten und Matches



3 Anwenderfeatures

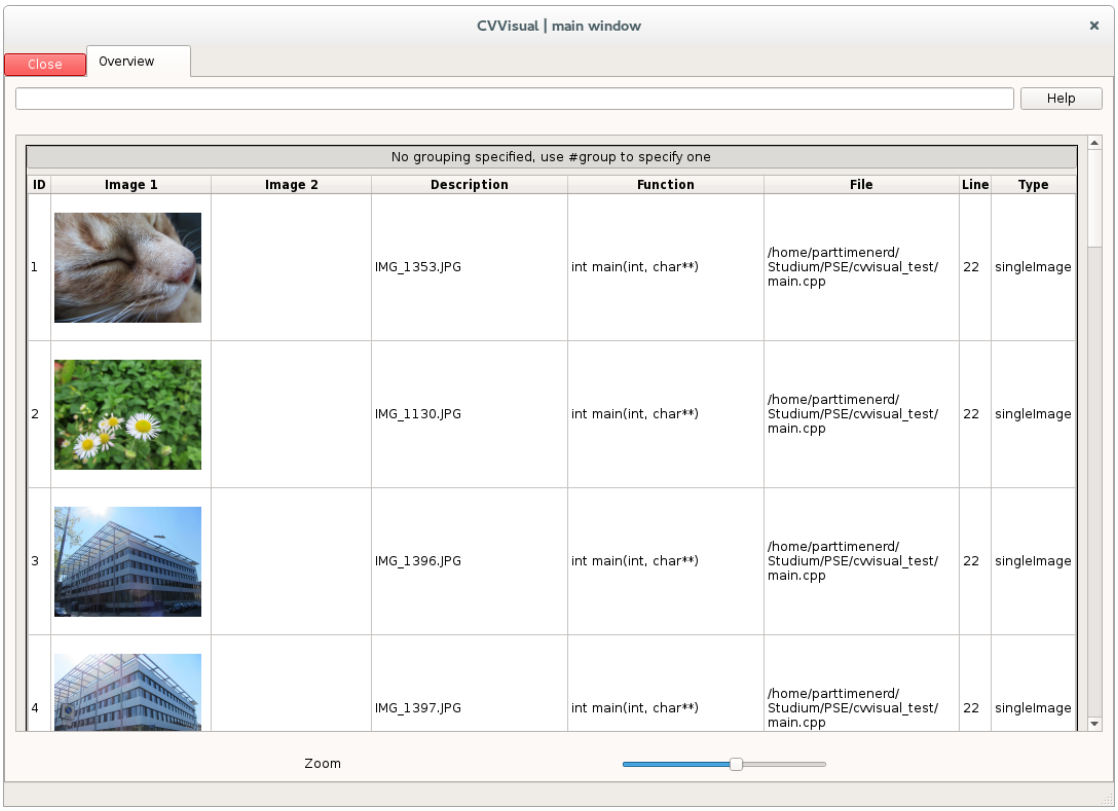
3.1 Verwendung

```
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");
```

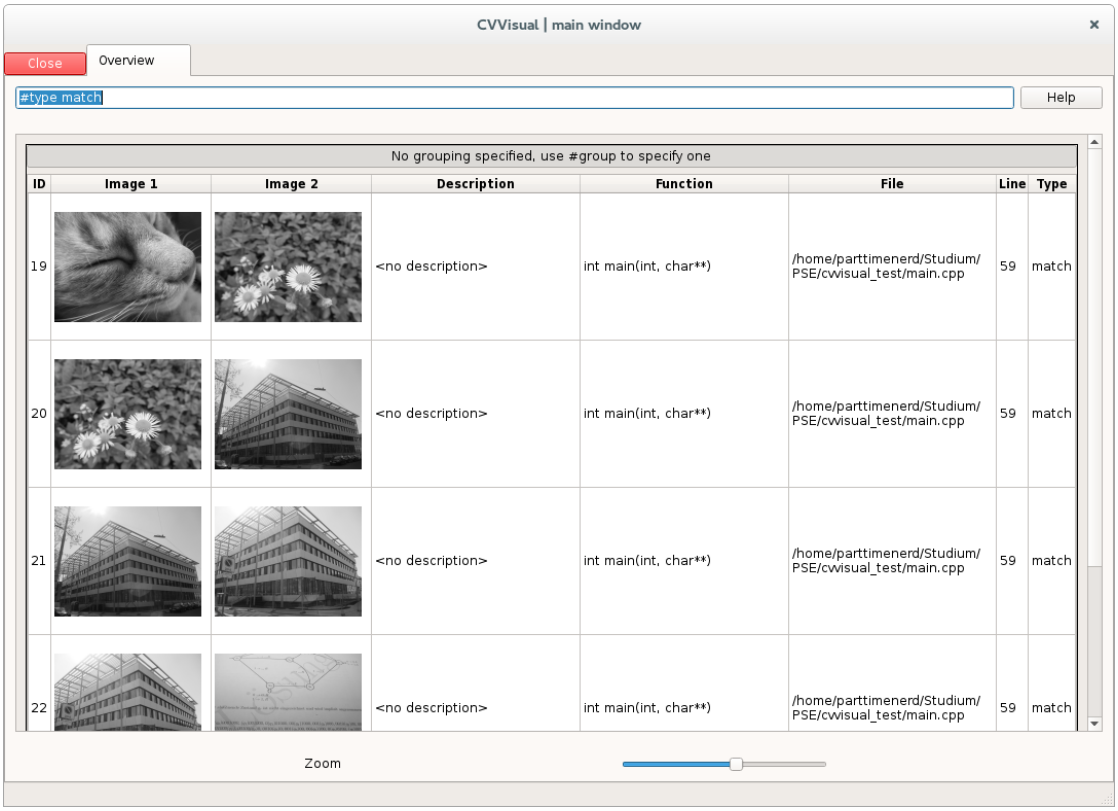
3.2 Übersicht

Übersicht über alle Aufrufe



3.3 Übersicht

Filterbar



3.4 Übersicht

Sortierbar

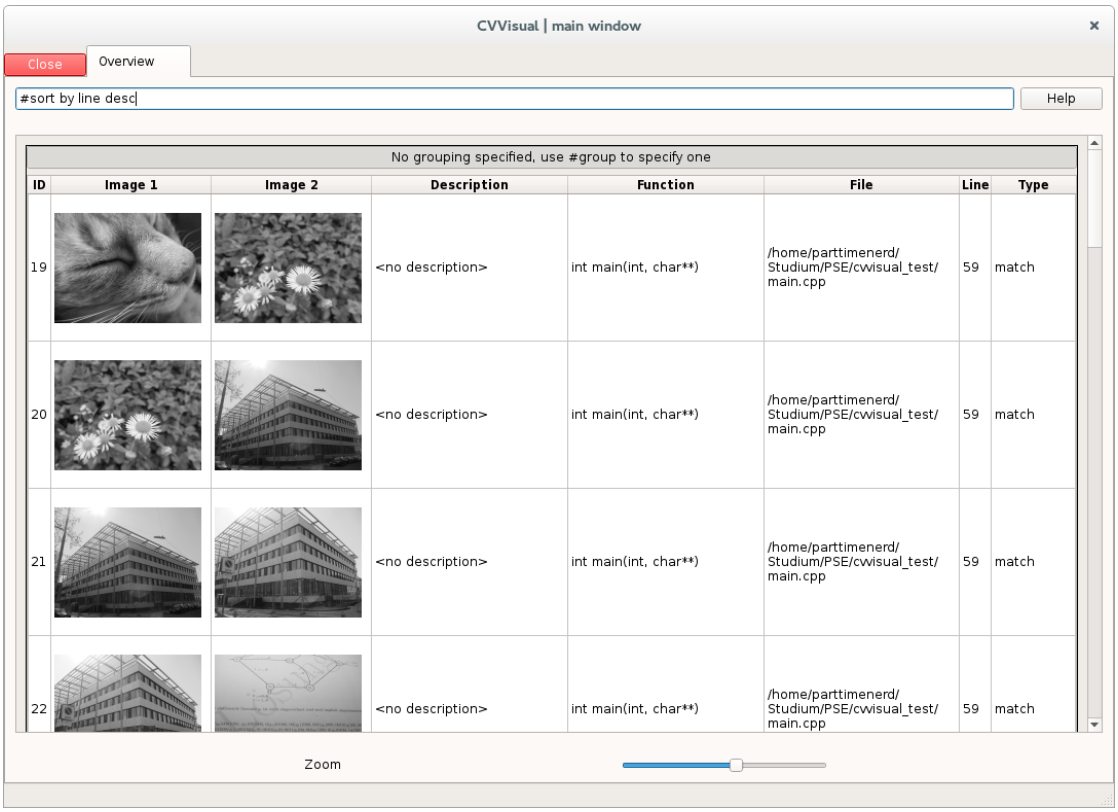
3.5 Übersicht

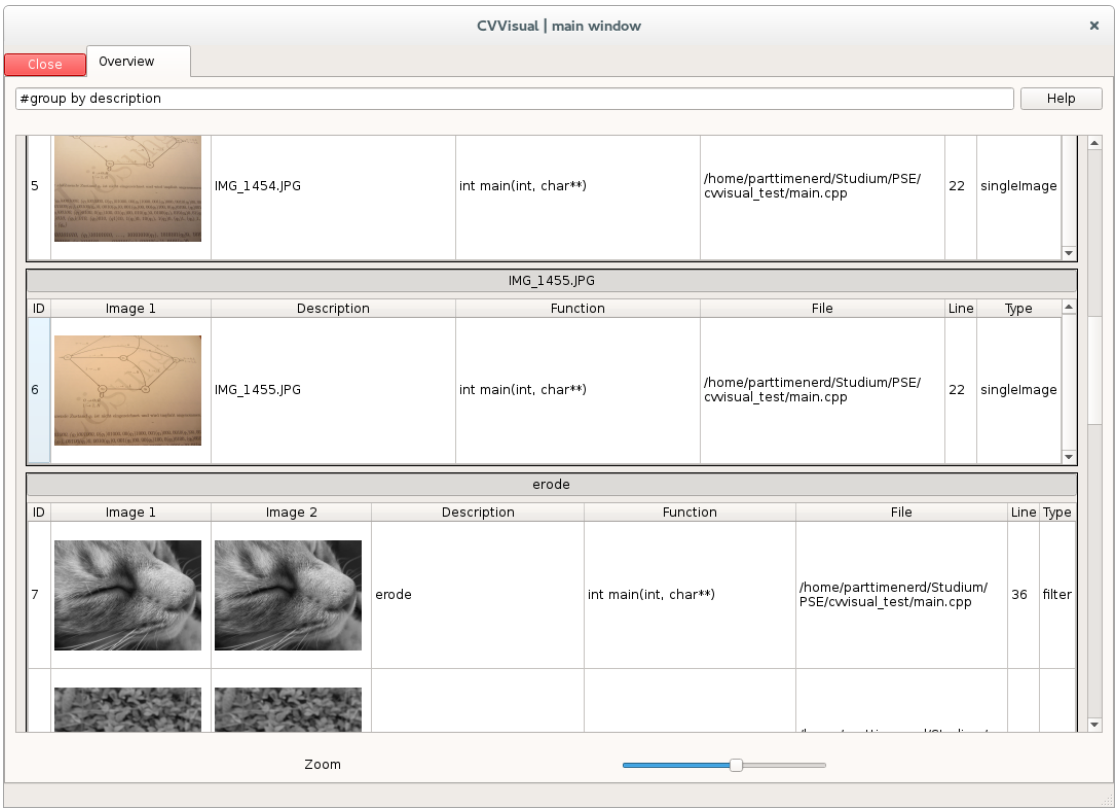
Gruppierbar

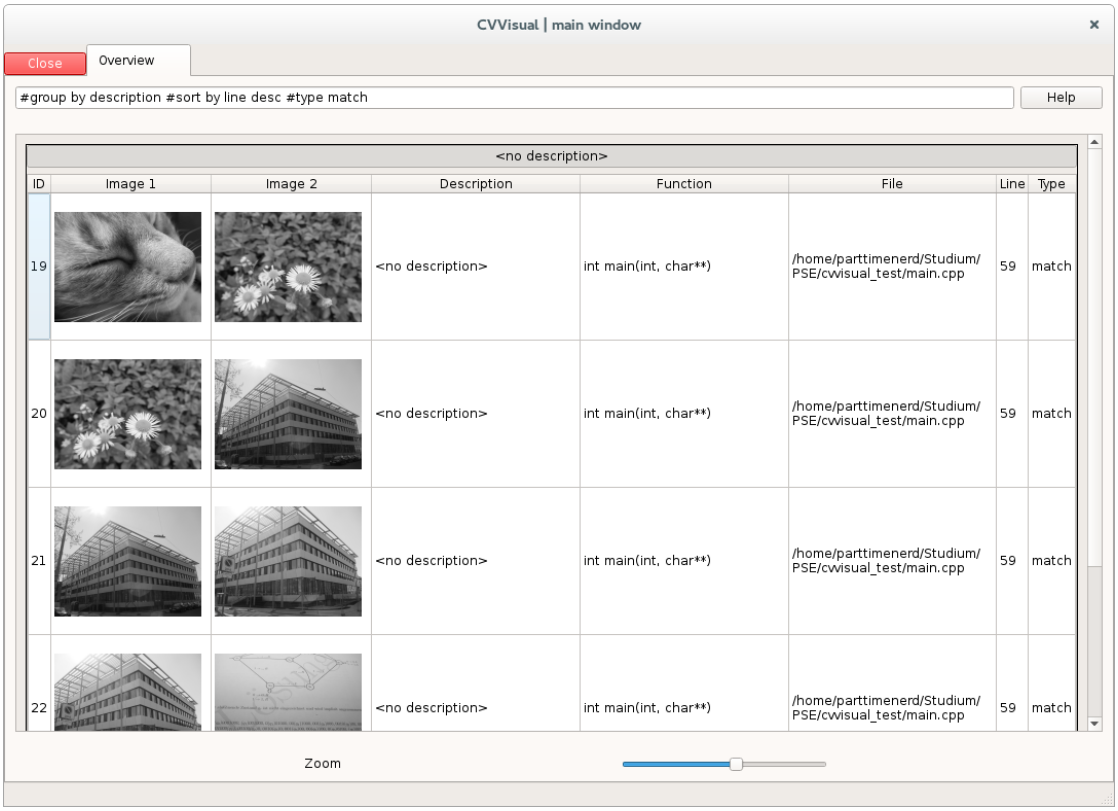
3.6 Übersicht

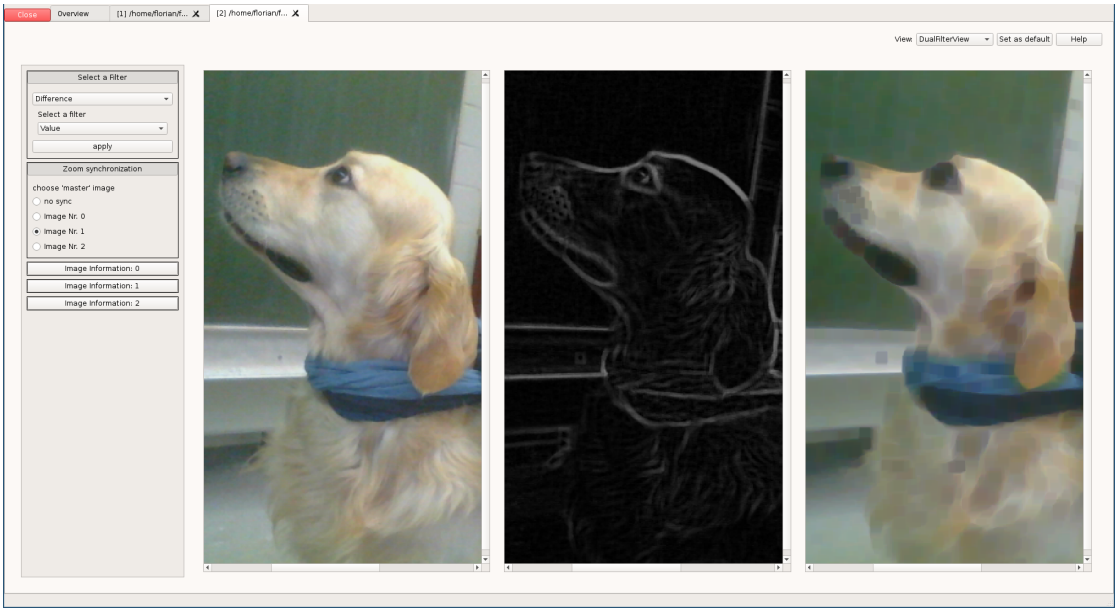
3.7 Filter

- 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

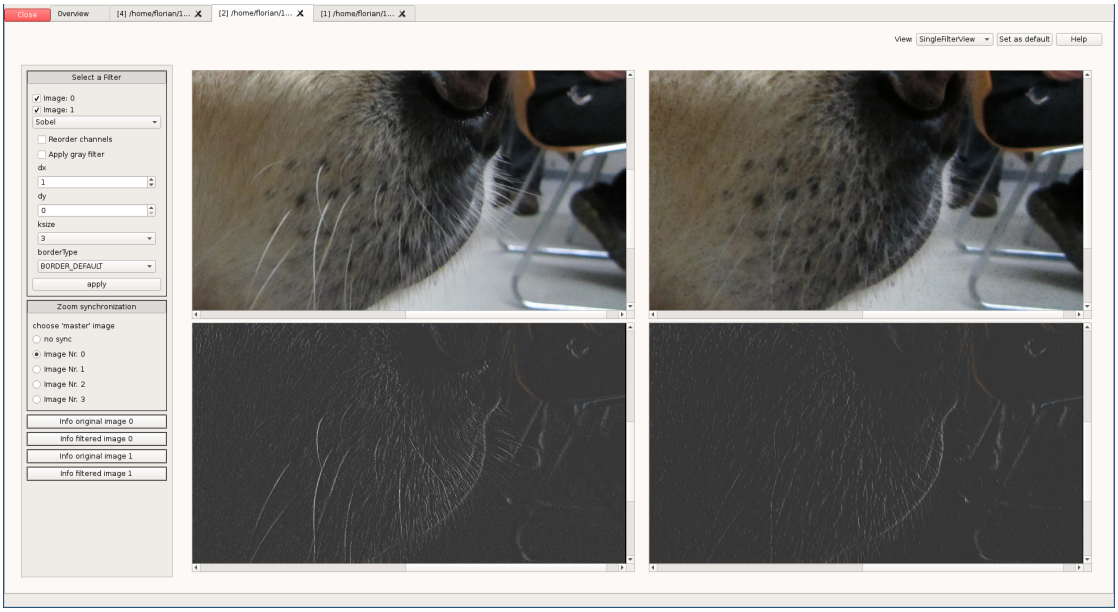

CVVisual | main window
Close
Overview
#group by description
Help
5
IMG_1454.JPG
int main(int, char**)
/home/parttimenerd/Studium/PSE/cvvisual_test/main.cpp
22
singleImage
IMG_1455.JPG
ID
Image 1
Description
Function
File
Line
Type
6
IMG_1455.JPG
int main(int, char**)
/home/parttimenerd/Studium/PSE/cvvisual_test/main.cpp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

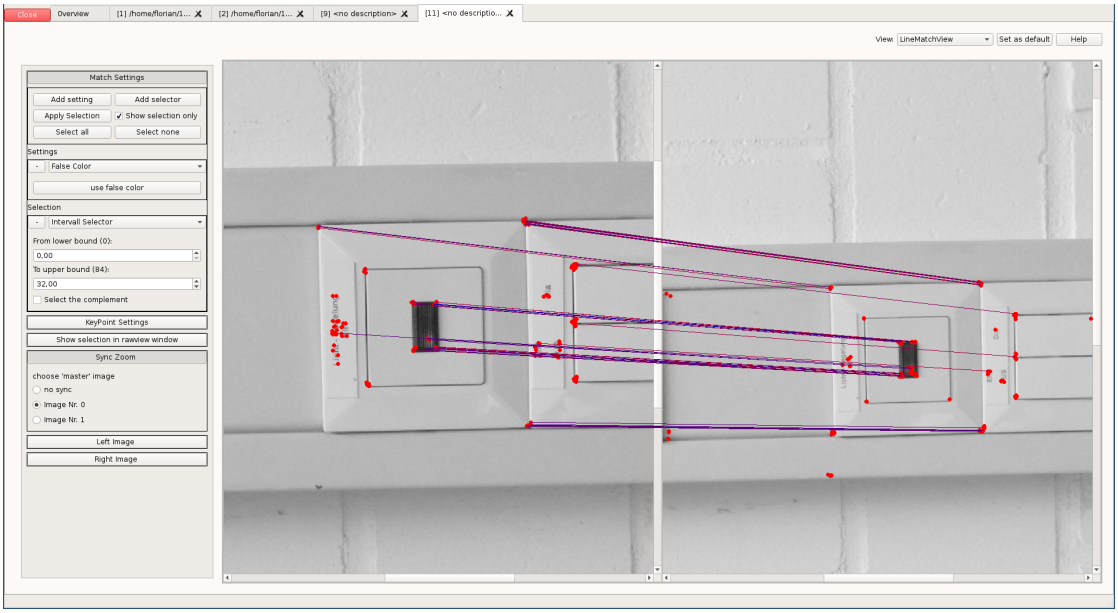
- Anzeigen / Filtern von Keypoints / Matches
- Anzeige der Translation von Keypoints

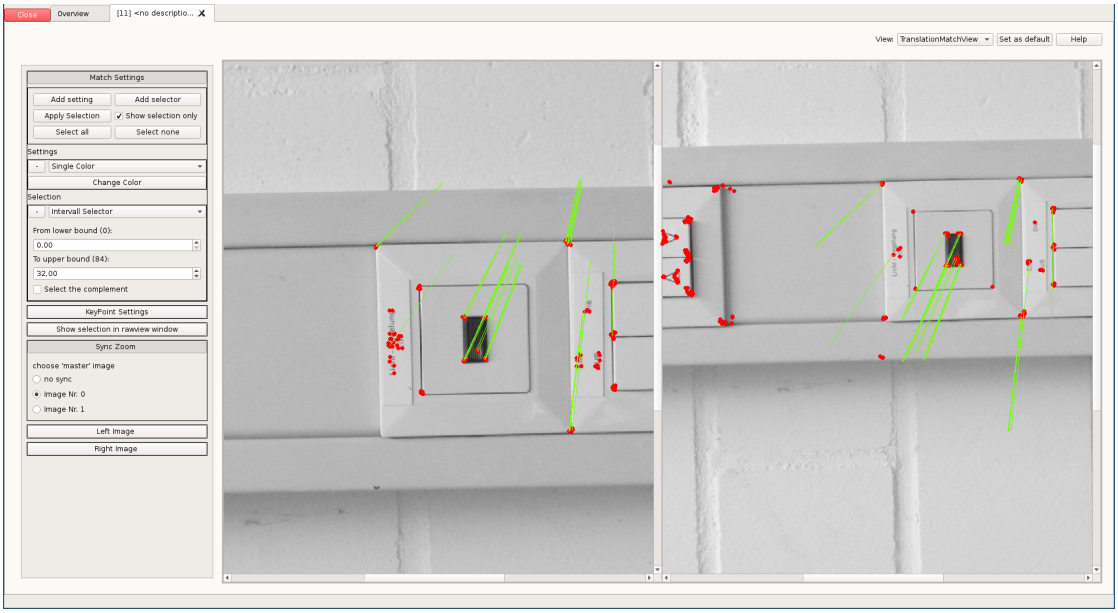
4 GUI-Demo

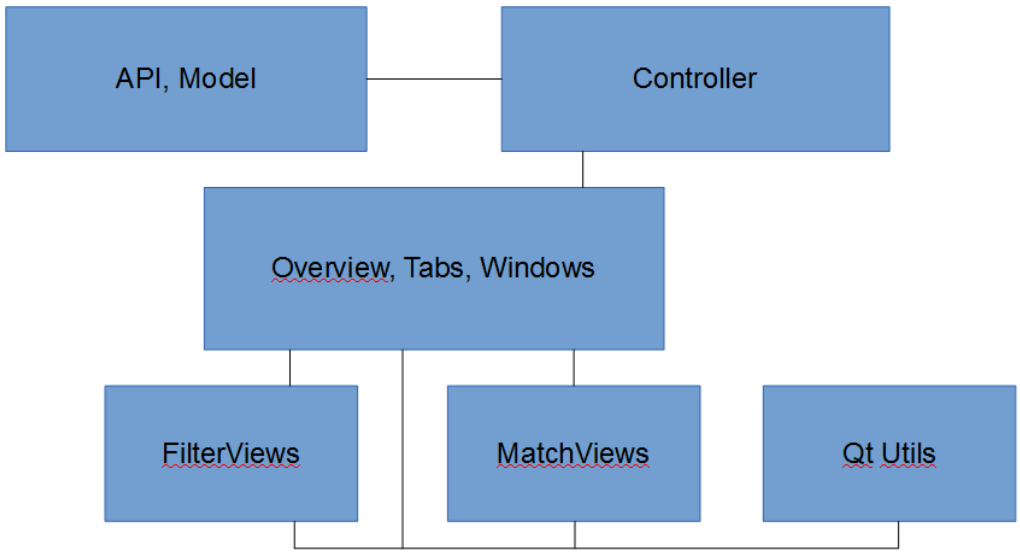
5 Architektur

5.1 Entwurf

- Trennung in API, Datenhaltung, Visualisierung


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



5.2 Signals/Slots & Templates

- Qt erlaubt keine Templateklassen mit Q_OBJECT
- Signals/Slots in Objekte ausgelagert

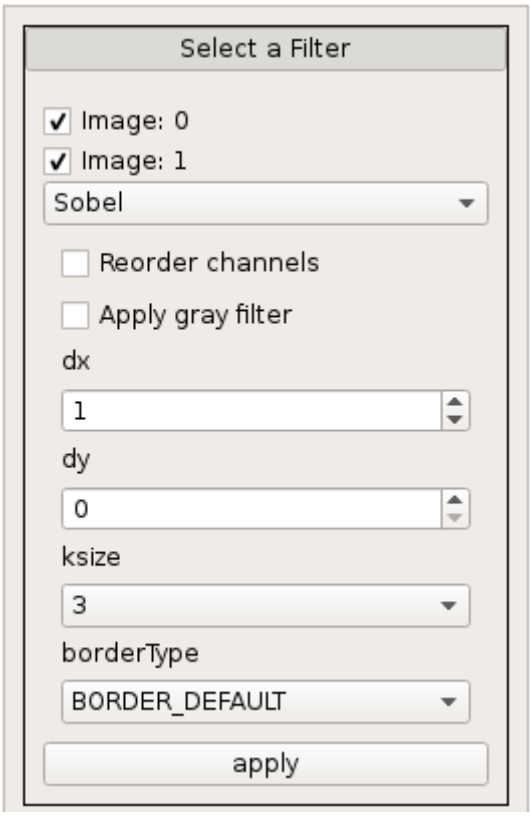
```
class SlotQString : public QObject
{    Q_OBJECT
  public:
    SlotQString(const std::function<void(QString)> &f,
                QObject *parent = nullptr)
    : QObject{ parent }, function_{ f }
    {    if (!f)
             throw std::invalid_argument{ "invalide function" };
    }
public slots: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

5.3 RegisterHelper

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

5.4 (Auto-)FilterWidget

- Unterklasse von RegisterHelper
- Ermöglicht Auswahl von Filtern
- Gibt Ergebnise per Signal weiter (z.B. an ein ZoomableImage)

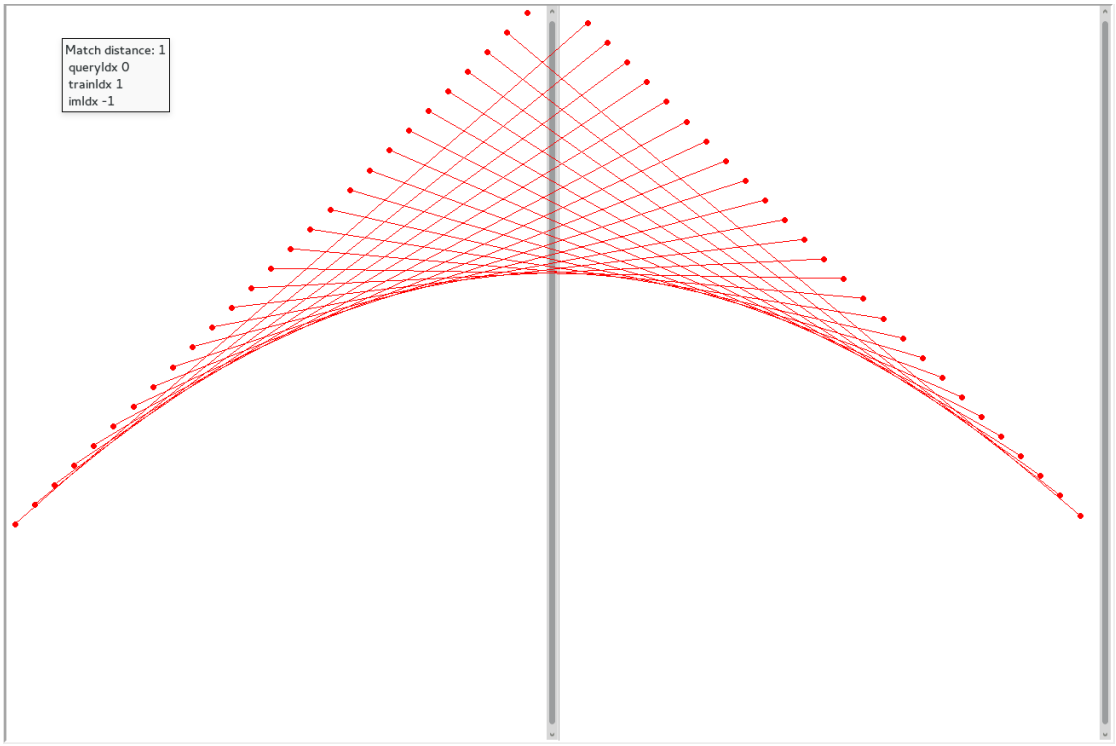


5.5 ZoomableImage

- 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

5.6 MatchScene

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



5.7 Match/KeyPointSetting

- Keine Auslagerung von Singals/Slots möglich
- Daher parallele Entwicklung von KeyPoint und MatchSetting
- Nur Selektierte KeyPoints/Matches werden angezeigt

5.8 Views

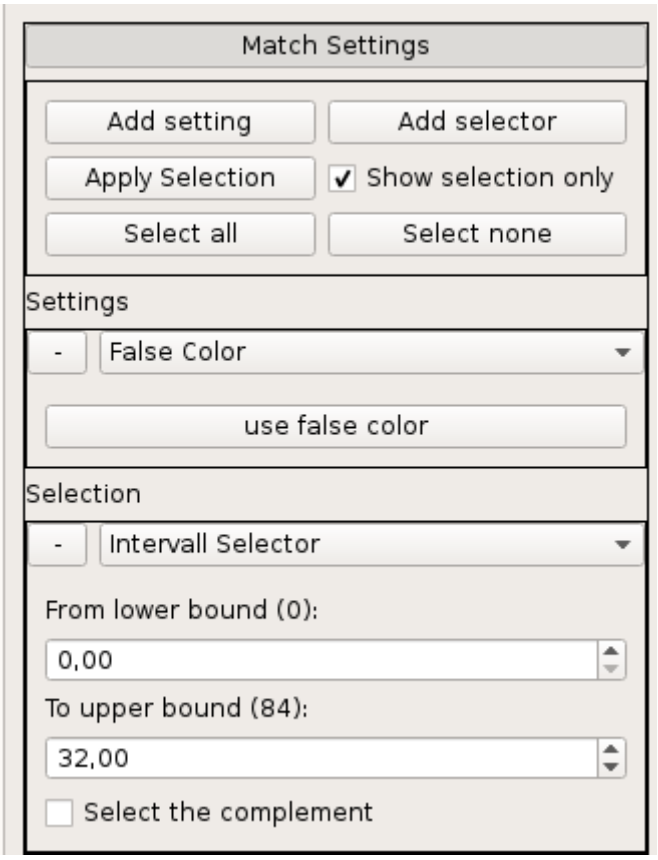
- Visualisierung der unterschiedlichen Aufrufe
- Unterscheiden sich meist in unterschidlichen Nutzen von QT Util Klassen
- Einzige Aufgabe Weiterleitung und Annahme der Selektion (beim Wechsel der Views)

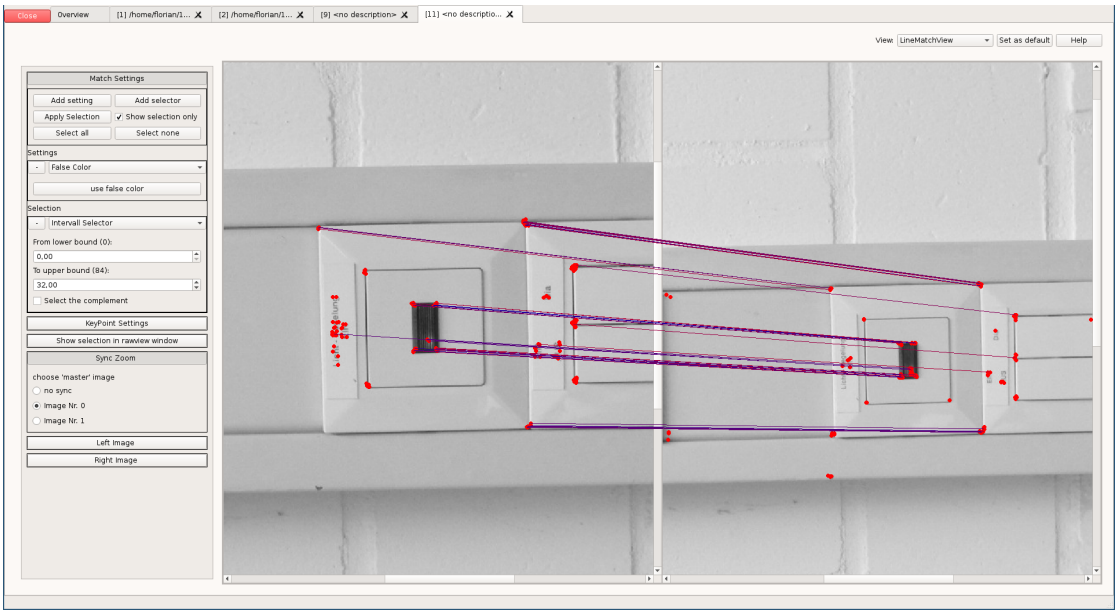
6 Dokumentation

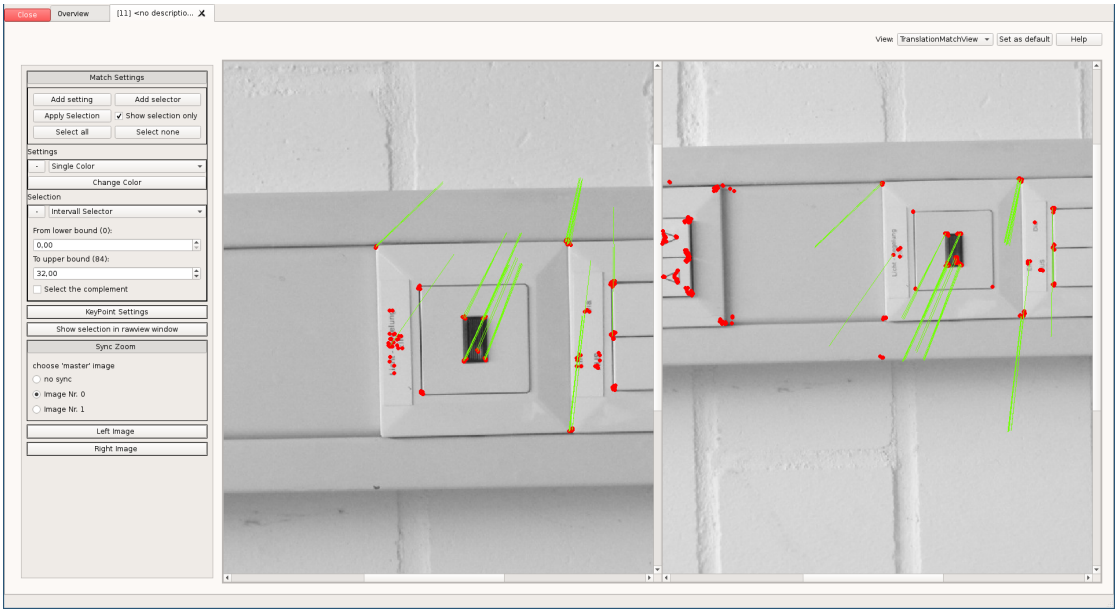
6.1 Tutorials, Beispiele

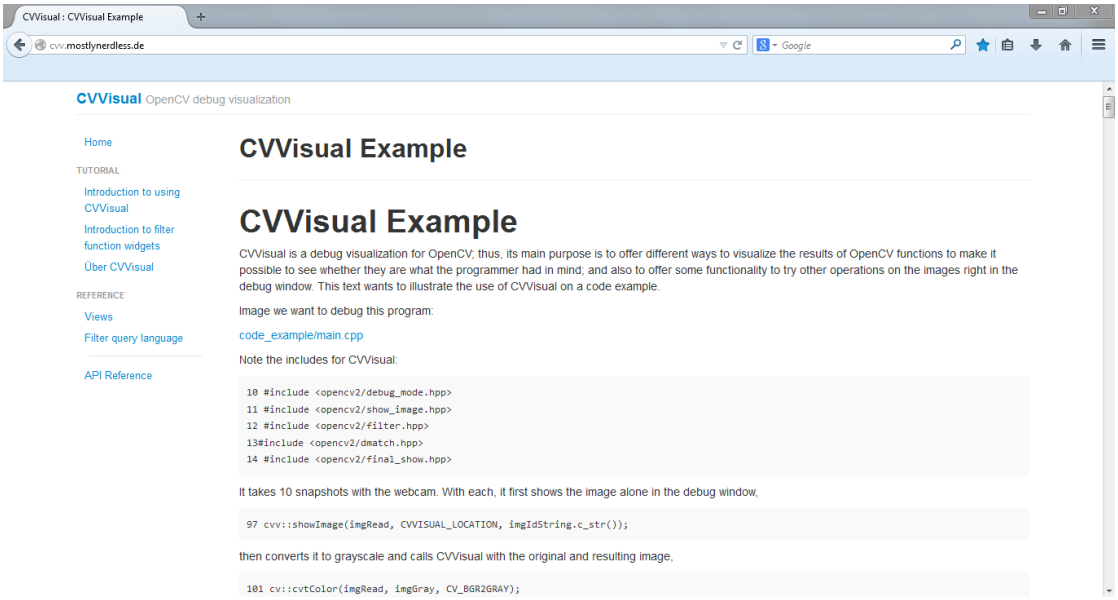
6.2 Kurzdokumentation

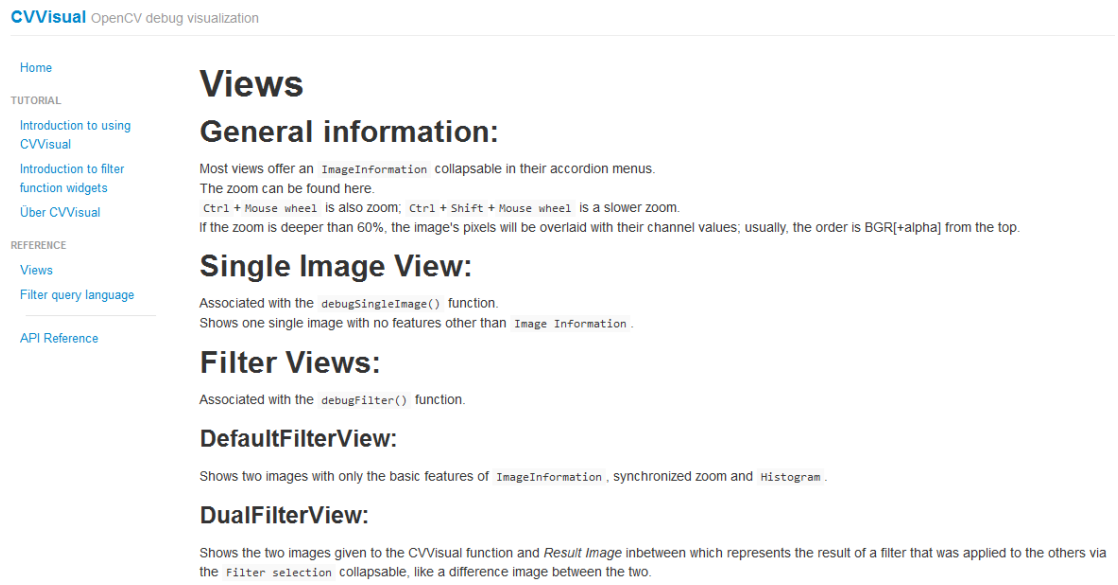
Wird von der Hilfefunktion des Programms benutzt.


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



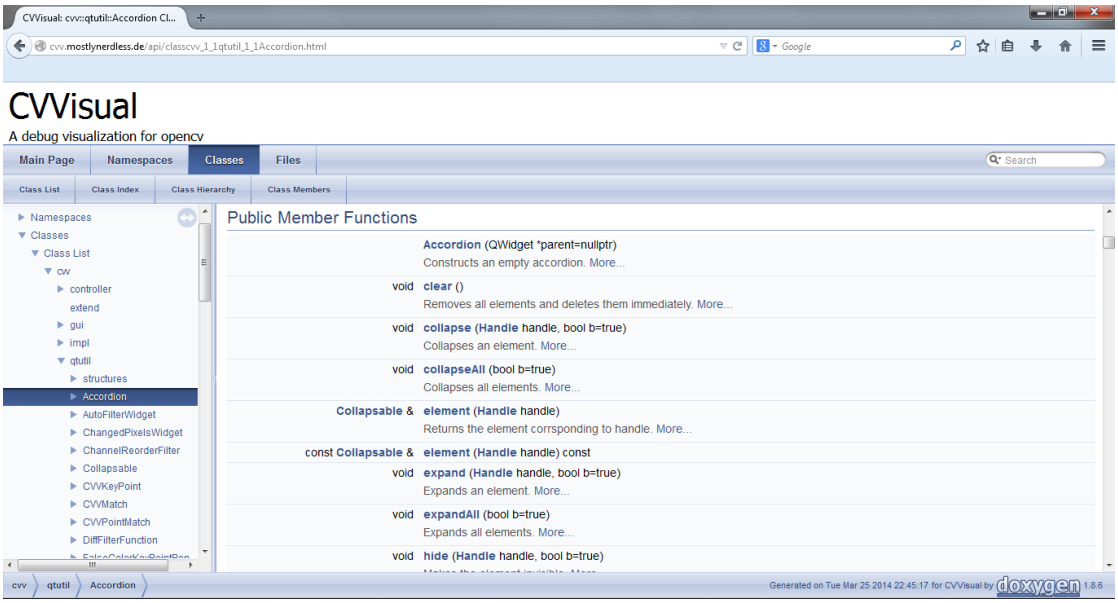

Close
Overview
[11] <no descriptio...
View
TranslationMatchView
Set as default
Help
Match Settings
Add setting
Add selector
Apply Selection
Show selection only
Select all
Select none
Settings
Single Color
Change Color
Selection
Intervall Selector
From lower bound (0):
0,00
To upper bound (84):
32,00
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


CVVisual : CVVisual Example
cvv.mostlynerdless.de
Google
CVVisual OpenCV debug visualization
Home
TUTORIAL
Introduction to using CVVisual
Introduction to filter function widgets
Über CVVisual
REFERENCE
Views
Filter query language
API Reference
CVVisual Example
CVVisual Example
CVVisual is a debug visualization for OpenCV; thus, its main purpose is to offer different ways to visualize the results of OpenCV functions to make it possible to see whether they are what the programmer had in mind; and also to offer some functionality to try other operations on the images right in the debug window. This text wants to illustrate the use of CVVisual on a code example.
Image we want to debug this program:
code_example/main.cpp
Note the includes for CVVisual:
10 #include <opencv2/debug_mode.hpp>
11 #include <opencv2/show_image.hpp>
12 #include <opencv2/filter.hpp>
13#include <opencv2/dmatch.hpp>
14 #include <opencv2/final_show.hpp>
It takes 10 snapshots with the webcam. With each, it first shows the image alone in the debug window,
97 cvv::showImage(imgRead, CVVISUAL_LOCATION, imgIdString.c_str());
then converts it to grayscale and calls CVVisual with the original and resulting image,
101 cv::cvtColor(imgRead, imgGray, CV_BGR2GRAY);



6.3 Referenz:

- Mit Hilfe von Doxygen



7 API

7.1 Anwender API

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

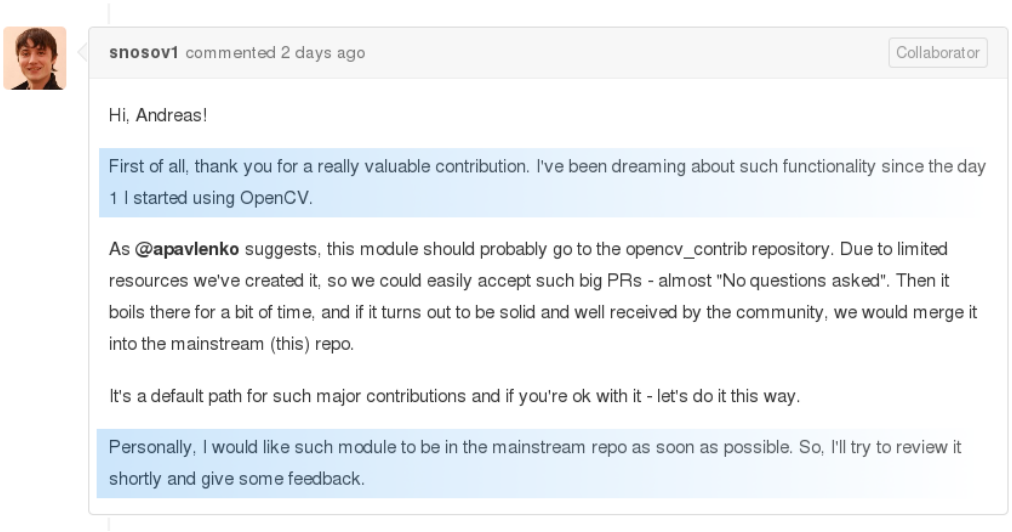
7.2 Interne API

- 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/

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.

- Dokumentation: https://cvv.mostlynerdless.de/
- Doxygen: https://cvv.mostlynerdless.de/api/