CVVisual

Ein Debug-Framework für OpenCV

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Gliederung

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

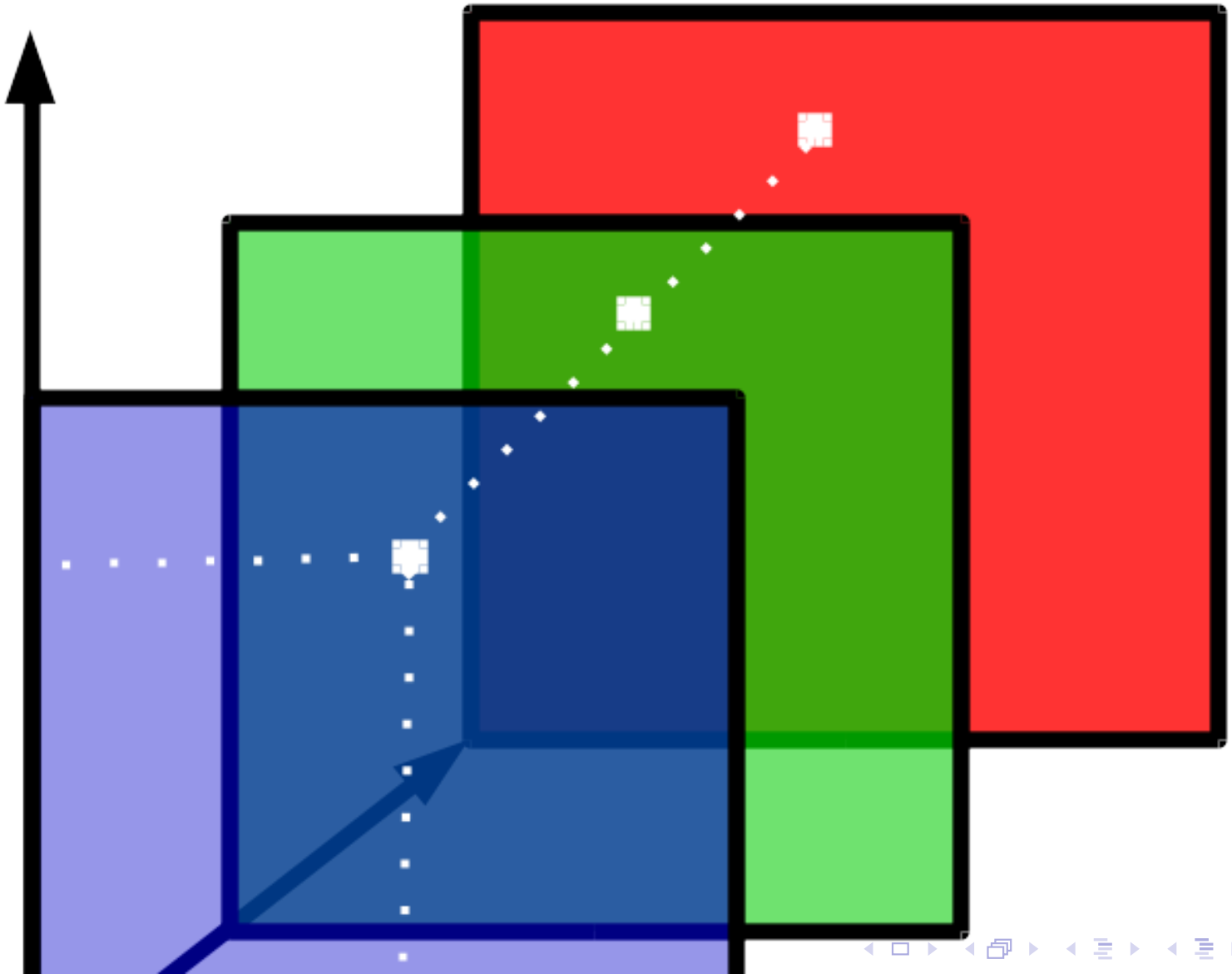
Einführung in OpenCV

Überblick

- Bildverarbeitung
- weite Verbreitung
- Matrizen als Grundlage
- Filter + Matches

Matrizen

Bild = mehrdimensionale Matrix



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

Filter

Beispiel dilate: helle Flächen werden größer

Filter

Beispiel dilate: helle Flächen werden größer

Matches

Keypoints = charakteristische Punkte

Matches

Match = Paar aus Keypoints

Motivation

Debuggen von OpenCV

Systematisches Debugging statt „Random Code“

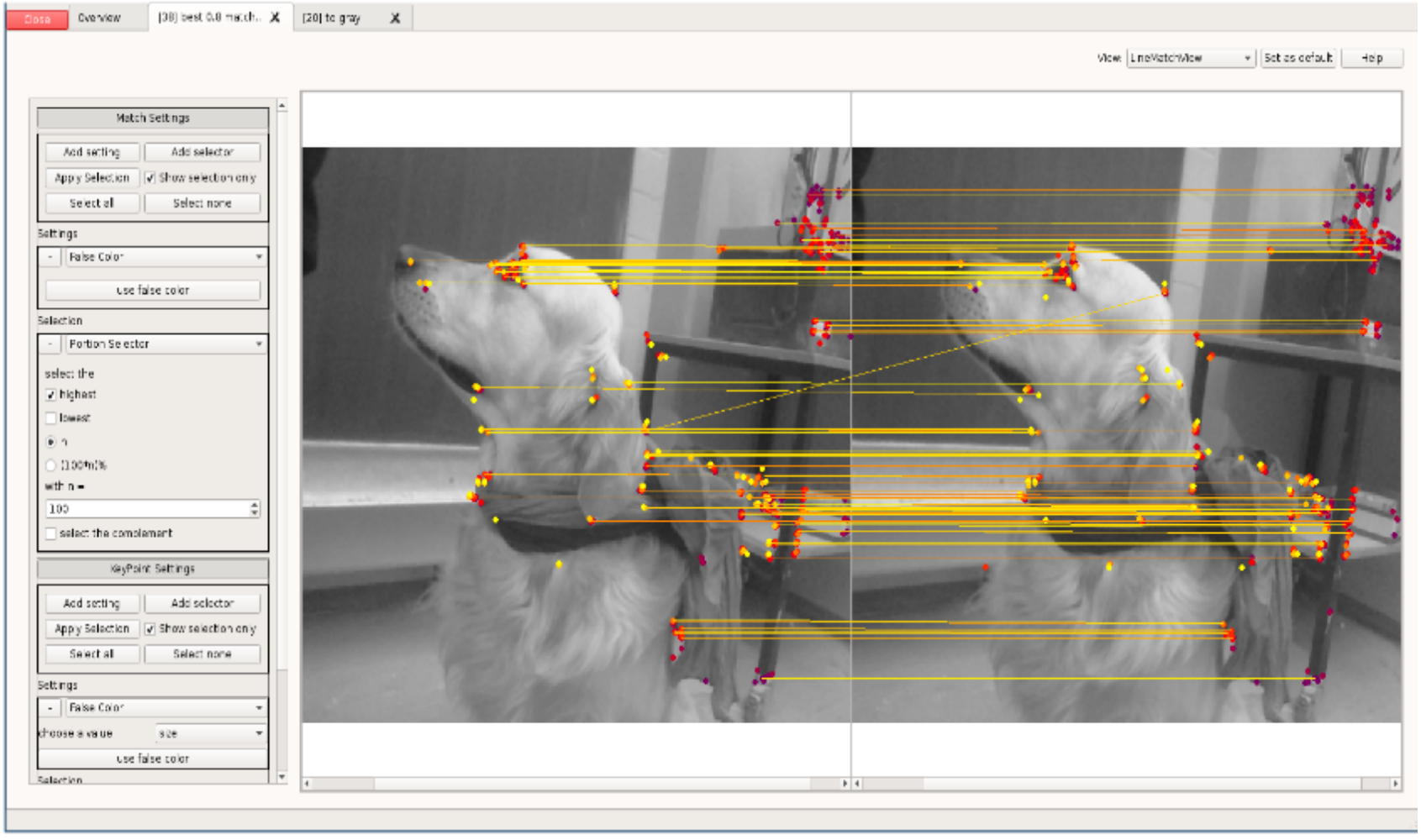
```
#ifdef DEBUG
        Mat img_matches;
        drawMatches( img_1, keypoints_1, img_2, keypoints_2,
                     good_matches, img_matches, Scalar::all(-1), Scalar::all(-1),
                     vector<char>(), DrawMatchesFlags::NOT_DRAW_SINGLE_POINTS );
        imshow("good matches", img_matches);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

versus

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

Ziele

Visualisierung von Matritzen, Filtereffekten und Matches



Anwenderfeatures

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");
```

Übersicht

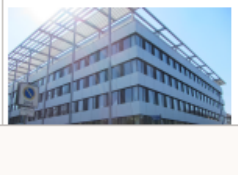
Übersicht über alle Aufrufe

CVVisual | main window

Close | Overview

Help

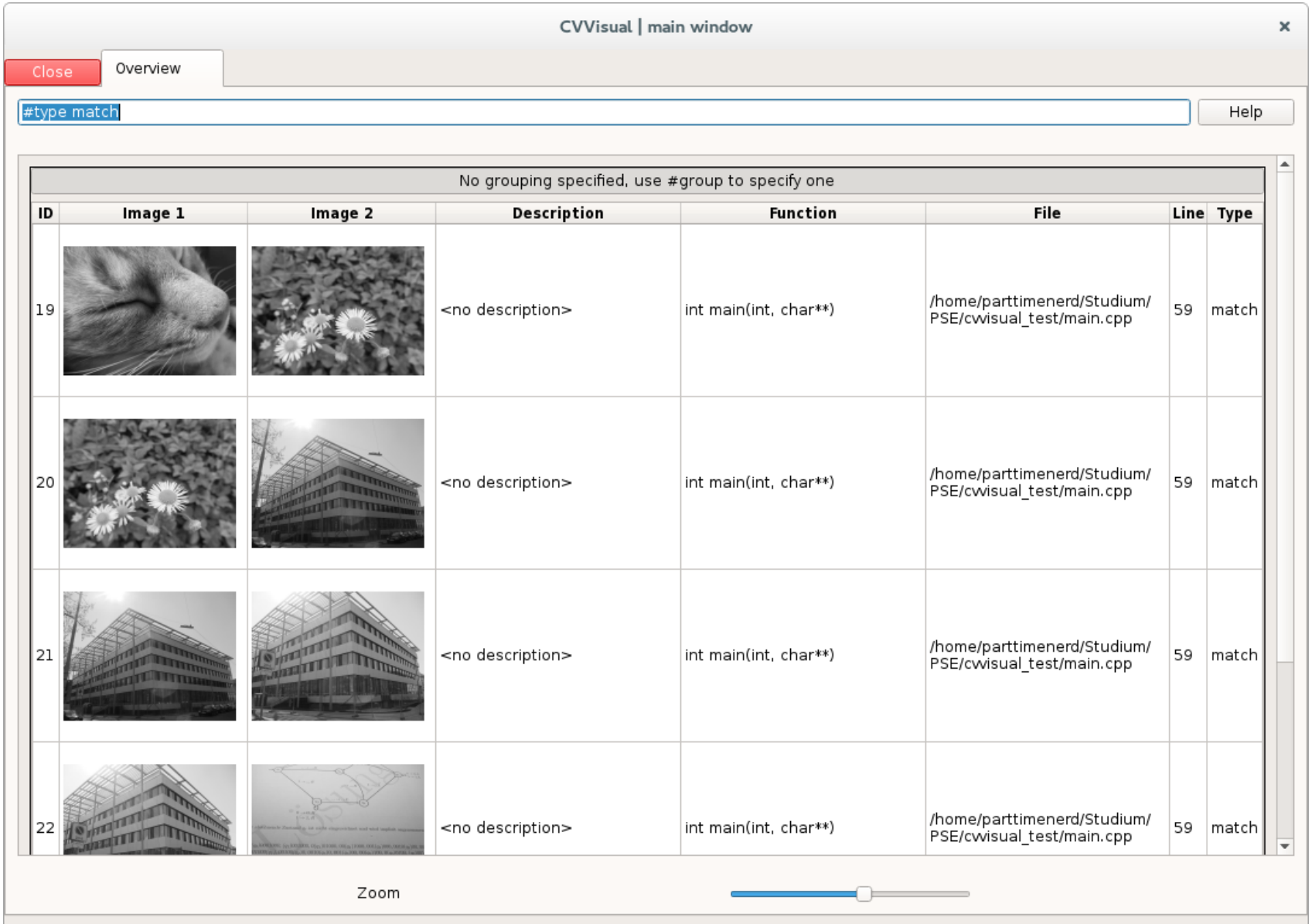
No grouping specified, use #group to specify one

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

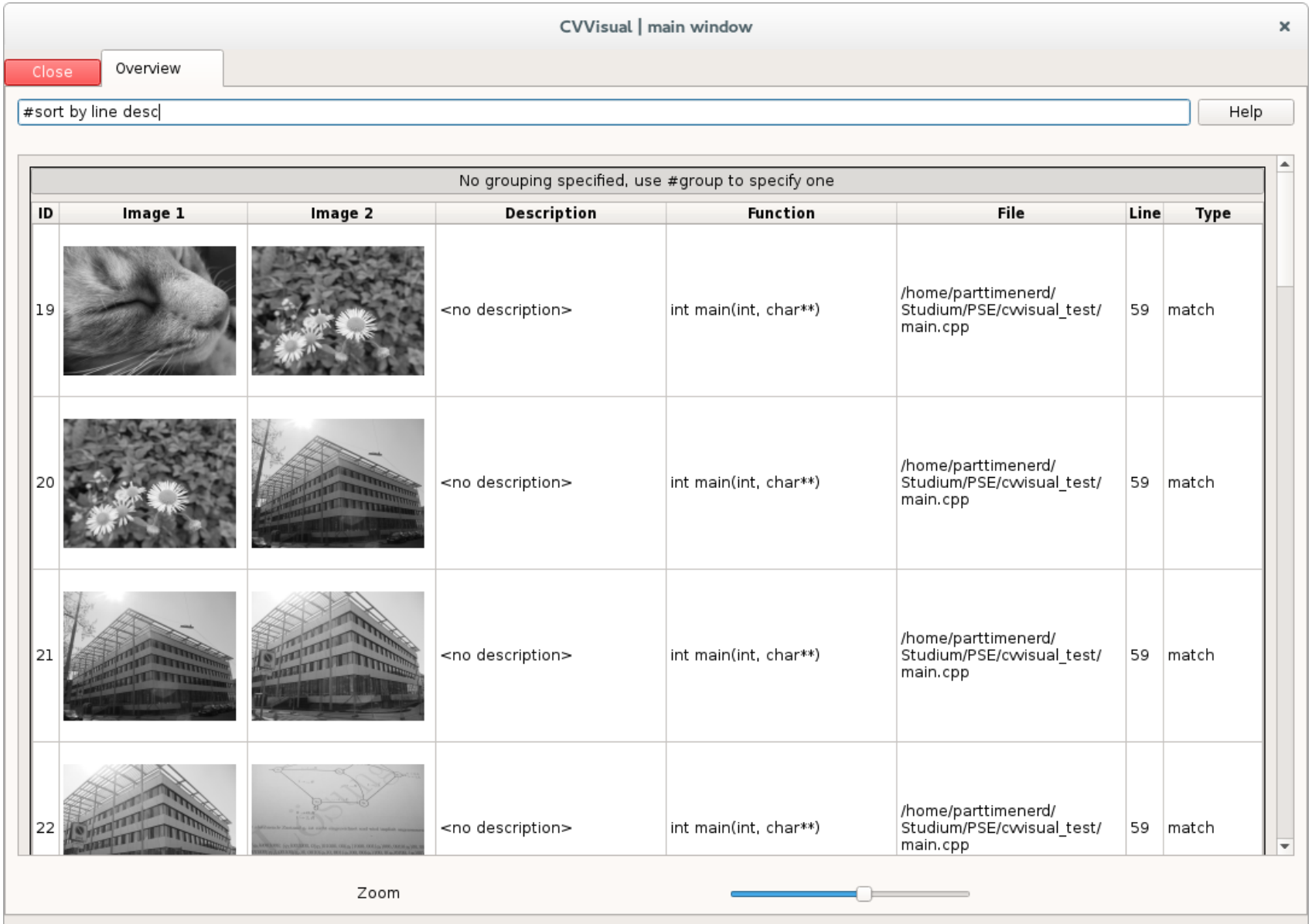
Übersicht

Filterbar



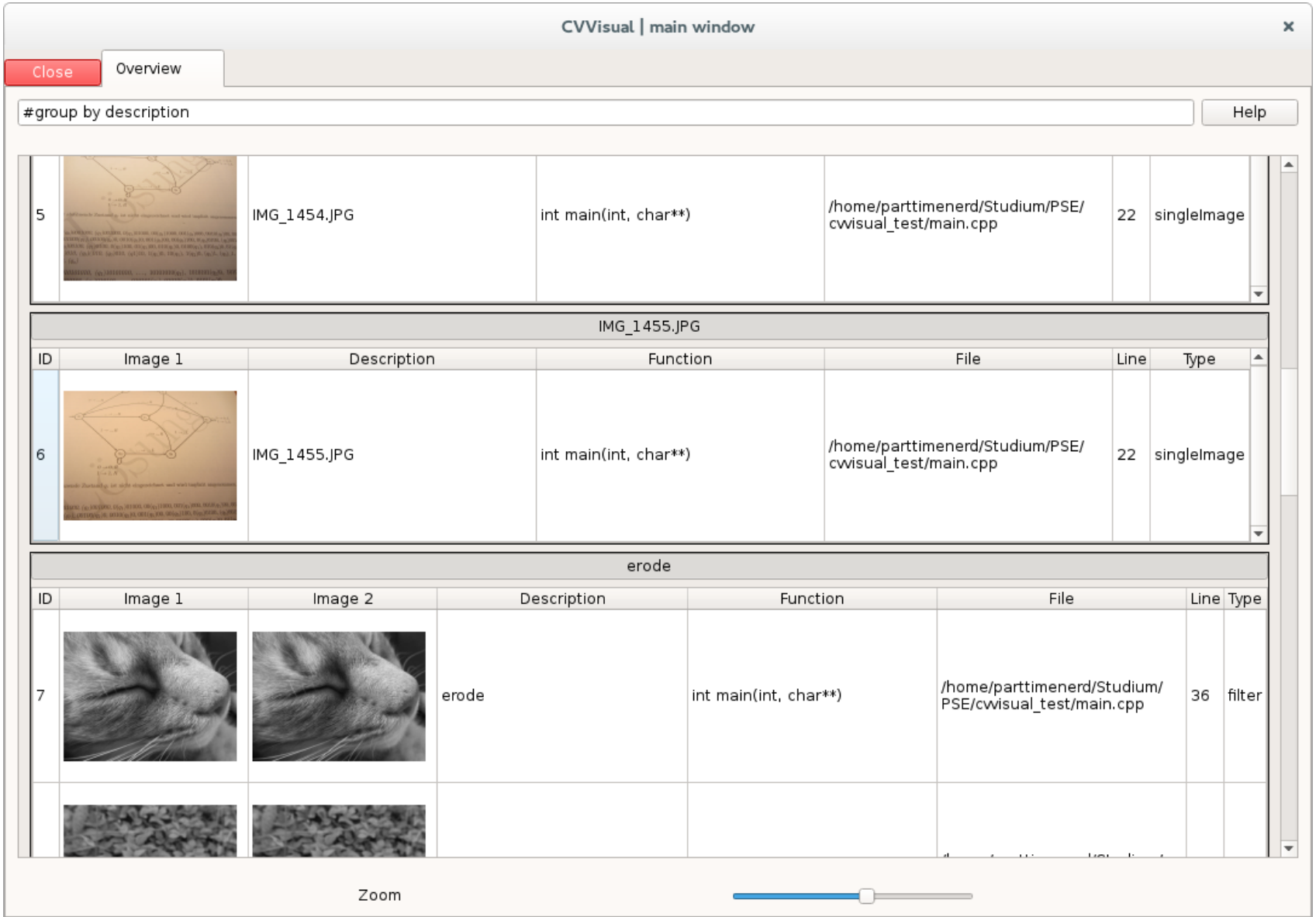
Übersicht

Sortierbar



Übersicht

Gruppierbar



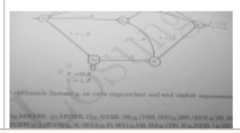
Übersicht

CVVisual | main window

Close | Overview

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

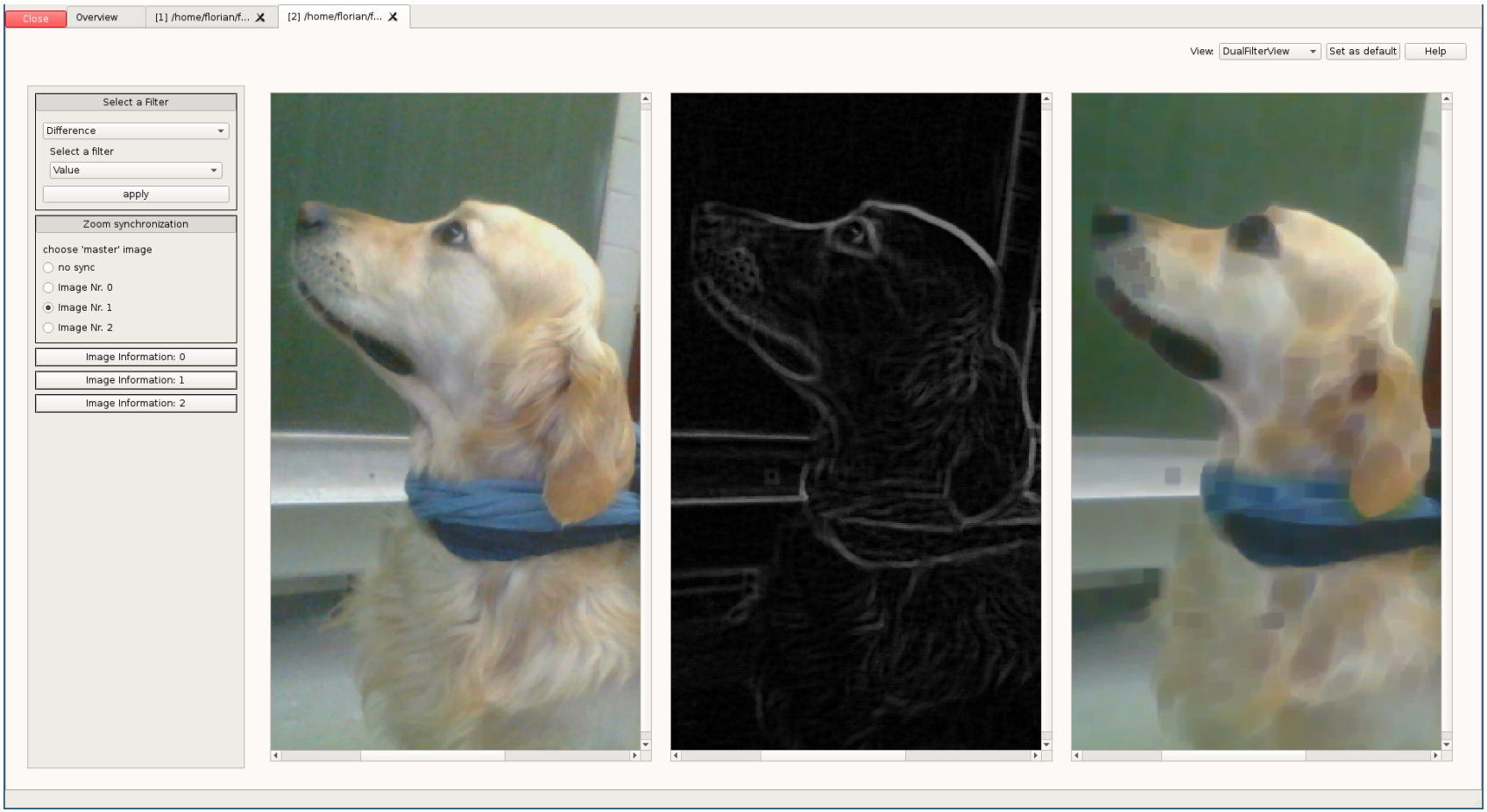
<no description>

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

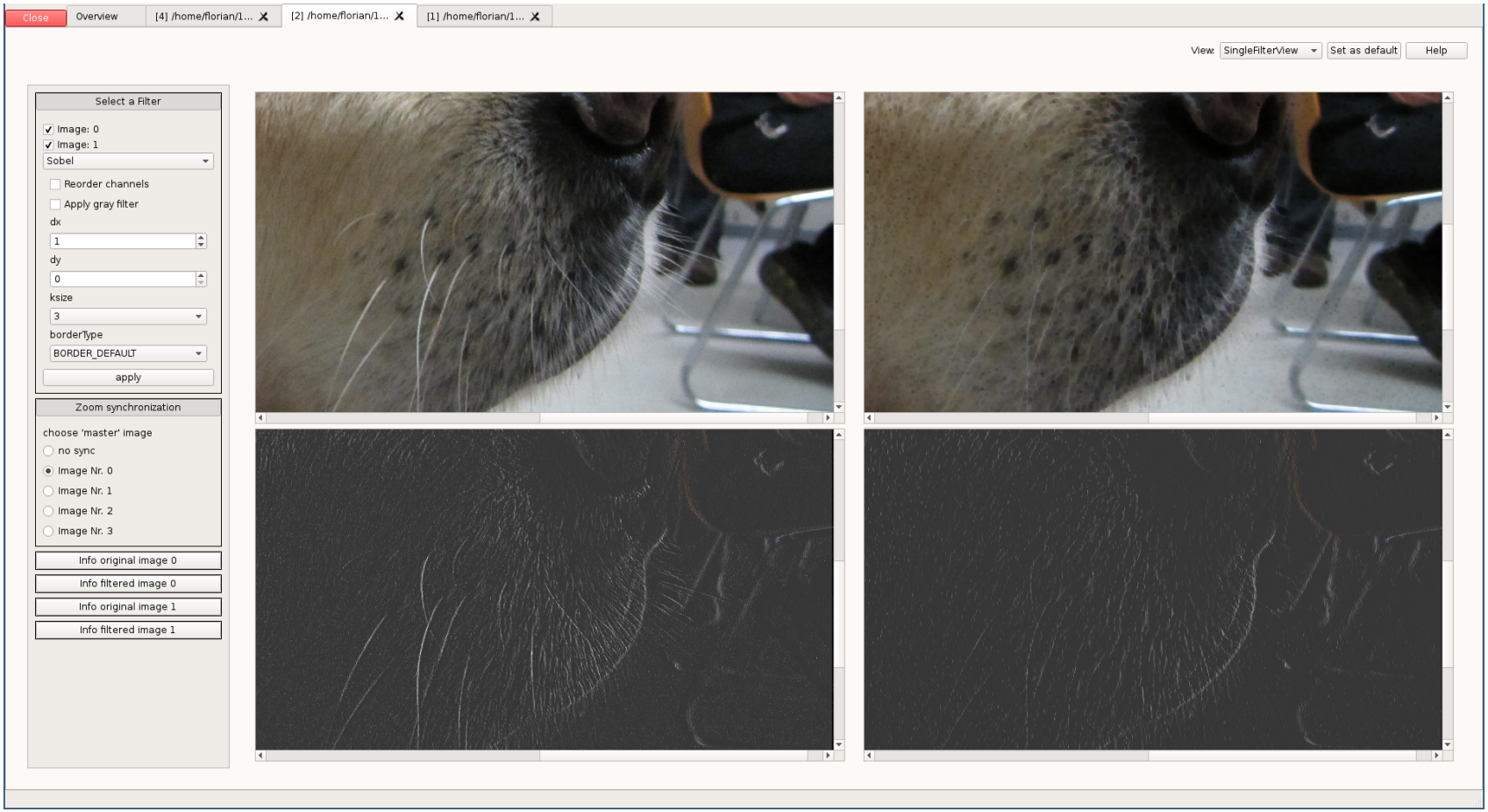
Filter

- 2 Bilder $\rightarrow$ 1 Bild
- Differenzbilder, Overlay, geänderte Pixel für Filter



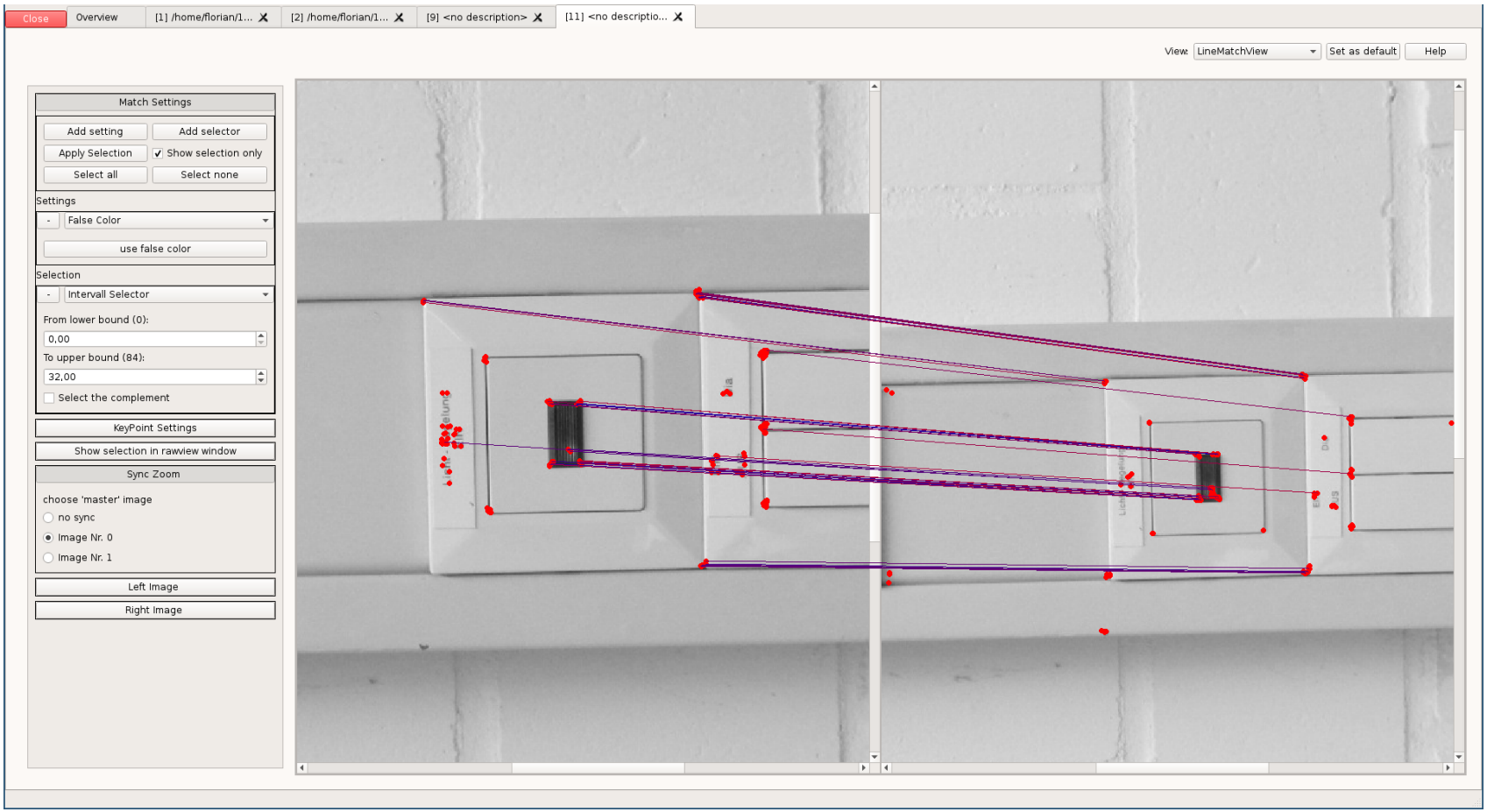
Filter

- 1 Bild $\rightarrow$ 1 Bild
- Nachträgliche Anwendung weiterer Filter



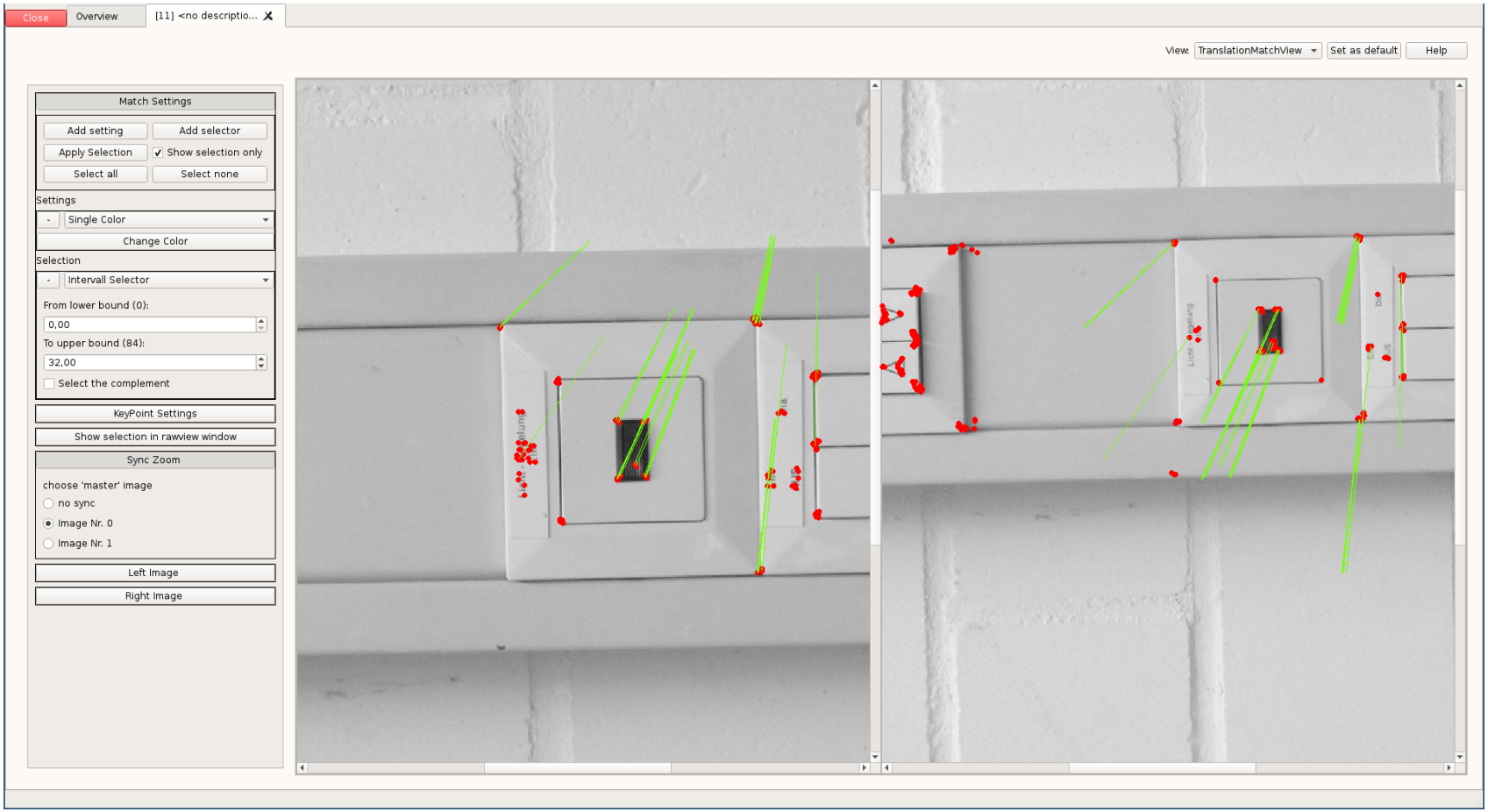
Matches

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



Matches

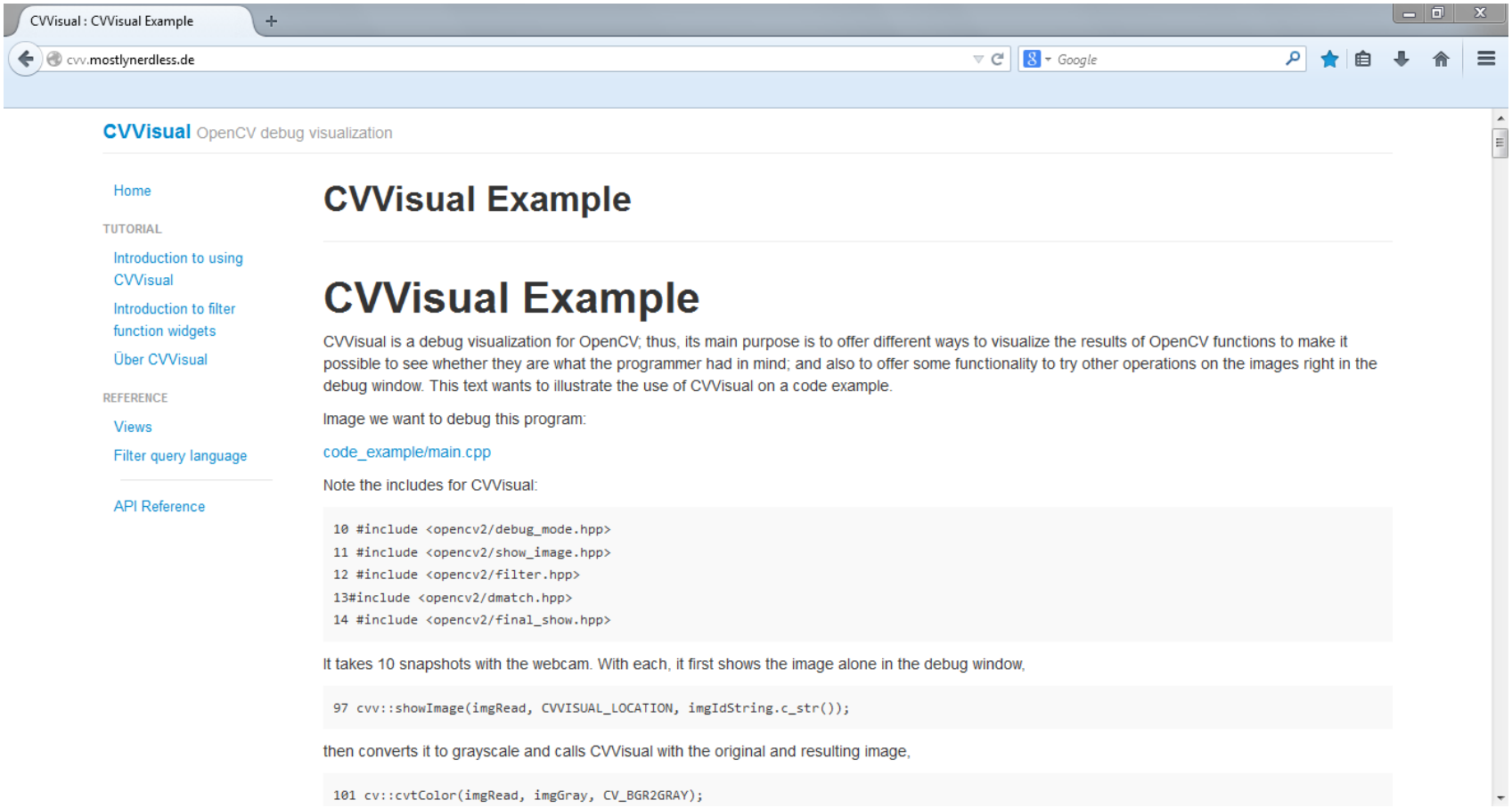
- Anzeigen / Filtern von Keypoints / Matches
- Anzeige der Translation von Keypoints



GUI-Demo

Dokumentation

Tutorials, Beispiele



Kurzdokumentation

Wird von der Hilfefunktion des Programms benutzt.

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:

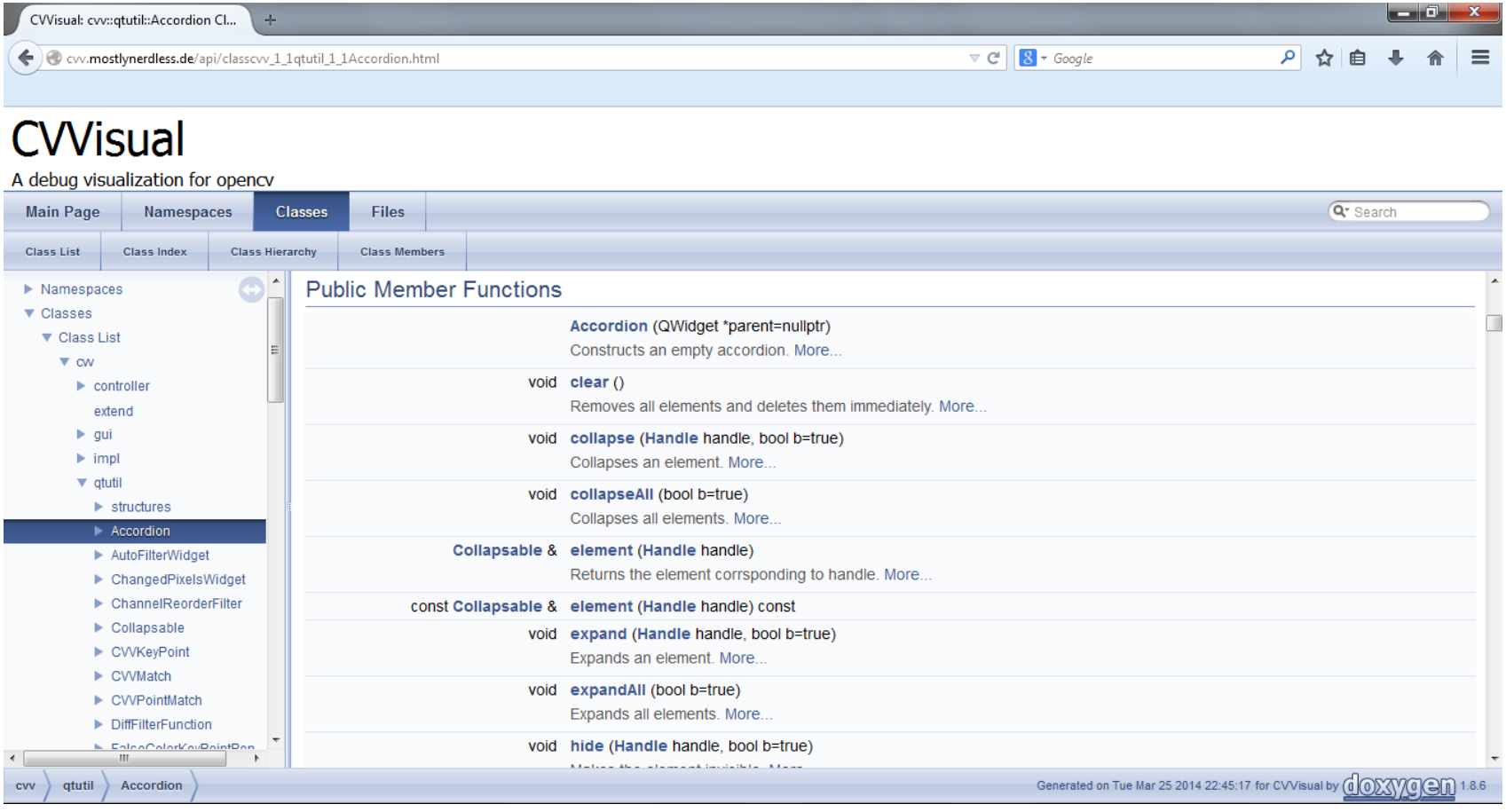
Shows two images with only the basic features of `ImageInformation`, synchronized zoom and `Histogram`.

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.

Referenz:

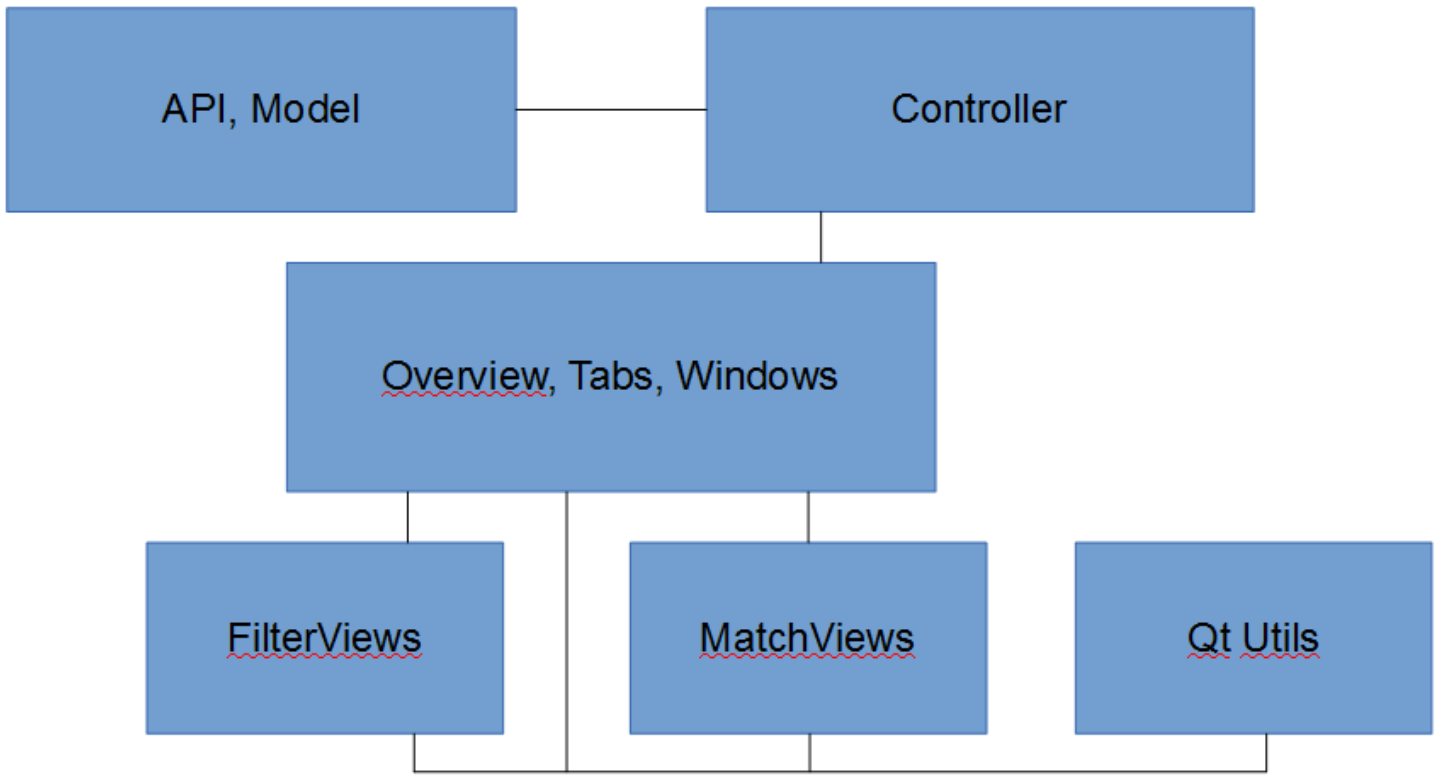
- Mit Hilfe von Doxygen



Architektur

Entwurf

- Trennung in API, Datenhaltung, Visualisierung



Signals/Slots & Templates

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

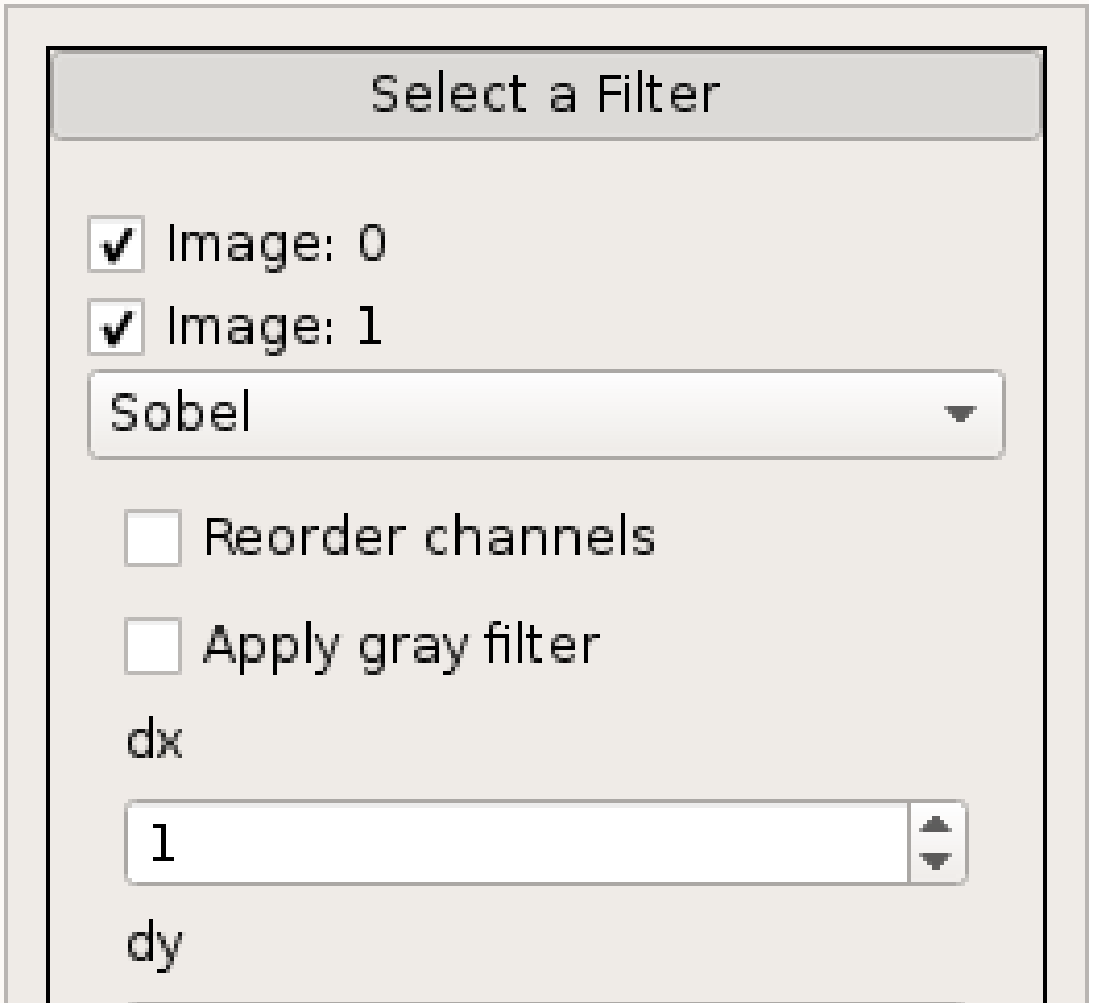
```
class SlotQString : public QObject
{    Q_OBJECT
  public:
    SlotQString(const std::function<void(QString)> &f,
                QObject *parent = nullptr)
    : QObject{ parent }, function_{ f }
    {    if (!f)
             throw std::invalid_argument{ "invalide function" };
    }
public slots: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

RegisterHelper

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

(Auto-)FilterWidget

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

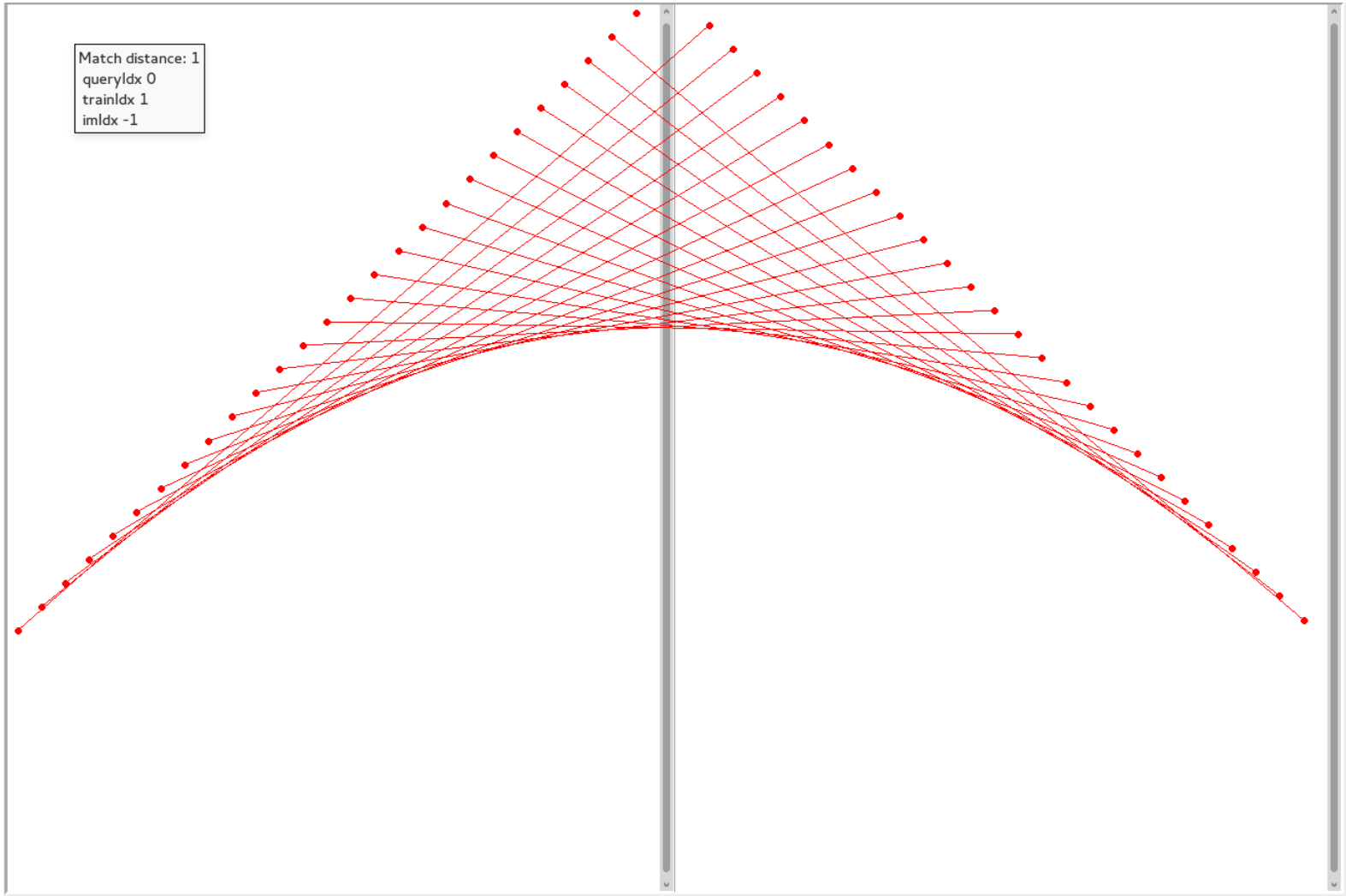


ZoomableImage

- 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

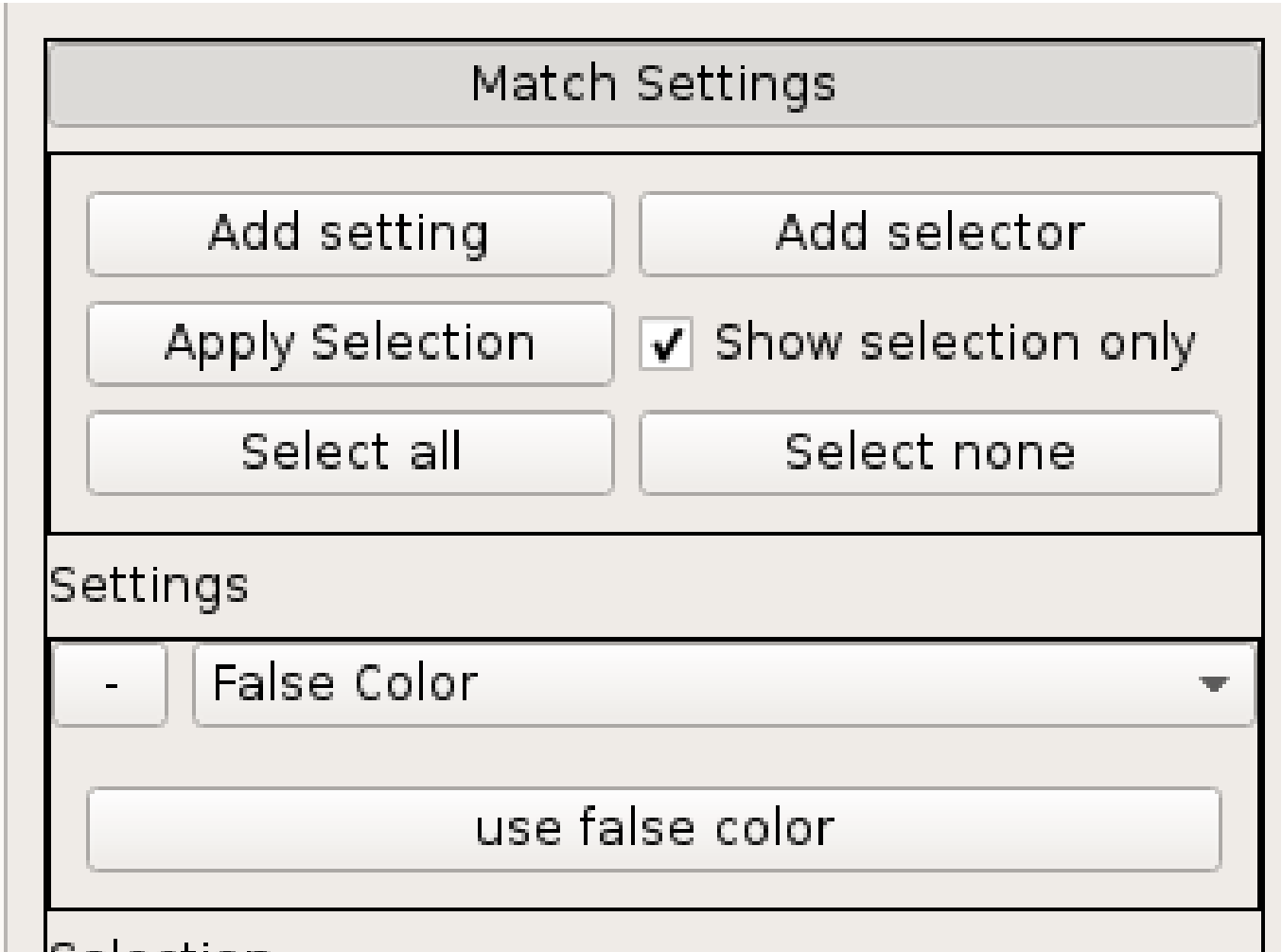
MatchScene

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



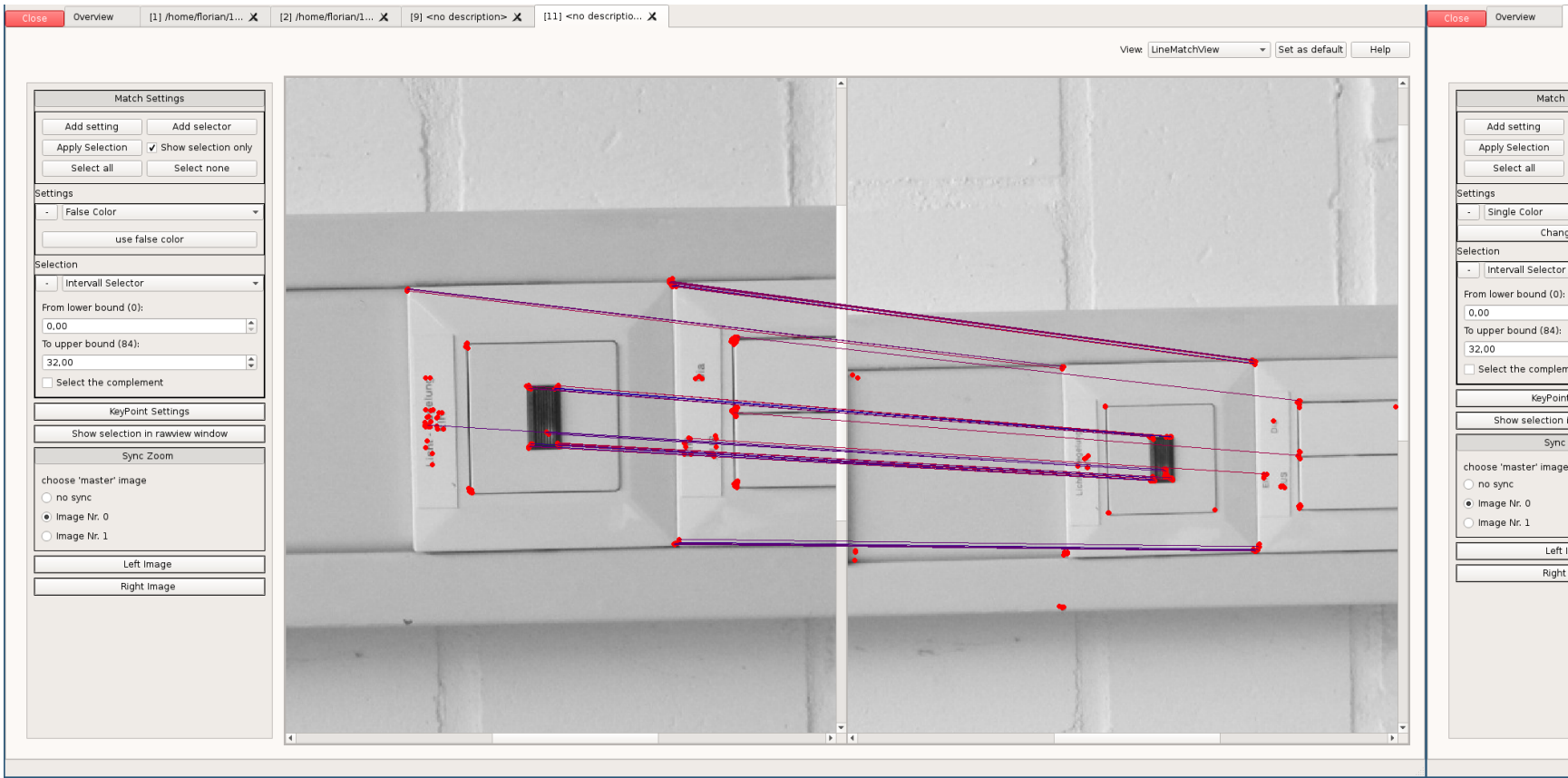
Match/KeyPointSetting

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



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)



API

Anwender API

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

Interne API

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

Ausblick

Rezeption

Projekt schien von der OpenCV-Community wohlwollend aufgenommen zu werden

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.

Rezeption

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

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.

Links

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