

CVVisual

20. Juni 2014

Inhaltsverzeichnis

0.1	Gliederung	2
1	Einführung in OpenCV	2
1.1	Überblick	2
1.2	Matrizen	3
1.3	Filter	3
1.4	Filter	3
1.5	Filter	4
1.6	Filter	4
1.7	Matches	4
1.8	Matches	4
2	Motivation	6
2.1	Debuggen von OpenCV	6
2.2	Ziele	6
3	Anwenderfeatures	7
3.1	Verwendung	7
3.2	Übersicht	7
3.3	Übersicht	8
3.4	Übersicht	8
3.5	Übersicht	8
3.6	Übersicht	8
3.7	Filter	8
3.8	Filter	12
3.9	Matches	12
3.10	Matches	12
4	GUI-Demo	12

5 Architektur	12
5.1 Entwurf	12
5.2 Signals/Slots & Templates	14
5.3 RegisterHelper	14
5.4 (Auto-)FilterWidget	15
5.5 ZoomableImage	15
5.6 MatchScene	15
5.7 Match/KeyPointSetting	16
5.8 Views	16
6 Dokumentation	16
6.1 Tutorials, Beispiele	16
6.2 Kurzdokumentation	16
6.3 Referenz:	19
7 API	20
7.1 Anwender API	20
7.2 Interne API	20
8 Ausblick	20
8.1 Rezeption	20
8.2 Rezeption	20
8.3 Links	20

0.1 Gliederung

- Einführung in OpenCV
- Motivation
- Anwenderfeatures
- Gui-Demo
- Dokumentation
- Architektur
- API
- Ausblick

1 Einführung in OpenCV

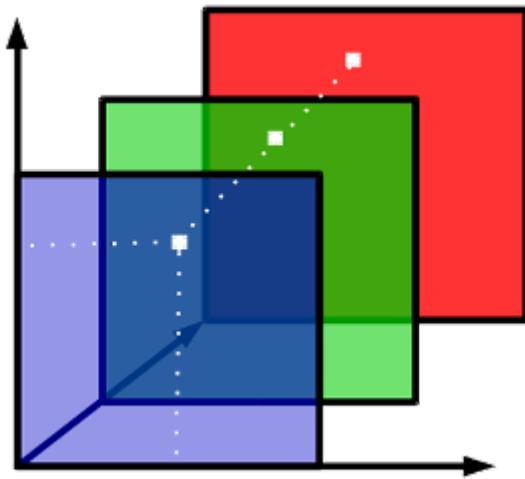
1.1 Überblick

- 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

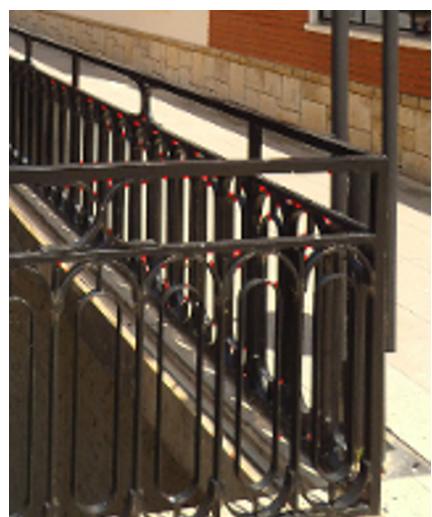
Beispiel dilate: helle Flächen werden größer

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
```

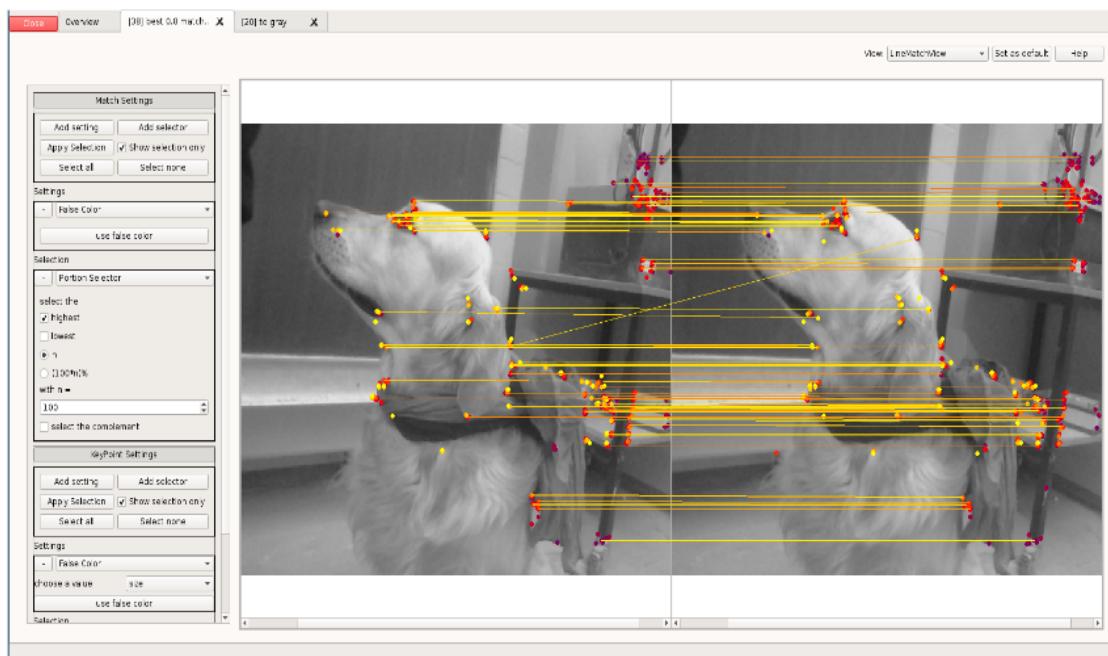
versus

```
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" + 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");
```

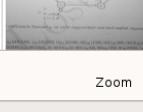
3.2 Übersicht

Übersicht über alle Aufrufe

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/cvisual_test/main.cpp	22	singleImage
2			IMG_1130.JPG	int main(int, char**)	/home/parttimenerd/Studium/PSE/cvisual_test/main.cpp	22	singleImage
3			IMG_1396.JPG	int main(int, char**)	/home/parttimenerd/Studium/PSE/cvisual_test/main.cpp	22	singleImage
4			IMG_1397.JPG	int main(int, char**)	/home/parttimenerd/Studium/PSE/cvisual_test/main.cpp	22	singleImage

3.3 Übersicht

Filterbar

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/cvisual_test/main.cpp	59	match
20			<no description>	int main(int, char**)	/home/parttimenerd/Studium/PSE/cvisual_test/main.cpp	59	match
21			<no description>	int main(int, char**)	/home/parttimenerd/Studium/PSE/cvisual_test/main.cpp	59	match
22			<no description>	int main(int, char**)	/home/parttimenerd/Studium/PSE/cvisual_test/main.cpp	59	match

3.4 Übersicht

Sortierbar

3.5 Übersicht

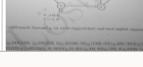
Gruppierbar

3.6 Übersicht

3.7 Filter

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

CVVisual | main window

ID	Image 1	Image 2	Description	Function	File	Line	Type
19			<no description>	int main(int, char**)	/home/partimenerd/Studium/PSE/cvisual_test/main.cpp	59	match
20			<no description>	int main(int, char**)	/home/partimenerd/Studium/PSE/cvisual_test/main.cpp	59	match
21			<no description>	int main(int, char**)	/home/partimenerd/Studium/PSE/cvisual_test/main.cpp	59	match
22			<no description>	int main(int, char**)	/home/partimenerd/Studium/PSE/cvisual_test/main.cpp	59	match

Zoom

CVVisual | main window

#group by description

ID	Image 1	Description	Function	File	Line	Type
5		IMG_1454.JPG	int main(int, char**)	/home/partimenerd/Studium/PSE/cvvisual_test/main.cpp	22	singleImage
6		IMG_1455.JPG	int main(int, char**)	/home/partimenerd/Studium/PSE/cvvisual_test/main.cpp	22	singleImage
erode						
ID	Image 1	Image 2	Description	Function	File	Line
7			erode	int main(int, char**)	/home/partimenerd/Studium/PSE/cvvisual_test/main.cpp	36

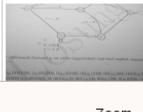
Zoom

CVVisual | main window

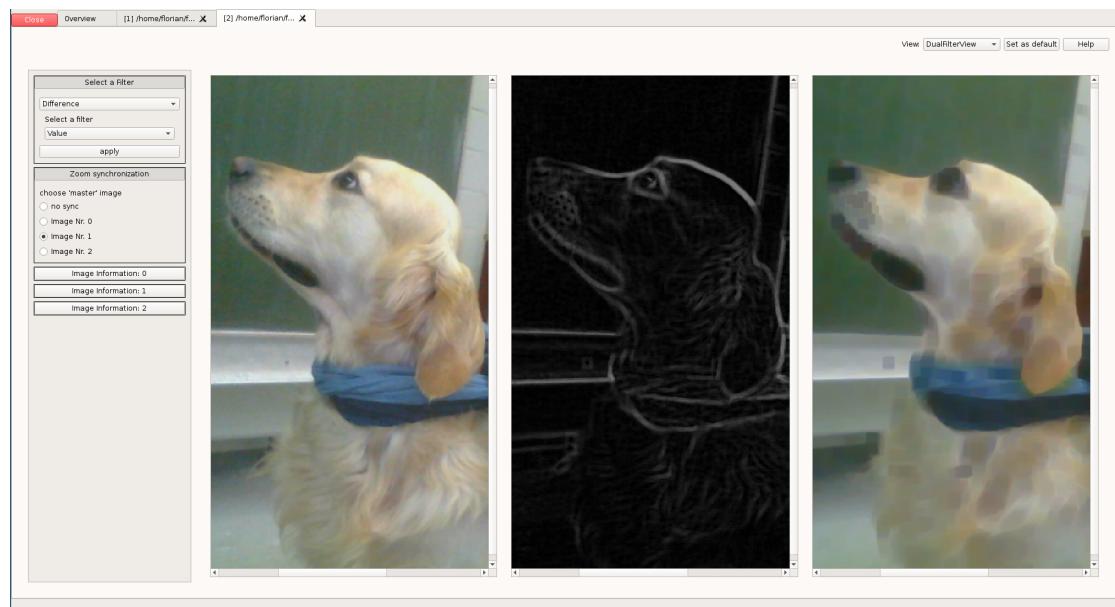
Overview

#group by description #sort by line desc #type match

<no description>

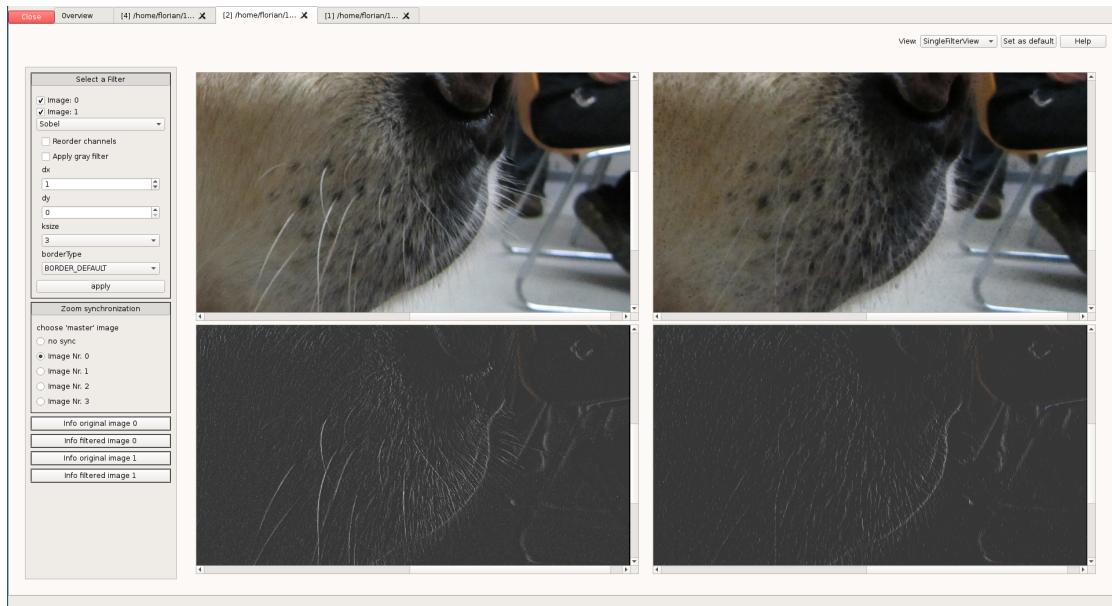
ID	Image 1	Image 2	Description	Function	File	Line	Type
19			<no description>	int main(int, char**)	/home/parttimenerd/Studium/PSE/cvisual_test/main.cpp	59	match
20			<no description>	int main(int, char**)	/home/parttimenerd/Studium/PSE/cvisual_test/main.cpp	59	match
21			<no description>	int main(int, char**)	/home/parttimenerd/Studium/PSE/cvisual_test/main.cpp	59	match
22			<no description>	int main(int, char**)	/home/parttimenerd/Studium/PSE/cvisual_test/main.cpp	59	match

Zoom 



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

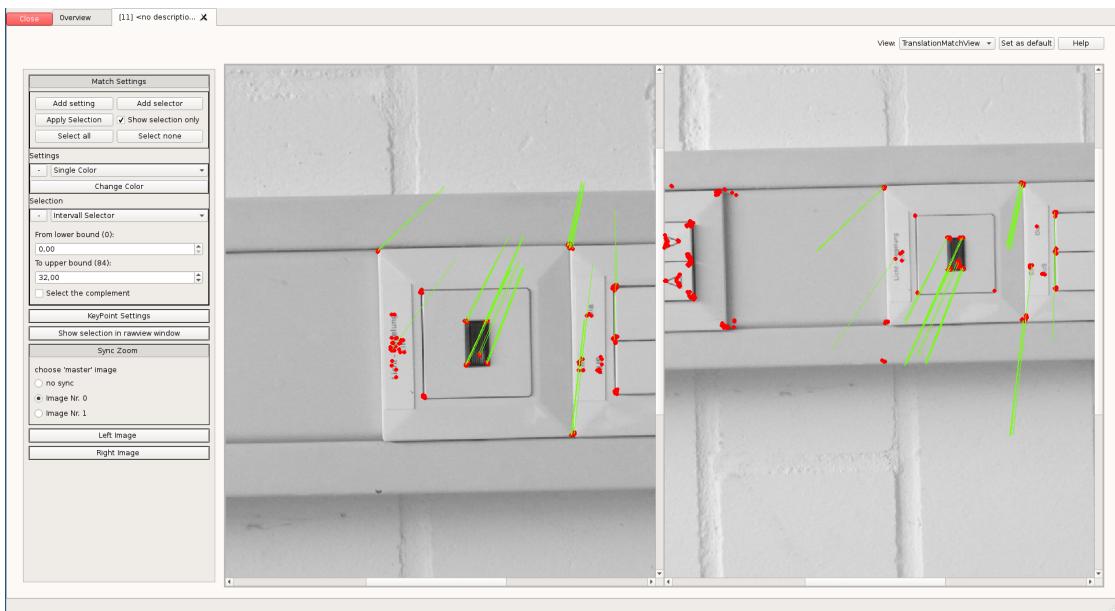
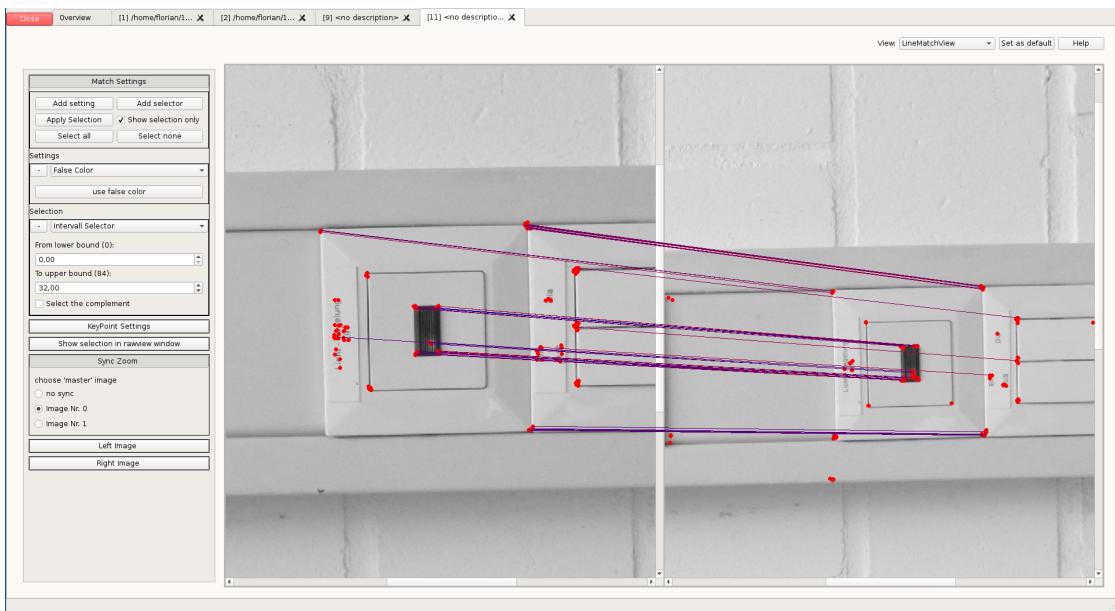
- Anzeigen / Filtern von Keypoints / Matches
- Anzeige der Translation von Keypoints

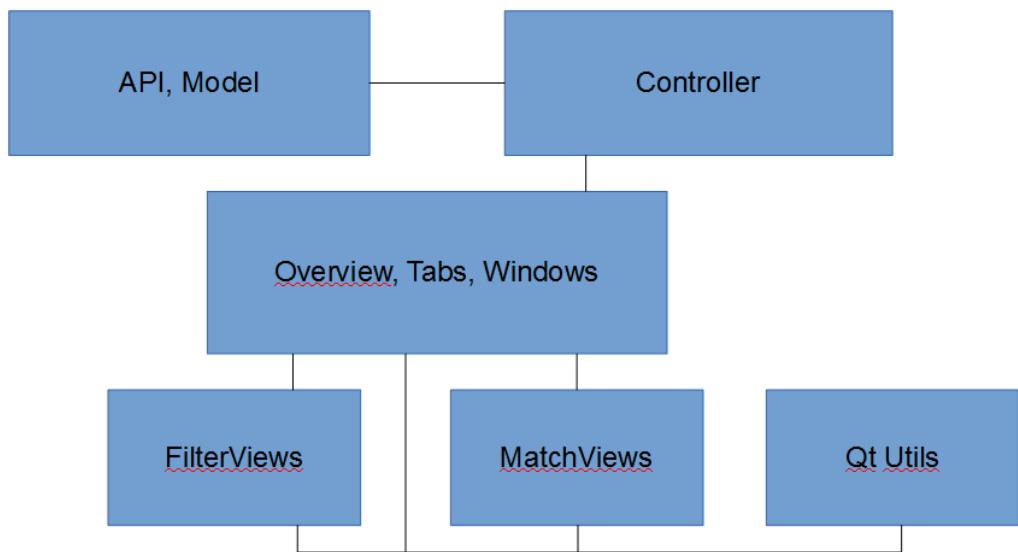
4 GUI-Demo

5 Architektur

5.1 Entwurf

- Trennung in API, Datenhaltung, Visualisierung





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{"invalid 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 Funktion registriert

5.4 (Auto-)FilterWidget

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

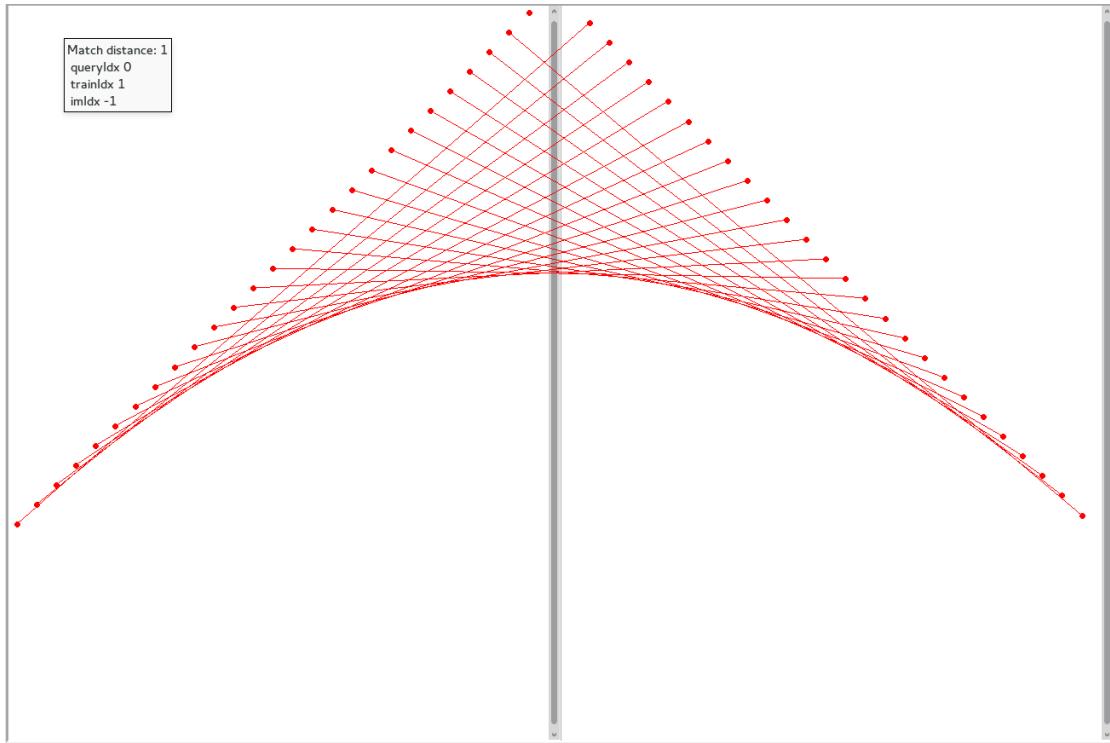


5.5 ZoomableImage

- 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

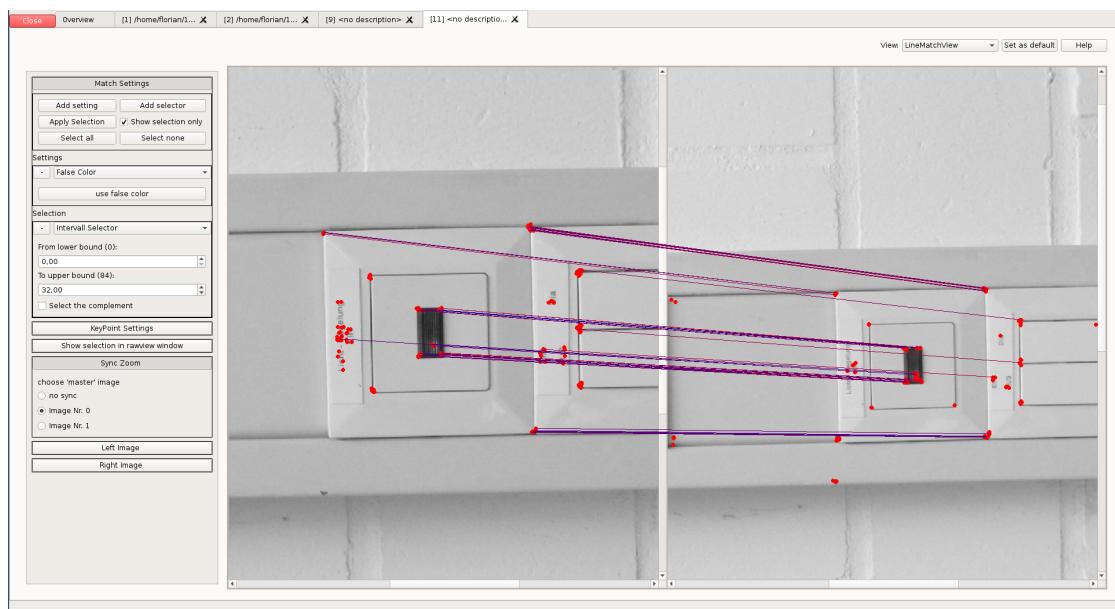
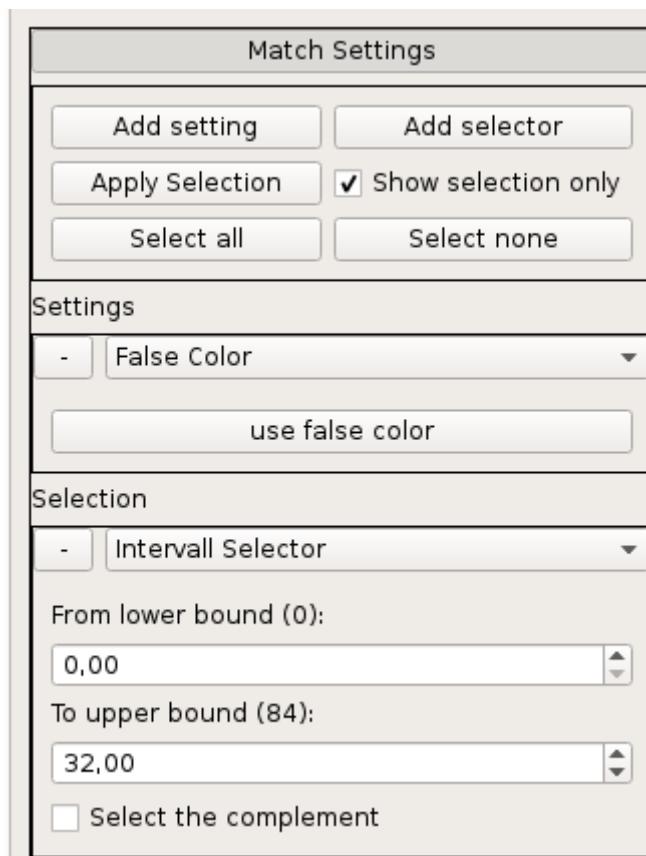
- Visualisierung der unterschiedlichen Aufrufe
- Unterscheiden sich meist in unterschiedlichen Nutzen von QT Util Klassen
- Einzige Aufgabe Weiterleitung und Annahme der Selektion (beim Wechsel der Views)

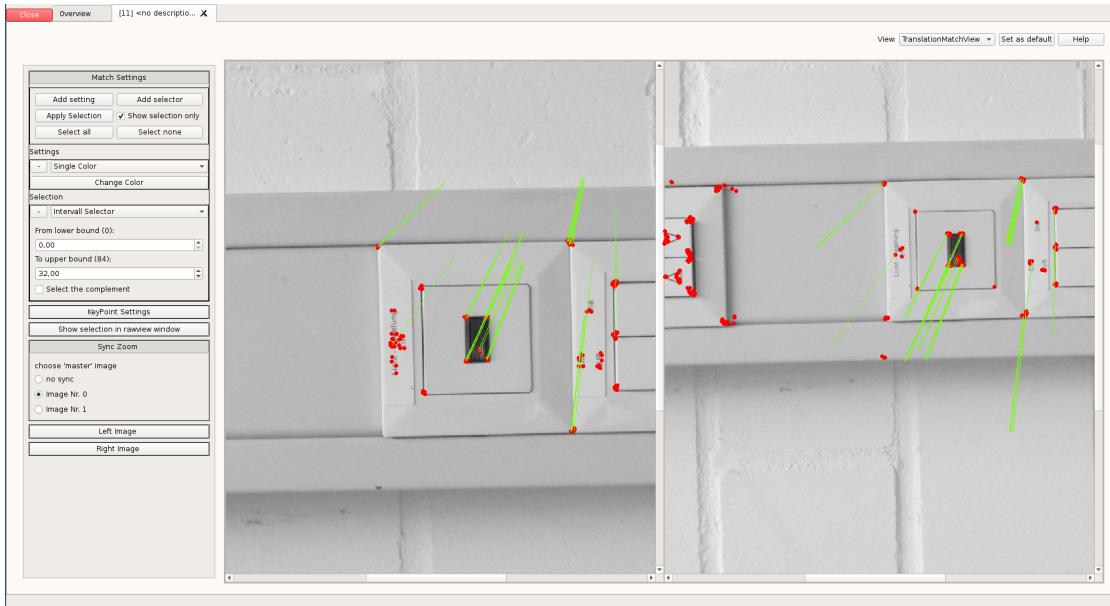
6 Dokumentation

6.1 Tutorials, Beispiele

6.2 Kurzdokumentation

Wird von der Hilfefunktion des Programms benutzt.





CVVisual : CVVisual Example

cv.mustlynerdless.de

CVVisual OpenCV debug visualization

CVVisual Example

TUTORIAL

- Introduction to using CVVisual
- Introduction to filter function widgets
- Über CVVisual

REFERENCE

- Views
- Filter query language

[API Reference](#)

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);

```

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.

6.3 Referenz:

- Mit Hilfe von Doxygen

CVVisual: cvv::qutil::Accordion Class Reference

cvv mostlynerdless.de/api/classcvv_1_1qutil_1_1Accordion.html

CVVisual

A debug visualization for opencv

Main Page Namespaces Classes Files Search

Class List Class Index Class Hierarchy Class Members

Public Member Functions

Accordion (QWidget *parent=nullptr)
Constructs an empty accordion. More...

void **clear ()**
Removes all elements and deletes them immediately. More...

void **collapse (Handle handle, bool b=true)**
Collapses an element. More...

void **collapseAll (bool b=true)**
Collapses all elements. More...

Collapsable & **element (Handle handle)**
Returns the element corresponding to handle. More...

const Collapsable & **element (Handle handle) const**

void **expand (Handle handle, bool b=true)**
Expands an element. More...

void **expandAll (bool b=true)**
Expands all elements. More...

void **hide (Handle handle, bool b=true)**

Generated on Tue Mar 25 2014 22:45:17 for CVVisual by doxygen 1.8.6

7 API

7.1 Anwender API

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

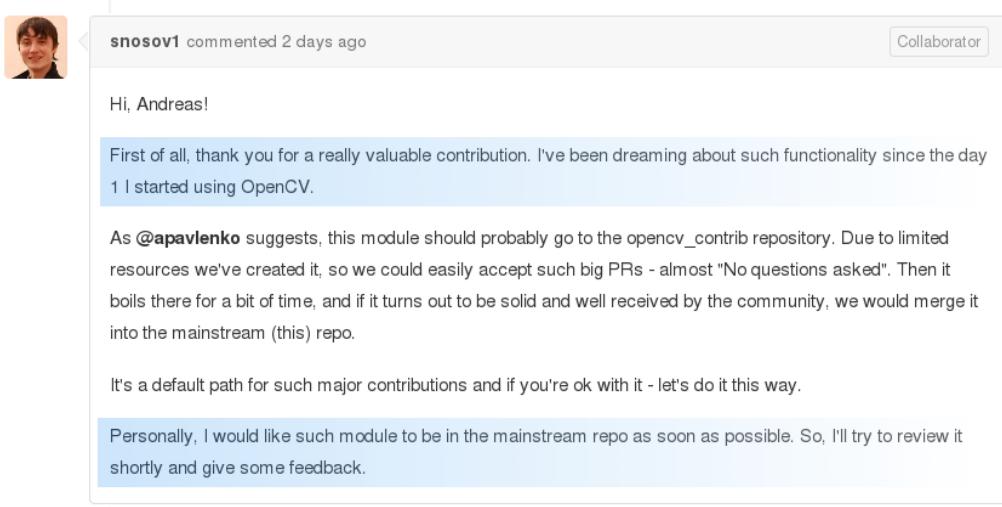
7.2 Interne API

- 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/>