Colour - Checker Detection Documentation

Release 0.1.3

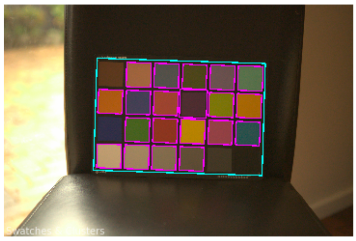
Colour Developers

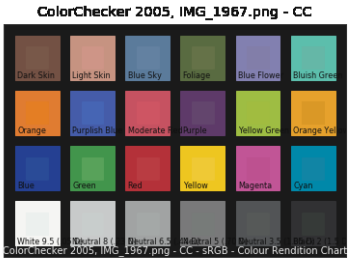
Feb 27, 2022

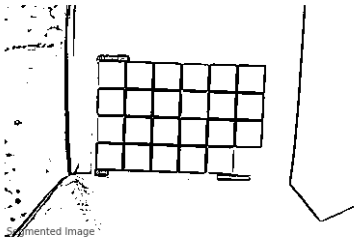
CONTENTS

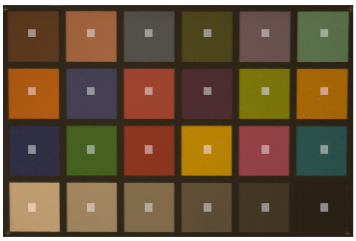
A Python package implementing various colour checker detection algorithms and related utilities.

It is open source and freely available under the New BSD License terms.









CHAPTER

ONE

1.1 FEATURES

The following colour checker detection algorithms are implemented:

- Segmentation

1.1 1.1.1 Examples

Various usage examples are available from the examples directory.

CHAPTER

TWO

1.2 USER GUIDE

2.1 User Guide

The user guide provides an overview of **Colour - Checker Detection** and explains important concepts and features, details can be found in the API Reference.

2.1.1 Installation Guide

Because of their size, the resources dependencies needed to run the various examples and unit tests are not provided within the Pypi package. They are separately available as Git Submodules when cloning the repository.

Primary Dependencies

Colour - Checker Detection requires various dependencies in order to run:

- python >= 3.8, < 4
- colour-science >= 4
- imageio >= 2, < 3
- numpy >= 1.19, < 2
- opencv-python >= 4, < 5
- scipy >= 1.5, < 2

Pypi

Once the dependencies are satisfied, **Colour - Checker Detection** can be installed from the Python Package Index by issuing this command in a shell:

```
pip install --user colour-checker-detection
```

The tests suite dependencies are installed as follows:

```
pip install --user 'colour-checker-detection[tests]'
```

The documentation building dependencies are installed as follows:

```
pip install --user 'colour-checker-detection[docs]'
```

The overall development dependencies are installed as follows:

```
pip install --user 'colour-checker-detection[development]'
```

2.1.2 Bibliography

CHAPTER

THREE

1.3 API REFERENCE

3.1 API Reference

3.1.1 Colour - Checker Detection

Colour Checker Detection

Segmentation

colour_checker_detection

SETTINGS_SEGMENTATION_COLORCHECKER_CLASSIC	Settings for the segmentation of the *X-Rite ColorChecker Classic* and *X-Rite ColorChecker Passport*.
SETTINGS_SEGMENTATION_COLORCHECKER_SG	Settings for the segmentation of the *X-Rite ColorChecker SG**.
colour_checkers_coordinates_segmentation(image)	Detect the colour checkers coordinates in given image $image$ using segmentation.
extract_colour_checkers_segmentation(image, ...)	Extract the colour checkers sub-images in given image using segmentation.
detect_colour_checkers_segmentation(image[, ...])	Detect the colour checkers swatches in given image using segmentation.

colour_checker_detection.SETTINGS_SEGMENTATION_COLORCHECKER_CLASSIC

colour_checker_detection.**SETTINGS_SEGMENTATION_COLORCHECKER_CLASSIC** =
{'adaptive_threshold_kwargs': {'C': 3, 'adaptiveMethod': 0, 'blockSize': 21, 'maxValue': 255, 'thresholdType': 0}, 'aspect_ratio': 1.5, 'aspect_ratio_maximum': 1.6500000000000001, 'aspect_ratio_minimum': 1.35, 'cluster_contour_scale': 0.975, 'fast_non_local_means_denoising_kwargs': {'h': 10, 'searchWindowSize': 21, 'templateWindowSize': 7}, 'interpolation_method': 2, 'swatch_contour_scale': 1.3333333333333333, 'swatch_minimum_area_factor': 200, 'swatches': 24, 'swatches_achromatic_slice': slice(19, 23, 1), 'swatches_chromatic_slice': slice(1, 5, 1), 'swatches_count_maximum': 30, 'swatches_count_minimum': 18, 'swatches_horizontal': 6, 'swatches_vertical': 4, 'working_width': 1440}

Settings for the segmentation of the *X-Rite ColorChecker Classic* and *X-Rite ColorChecker Passport*.

colour_checker_detection.SETTINGS_SEGMENTATION_COLORCHECKER_SG

colour_checker_detection.**SETTINGS_SEGMENTATION_COLORCHECKER_SG** =
{'adaptive_threshold_kwargs': {'C': 3, 'adaptiveMethod': 0, 'blockSize': 21, 'maxValue': 255, 'thresholdType': 0}, 'aspect_ratio': 1.4, 'aspect_ratio_maximum': 1.54, 'aspect_ratio_minimum': 1.26, 'cluster_contour_scale': 1, 'fast_non_local_means_denoising_kwargs': {'h': 10, 'searchWindowSize': 21, 'templateWindowSize': 7}, 'interpolation_method': 2, 'swatch_contour_scale': 1.3333333333333333, 'swatch_minimum_area_factor': 200, 'swatches': 140, 'swatches_achromatic_slice': slice(115, 120, 1), 'swatches_chromatic_slice': slice(48, 53, 1), 'swatches_count_maximum': 210, 'swatches_count_minimum': 70, 'swatches_horizontal': 14, 'swatches_vertical': 10, 'working_width': 1440}

Settings for the segmentation of the *X-Rite ColorChecker SG**.

colour_checker_detection.colour_checkers_coordinates_segmentation

colour_checker_detection.**colour_checkers_coordinates_segmentation**(*image: ArrayLike*, *additional_data: bool = False*, ***kwargs: Any*) → Union[colour_checker_detection.detection.se Tuple[numpy.ndarray, ...]]

Detect the colour checkers coordinates in given image $image$ using segmentation.

This is the core detection definition. The process is a follows:

- Input image $image$ is converted to a grayscale image $image_g$.
- Image $image_g$ is denoised.
- Image $image_g$ is thresholded/segmented to image $image_s$.
- Image $image_s$ is eroded and dilated to cleanup remaining noise.
- Contours are detected on image $image_s$.
- Contours are filtered to only keep squares/swatches above and below defined surface area.
- Squares/swatches are clustered to isolate region-of-interest that are potentially colour checkers: Contours are scaled by a third so that colour checkers swatches are expected to be joined, creating a large rectangular cluster. Rectangles are fitted to the clusters.
- Clusters with an aspect ratio different to the expected one are rejected, a side-effect is that the complementary pane of the *X-Rite ColorChecker Passport* is omitted.
- Clusters with a number of swatches close to the expected one are kept.

Parameters

- **image** (ArrayLike) – Image to detect the colour checkers in.
- **additional_data** (bool) – Whether to output additional data.
- **aspect_ratio** – Colour checker aspect ratio, e.g. 1.5.
- **aspect_ratio_minimum** – Minimum colour checker aspect ratio for detection: projective geometry might reduce the colour checker aspect ratio.
- **aspect_ratio_maximum** – Maximum colour checker aspect ratio for detection: projective geometry might increase the colour checker aspect ratio.
- **swatches** – Colour checker swatches total count.
- **swatches_horizontal** – Colour checker swatches horizontal columns count.
- **swatches_vertical** – Colour checker swatches vertical row count.

- **swatches_count_minimum** – Minimum swatches count to be considered for the detection.
- **swatches_count_maximum** – Maximum swatches count to be considered for the detection.
- **swatches_chromatic_slice** – A *slice* instance defining chromatic swatches used to detect if the colour checker is upside down.
- **swatches_achromatic_slice** – A *slice* instance defining achromatic swatches used to detect if the colour checker is upside down.
- **swatch_minimum_area_factor** – Swatch minimum area factor f with the minimum area m_a expressed as follows: $m_a = image_w * image_h / s_c / f$ where $image_w$, $image_h$ and s_c are respectively the image width, height and the swatches count.
- **swatch_contour_scale** – As the image is filtered, the swatches area will tend to shrink, the generated contours can thus be scaled.
- **cluster_contour_scale** – As the swatches are clustered, it might be necessary to adjust the cluster scale so that the masks are centred better on the swatches.
- **working_width** – Size the input image is resized to for detection.
- **fast_non_local_means_denoising_kwargs** – Keyword arguments for `cv2.fastNlMeansDenoising()` definition.
- **adaptive_threshold_kwargs** – Keyword arguments for `cv2.adaptiveThreshold()` definition.
- **interpolation_method** – Interpolation method used when resizing the images, *cv2.INTER_CUBIC* and *cv2.INTER_LINEAR* methods are recommended.
- **kwargs** (`Any`) –

Returns Tuple of colour checkers coordinates or `ColourCheckersDetectionData` class instance with additional data.

Return type `colour_checker_detection.detection.segmentation.ColourCheckersDetectionData` or `tuple`

Notes

- Multiple colour checkers can be detected if presented in `image`.

Examples

```
>>> import os
>>> from colour import read_image
>>> from colour_checker_detection import TESTS_RESOURCES_DIRECTORY
>>> path = os.path.join(TESTS_RESOURCES_DIRECTORY,
...                     'colour_checker_detection', 'detection',
...                     'IMG_1967.png')
>>> image = read_image(path)
>>> colour_checkers_coordinates_segmentation(image)
(array([[ 369,  688],
       [ 382,  226],
       [1078,  246],
       [1065,  707]]...)
```

colour_checker_detection.extract_colour_checkers_segmentation

colour_checker_detection.**extract_colour_checkers_segmentation**(*image: ArrayLike*, ***kwargs: Any*) → Tuple[numpy.ndarray, ...]

Extract the colour checkers sub-images in given image using segmentation.

Parameters

- **image** (ArrayLike) – Image to extract the colours checkers sub-images from.
- **aspect_ratio** – Colour checker aspect ratio, e.g. 1.5.
- **aspect_ratio_minimum** – Minimum colour checker aspect ratio for detection: projective geometry might reduce the colour checker aspect ratio.
- **aspect_ratio_maximum** – Maximum colour checker aspect ratio for detection: projective geometry might increase the colour checker aspect ratio.
- **swatches** – Colour checker swatches total count.
- **swatches_horizontal** – Colour checker swatches horizontal columns count.
- **swatches_vertical** – Colour checker swatches vertical row count.
- **swatches_count_minimum** – Minimum swatches count to be considered for the detection.
- **swatches_count_maximum** – Maximum swatches count to be considered for the detection.
- **swatches_chromatic_slice** – A *slice* instance defining chromatic swatches used to detect if the colour checker is upside down.
- **swatches_achromatic_slice** – A *slice* instance defining achromatic swatches used to detect if the colour checker is upside down.
- **swatch_minimum_area_factor** – Swatch minimum area factor f with the minimum area m_a expressed as follows: $m_a = image_w * image_h / s_c / f$ where $image_w$, $image_h$ and s_c are respectively the image width, height and the swatches count.
- **swatch_contour_scale** – As the image is filtered, the swatches area will tend to shrink, the generated contours can thus be scaled.
- **cluster_contour_scale** – As the swatches are clustered, it might be necessary to adjust the cluster scale so that the masks are centred better on the swatches.
- **working_width** – Size the input image is resized to for detection.
- **fast_non_local_means_denoising_kwargs** – Keyword arguments for `cv2.fastNlMeansDenoising()` definition.
- **adaptive_threshold_kwargs** – Keyword arguments for `cv2.adaptiveThreshold()` definition.
- **interpolation_method** – Interpolation method used when resizing the images, *cv2.INTER_CUBIC* and *cv2.INTER_LINEAR* methods are recommended.
- **kwargs** (Any) –

Returns Tuple of colour checkers sub-images.

Return type tuple

Examples

```
>>> import os
>>> from colour import read_image
>>> from colour_checker_detection import TESTS_RESOURCES_DIRECTORY
>>> path = os.path.join(TESTS_RESOURCES_DIRECTORY,
...                     'colour_checker_detection', 'detection',
...                     'IMG_1967.png')
>>> image = read_image(path)
>>> extract_colour_checkers_segmentation(image)
...
(array([[[ 0.17908671,  0.14010708,  0.09243158],
        [ 0.17805016,  0.13058874,  0.09513047],
        [ 0.17175764,  0.13128328,  0.08811688],
        ...,
        [ 0.15934898,  0.13436384,  0.07479276],
        [ 0.17178158,  0.13138185,  0.07703256],
        [ 0.15082785,  0.11866678,  0.07680314]],

       [[ 0.16597673,  0.13563241,  0.08780421],
        [ 0.16490564,  0.13110894,  0.08601525],
        [ 0.16939694,  0.12963502,  0.08783565],
        ...,
        [ 0.14708202,  0.12856133,  0.0814603 ],
        [ 0.16883563,  0.12862256,  0.08452422],
        [ 0.16781917,  0.12363558,  0.07361614]],

       [[ 0.16326806,  0.13720085,  0.08925959],
        [ 0.16014062,  0.13585283,  0.08104862],
        [ 0.16657823,  0.12889633,  0.08870038],
        ...,
        [ 0.14619341,  0.13086307,  0.07367594],
        [ 0.16302426,  0.13062705,  0.07938427],
        [ 0.16618022,  0.1266259 ,  0.07200021]],

       ...,
       [[ 0.1928642 ,  0.14578913,  0.11224515],
        [ 0.18931177,  0.14416392,  0.10288388],
        [ 0.17707473,  0.1436448 ,  0.09188452],
        ...,
        [ 0.16879168,  0.12867133,  0.09001681],
        [ 0.1699731 ,  0.1287041 ,  0.07616285],
        [ 0.17137891,  0.129711  ,  0.07517841]],

       [[ 0.19514292,  0.1532704 ,  0.10375113],
        [ 0.18217109,  0.14982903,  0.10452617],
        [ 0.18830594,  0.1469499 ,  0.10896181],
        ...,
        [ 0.18234864,  0.12642328,  0.08047272],
        [ 0.17617388,  0.13000189,  0.06874527],
        [ 0.17108543,  0.13264084,  0.06309374]],

       [[ 0.16243187,  0.14983535,  0.08954653],
        [ 0.155507  ,  0.14899652,  0.10273992],
        [ 0.17993385,  0.1498394 ,  0.1099571 ],
        ...,
        [ 0.18079454,  0.1253967 ,  0.07739887],
```

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```
        [ 0.17239226,  0.13181566,  0.07806754],
        [ 0.17422497,  0.13277327,  0.07513551]]], dtype=float32),)
```

colour_checker_detection.detect_colour_checkers_segmentation

colour_checker_detection.**detect_colour_checkers_segmentation**(*image: ArrayLike*, *samples: int = 16*, *additional_data: bool = False*, ***kwargs: Any*) → Union[Tuple[colour_checker_detection.detection.s ...], Tuple[numpy.ndarray, ...]]

Detect the colour checkers swatches in given image using segmentation.

Parameters

- **image** (array_like) – Image to detect the colour checkers swatches in.
- **samples** (int) – Samples count to use to compute the swatches colours. The effective samples count is $samples^2$.
- **additional_data** (bool, optional) – Whether to output additional data.
- **aspect_ratio** – Colour checker aspect ratio, e.g. 1.5.
- **aspect_ratio_minimum** – Minimum colour checker aspect ratio for detection: projective geometry might reduce the colour checker aspect ratio.
- **aspect_ratio_maximum** – Maximum colour checker aspect ratio for detection: projective geometry might increase the colour checker aspect ratio.
- **swatches** – Colour checker swatches total count.
- **swatches_horizontal** – Colour checker swatches horizontal columns count.
- **swatches_vertical** – Colour checker swatches vertical row count.
- **swatches_count_minimum** – Minimum swatches count to be considered for the detection.
- **swatches_count_maximum** – Maximum swatches count to be considered for the detection.
- **swatches_chromatic_slice** – A *slice* instance defining chromatic swatches used to detect if the colour checker is upside down.
- **swatches_achromatic_slice** – A *slice* instance defining achromatic swatches used to detect if the colour checker is upside down.
- **swatch_minimum_area_factor** – Swatch minimum area factor f with the minimum area m_a expressed as follows: $m_a = image_w * image_h / s_c / f$ where $image_w$, $image_h$ and s_c are respectively the image width, height and the swatches count.
- **swatch_contour_scale** – As the image is filtered, the swatches area will tend to shrink, the generated contours can thus be scaled.
- **cluster_contour_scale** – As the swatches are clustered, it might be necessary to adjust the cluster scale so that the masks are centred better on the swatches.
- **working_width** – Size the input image is resized to for detection.
- **fast_non_local_means_denoising_kwargs** – Keyword arguments for cv2.fastNlMeansDenoising() definition.
- **adaptive_threshold_kwargs** – Keyword arguments for cv2.adaptiveThreshold() definition.

- **interpolation_method** – Interpolation method used when resizing the images, *cv2.INTER_CUBIC* and *cv2.INTER_LINEAR* methods are recommended.
- **kwargs** (Any) –

Returns Tuple of ColourCheckerSwatchesData class instances or colour checkers swatches.

Return type class`tuple`

Examples

```
>>> import os
>>> from colour import read_image
>>> from colour_checker_detection import TESTS_RESOURCES_DIRECTORY
>>> path = os.path.join(TESTS_RESOURCES_DIRECTORY,
...                     'colour_checker_detection', 'detection',
...                     'IMG_1967.png')
>>> image = read_image(path)
>>> detect_colour_checkers_segmentation(image)
(array([[ 0.361626... ,  0.2241066...,  0.1187837...],
       [ 0.6280594...,  0.3950883...,  0.2434766...],
       [ 0.3326232...,  0.3156182...,  0.2891038...],
       [ 0.3048414...,  0.2738973...,  0.1069985...],
       [ 0.4174869...,  0.3199669...,  0.3081552...],
       [ 0.347873 ...,  0.4413193...,  0.2931614...],
       [ 0.6816301...,  0.3539050...,  0.0753397...],
       [ 0.2731050...,  0.2528467...,  0.3312920...],
       [ 0.6192335...,  0.2703833...,  0.1866387...],
       [ 0.3068567...,  0.1803366...,  0.1919807...],
       [ 0.4866354...,  0.4594004...,  0.0374186...],
       [ 0.6518523...,  0.4010608...,  0.0171886...],
       [ 0.1941571...,  0.1855801...,  0.2750632...],
       [ 0.2799946...,  0.3854609...,  0.1241038...],
       [ 0.5537481...,  0.2139004...,  0.1267332...],
       [ 0.7208045...,  0.5152904...,  0.0061946...],
       [ 0.5778360...,  0.2578533...,  0.2687992...],
       [ 0.1809450...,  0.3174742...,  0.2959902...],
       [ 0.7427522...,  0.6107554...,  0.4398439...],
       [ 0.6296108...,  0.5177606...,  0.3728032...],
       [ 0.5139589...,  0.4216307...,  0.2992694...],
       [ 0.3704401...,  0.3033927...,  0.2093089...],
       [ 0.2641854...,  0.2154007...,  0.1441267...],
       [ 0.1650098...,  0.1345239...,  0.0817437...]], dtype=float32),)
```

3.1.2 Indices and tables

- genindex
- search

CHAPTER

FOUR

1.4 CODE OF CONDUCT

The *Code of Conduct*, adapted from the Contributor Covenant 1.4, is available on the Code of Conduct page.

CHAPTER

FIVE

1.5 CONTACT & SOCIAL

The *Colour Developers* can be reached via different means:

- Email
- Facebook
- Github Discussions
- Gitter
- Twitter

CHAPTER

SIX

1.6 ABOUT

BIBLIOGRAPHY

[Abe11] Felix Abecassis. Opencv - rotation (deskewing). 2011. URL: http://felix.abecassis.me/2011/10/opencv-rotation-deskewing/ (visited on 2018-10-27).

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