https://doi.org/10.2352/ISSN.2470-1173.2021.2.SDA-058

Hybrid Stereoscopic Photography - Analogue Stereo Photography meets the Digital Age with the StereoCompass app

Bjorn Sommer [1,$]
[1] ***School of Design, Royal College of Art, London, UK***
[$] ***Corresponding author: bjoern@CELLmicrocosmos.org***

Abstract

Stereoscopic photography has a long history which started just a few years after the first known photo was taken: 1849 Sir David Brewster introduced the first binocular camera. Whereas mobile photography is omnipresent because of the wide distribution of smart phones, stereoscopic photography is only used by a very small set of enthusiasts or professional (stereo) photographers. One important aspect of professional stereoscopic photography is that the required technology is usually quite expensive. Here, we present an alternative approach, uniting easily affordable vintage analogue SLR cameras with smart phone technology to measure and predict the stereo base/camera separation as well as the focal distance to zero parallax. For this purpose, the StereoCompass app was developed which is utilizing a number of smart phone sensors, combined with a Google Maps-based distance measurement. Three application cases including red/cyan anaglyph stereo photographs are shown. More information and the app can be found at: `http://stereocompass.i2d.uk`

Introduction

Nowadays, digital photography has become inflationary. A few decades ago, photography was a specific area for professional or enthusiastic photographers. The participation required decent financial investments and experience to produce technically appropriate photos. Today, nearly every smartphone user has a camera integrated in the phone, which often produces images of decent quality. Especially the flagship smartphones of Apple, Samsung and Huawai produce very satisfying photos.

Stereoscopic photography has a long history which started just a few years after the first known photo was taken by Joseph Nicéphore Niépce in 1826. 1849 Sir David Brewster – who also improved the stereoscope technology invented by Sir Charles Wheatstone around 1832 – introduced the first binocular camera. Whereas mobile photography is omnipresent because of the wide distribution of smartphones, stereoscopic photography is only used by a very small set of enthusiasts or professional (stereo) photographers. One important aspect of professional stereoscopic photography is that the required technology is usually quite expensive.

There was a time when the LG Optimus 3D MAX was launched where a number of 3D smartphones were available on the market [1]. But with the decline of the 3D TV market, also the 3D smartphones largely disappeared from the public view [2]. However, from time to time a 3D smartphone is launched, such as the ROKiT iO Pro 3D in 2019 equipped with a 13 MP dual camera [3]. But obviously these devices are quite limited in terms of flexibility and resolution and cannot be seen as a semi-professional alternative to SLR cameras. Of course, it is not possible to change the stereo base/camera separation as well as the focal distance to zero parallax using these basic 3D smartphone cameras.

The purpose of this paper is now two-fold: First of all, we want to show a way how to enter semi-professional stereoscopic photography without investing a decent amount of money - which should be especially interesting for starters. Second, we would like to show an alternative way to inflationary digital photography. Third, we would like to unite the world of analogue photography and digital technology – here represented by smartphones.

Why analogue photography? Going again back two decades, the medium of choice was still photographic film. And up to this day there are still many people using analogue film technology for various reasons, for example:

- aesthetics
- haptics
- camera mechanics
- non-digital
- photo film granularity
- photo film resolution
- precision
- skills
- sound experience
- sustainability/recycling
- vintage experience

Please note that we do not claim that the photo film resolution can compete with most-recent digital technology. A big advantage of analogue photography is the fact that the second-hand market provides very cheap high-quality photo SLR cameras from the professional and semi-professional market segment. Whereas these cameras can be often bought for the price of an USB stick, professional digital cameras usually cost a few thousand dollars. Many of these outdated cameras enable to acquire very affordable high quality object lenses.

In this paper, we want to unite the worlds of analogue photography and smartphone technology. For this purpose, a simple but effective Android app was developed which is supporting the process of taking stereoscopic images with two vintage analogue cameras: the *StereoCompass*. The app can be used to 1) calculate and predict the camera orientation, as well as for 2) documenting the current camera position and setup.

The stereo base/camera separation as well as the focal distance to zero parallax can be computed. For this purpose, a number of smart phone sensors are used, combined with a compass-based app and a Google® Maps-based distance measurement. Three application cases are discussed, showing screenshots of the app as well as the resulting red/cyan stereo photographs.

Material & Methods

Photo Gear

The project started with a heirloom, a single functional SLR camera, the Minolta Dynax 7000i [4]. When this camera was rolled-out in 1988, it was a semi-professional camera. It was an interesting hybrid between an analogue camera which provided already a number of digital developments. Many settings – such as aperture and shutter speed – can be manually configured. But it was also possible to use the expansion card system to use pre-configured settings, e.g. for portrait mode (this functionality is not used for this project).

After the idea emerged to create a stereoscopic camera setup, the existing setup was doubled. The final setup consisted of [5]:

- camera bodies: 2X Minolta Dynax 7000i
- object lenses: 2X Minolta AF 35-105
- flash lights: 2X Minolta 3200i
- infrared receiver: 2X Minolta IR-1 Receiver
- infrared transmitter: 1X Minolta IR-1 Transmitter
- tripods: 2X hama Beta 51 tripods
- tripods: 1X Neewer Dual Flash Bracket [6]

Except from the Neewer Dual Flash Bracket, all parts are outdated and bought from online second-hand markets like Ebay. The camera setup is shown in Figure 1 bottom. Obvioulsy, the Dual Flash Bracket is usually intended to be used in conjunction with flash lights, it is however a very stable construction and was easily able to carry both cameras at once without showing any signs of deformation over the time.

I strongly advise to not choose this setup but to look for the setup which fits the needs of the photographer. Important here is that the cameras can be synchronized. The synchronization is here enabled by the Minolta IR-1 Receiver which can be installed on the flash mount of the camera. The synchronized release is started by using the Minolta IR-1 Transmitter which communicates via infrared with the receivers.

Two tripod setups are possible in this context: two separated tripods, where each camera is assembled on top of a tripod, or a single tripod, on top which the Neewer Dual Flash Bracket is installed which allows a maximum distance of 24 cm between the camera lenses. The last mentioned setup of course enables a much easier alignment of the camera, as the vertical axis/height is already aligned.

Figure 1. *Photo bag closed (Top) and open (Bottom).*

Methods

The two analogue cameras had to be aligned to provide Toe-in stereoscopy. For this purpose, the distance between the cameras, the distance to the object to be focused has to be provided by the user. The sensors of the smartphone are used to support the alignment process.

This idea was inspired by our previous paper “Stereoscopic Cell Visualization: From Mesoscopic to Molecular Scale” [7, 8]. In this paper, a software was optimized to update the left and right stereo perspective rendering of a virtual environment based on the measurement to the closest object in the centre of the user’s view. In this way, the stereo rendering can be optimized for close as well as far objects. In the same way, a fixed position of photo cameras does not enable the photographer to optimize the stereo effect for different distances.

The prototype of an Android App *StereoCompass* was developed which can be used in conjunction with analogue cameras to align them and set for cross-eyed stereoscopy. Details will be discussed below. Moreover, limitations of this approach – especially in terms of sensor sensibility and reliability – will be discussed.

Table 1. Comparison of Compass Apps and the introduced StereoCompass app.

Category	**compass**					**alignm.**		**magnet.**		**position**				
App	**indicator**	**degree**	**geographic direction**	**true heading**	**calibration**	**indicator**	**roll/pitch**	**indicator**	**µT**	**longitude/latitude**	**altitude**	**address**	**sunrise and sunset**	**visual quality**
Compass Calibration Tool [15]	✓	✓	✓	✓	✓	✓	✓	✗	✓	✓	✗	✓	✗	●●○
Compass 360 Pro Free [16]	✓	✓	✓	✗	✗	✓	✓	✓	✓	✗	✗	✗	✗	●●●
Just a Compass [17]	✓	✓	✓	✓	✓	✗	✗	✓	✓	✓	✓	✓	✓	●●○
AX Lab's Material Compass [18]	✓	✓	✗	✗	✓	✗	✓	✗	✗	✓	✗	✗	✗	●○○
GSnathan's Material Compass [19]	✓	✓	✓	✗	✓	✗	✗	✗	✗	✓	✗	✗	✗	●○○
StereoCompass	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✗	✗	●●○

Related Projects

Stereoscopic Smartphone Apps

There are a few apps for stereoscopic photography with smartphones on the market which are focusing on using the smartphone as a stereo camera. Here a selection of mostly iOS apps will be discussed: *Film3D* is an app which can be used to take sequential images around a focal point [9]. *DazzCam* takes a single picture and uses AI-based methods to generate the 3D image, of course not always with optimal results [10]. *Parallax* combines the functionalities of the previous two apps and also enables the user to import external images which were not taken with the app [11]. *Prequel* is an aesthetic photo editor which offers many additional functionalities, 3D photos are just one option of many [12]. Similar, *Focos* provides many additional functionalities, among which is also the generation of 3D images [13]. These apps mostly provide a wiggle mode to show the stereoscopic effect and usually also enable to combine more than two perspectives. But probably the most professional app focusing on stereoscopic image generation is *3D Stereoid* developed by Masuji Suto, which enables stereoscopic photos with nearly every smartphone by sequential alignment of the two side-by-side perspectives [14]. By using a horizontal line as an indicator, two photos can be sequentially aligned using the smartphone's gyroscope sensor. It provides a number of options for viewing images, like wiggle mode, anaglyph stereoscopy, or cross-eyed viewing.

All these apps are optimized for smartphone photography and cannot be used to take professional images, as the second image – or even more additional images – have to be taken with delay.

The app proposed app here is intended to use the two previously introduced SLR cameras. To the best of my knowledge, there is no app available at the moment which provides the combination of different features discussed here.

Compass Smartphone Apps

Before we look into the StereoCompass app development, we first want to elaborate a number of compass apps for the smartphone. The reason is that the alignment and rotation related sensors of the smartphone – i.e., gyroscope, compass, gravity – should be used to compute the geographic orientation and alignment of the smartphone.

For this purpose, we first elaborated a number of commercial as well as free compass apps: Table 1 discusses a number of compass apps which were tested prior to the development of the StereoCompass. We are focusing here on freely available apps. Some of those apps provide extra functionalities which can be purchased - we are not taking these features into account here.

Five compass apps were compared. The result can be seen in Table 1: *Compass Calibration Tool* (com.appire.compasscalibration) [15], *Compass 360 Pro Free* (com.pro.app.compass) [16], *Just a Compass* (net.androgames.compass) [17], *AX Lab's Material Compass* (compass.it.dm.compass.free) [18], and *GSnathan's Material Compass* (com.gsnathan.compass) [19].

Based on the selected features, the Just a Compass app provides the largest number of features, whereas GSnathan's Material Compass shows the most-limited functionality.

The table shows also, which features were finally implemented into the StereoCompass app:

- compass: indicator
- compass: degree
- compass: geographic direction
- compass: true heading
- compass: calibration
- alignment: indicator
- alignment: roll/pitch
- magnetic field: indicator
- magnetic field: µT
- position: longitude/latitude

The StereoCompass app is based on the Open Source project from GSnathan's Material Compass [19]. As Table 1 shows that many required features were missing, they had to be implemented, drawing inspiration from the other apps discussed here.

Another app which was relevant for the development of the StereoCompass was the *Maps Measure* app (de.j4velin.mapsmeasure) [20]. It provides a Google® Maps integration which enables users to measure the distance between different points. Moreover, it provides elevation and area computations and a number of other features. For the StereoCompass, only the distance measurement between two points was relevant.

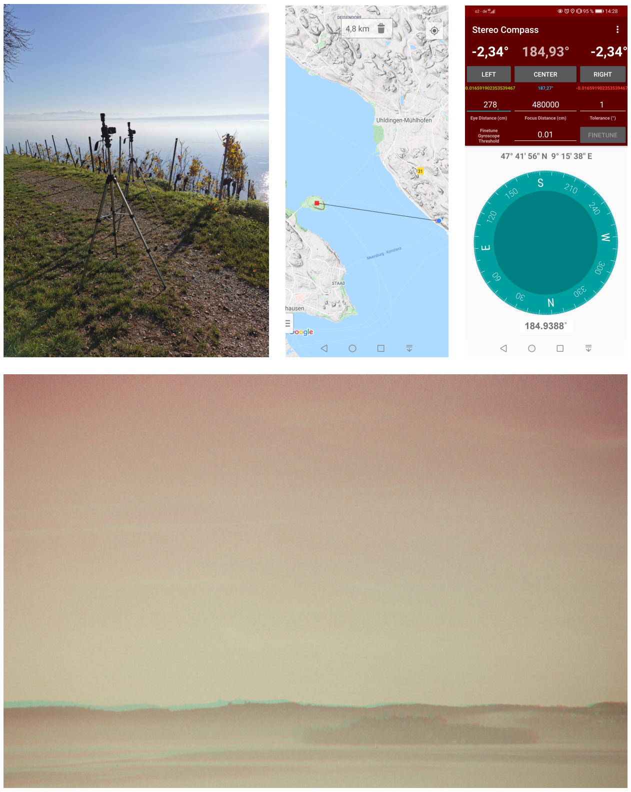

Figure 2. *The Mainau: top-left: camera setup with double tripod; top-center: Maps Measure app to measure the distance; top-right: StereoCompass v. 0.9; bottom: photo in red/cyan anaglyph*

Figure 3. *The Meersburg: top-left: camera setup with single tripod and dual flash bracket; top-center: Google Maps distance measurement in – top-right: StereoCompass v. 1.0; bottom: photo in red/cyan anaglyph*

Therefore, Google Maps was integrated into the StereoCompass app, and the user can measure the distance between two or more locations.

Table 1 shows also the feature "calibration". However, nearly all apps provide only a very basic description of how to do the calibration. To improve the calibration process, a dedicated calibration app was used, the *Accelerometer Calibration Free* app (redpi.apps.accelerometercalibrationfree) [21]. This calibration tool was usually used a single time before a new measurement/photo session was started.

StereoCompass – The App

Implementation Details

The StereoCompass was developed based on the Material Compass implementation from Gokul Swaminathan (GSnathan) in 2018. It is available Open Source on MIT License. The Material Compass app integrates code from various other contributors. For details and the source code, please check GitHub at:

`https://github.com/JavaCafe01/MaterialCompass`

During the development of the StereoCompass, the following extensions were made:

The precision of the compass was improved: whereas the original app only showed the rounded compass degree, the app works with a precision of up to four decimal places (the main view shows two decimal places).

A *Finetune* mode was added which activates averaging over the last 20 measurements to avoid too strong fluctuations during degree measurements. In this context, a *Finetune Gyroscope Threshold* can be defined which is used to avoid that the degree value is changed due to minor fluctuations below this threshold.

Another feature is the visualization of the slope in the center of the compass to level the smartphone out.

Magnetic Field measurement was added to detect interference with, e.g., electronic parts of the SLR camera.

The app was developed with Android Studio 4.1.1 on macOS 10.14.6. It was compiled against API 29 Android 10 and run on a Huawai P30 Pro (OS version: EMUI 10.1.0.171).

Software-wise, the following sensor variables were taken into account during the computation: *Sensor.TYPE_ACCELEROMETER*, *Sensor.TYPE_MAGNETIC_FIELD*, *Sensor.TYPE_GYROSCOPE*, and *Sensor.TYPE_ROTATION_VECTOR*.

Workflow

Figures 2, 3, and 4 show the camera setup and the app settings.

1. The initial cameras have to be setup correctly. If both cameras are not on the same Dual Flash Bracket and located on two different tripods, it has to be made sure that they are aligned correctly. The height should be correct and they should be in parallel position to each other. For finetuning the rotation of the cameras, the app will be used.
2. After opening the app on the smartphone, the eye/camera distance has to be defined, which is measured between both

lenses of the camera. This can be done e.g. with a tape measure.

3. Then, the focus distance has to be set. If the distance to the object in focus is very close, this can be done with a tape measure as well. But as it will be usually more far away, the StereoCompass app provides a *Distance Map*:

    - The map provides at the moment four different views: Standard, Hybrid, Satellite and Terrain. Usually, the terrain should be used, as it contains relevant information to locate the camera and objects to be focused.
    - After opening the map, the view has to be zoomed in or out to the corresponding location, and by pressing a location for a short time, the starting is point is set which should correspond to the position of the camera.
    - Then the second location has to be set. By clicking on the last marker, the overall distance is shown.
    - After returning to the main app, the measurement is directly transferred to the focus distance.

4. Now, the *Center* has to be set. If the bracket is used, the smartphone has to be moved to the centre of the bracket and the button *Centre* has to be pressed. For this purpose, the top of the smartphone has to be put against the back of the bracket. The slope indicator shows if the smartphone is in balance. After the button *Centre* was pressed, the compass direction is saved and the deviations for the left and right camera are computed.
5. The smartphone is moved to the left photo camera and physically aligned to the back of the camera. For this purpose, the top of the smartphone has to be put onto the back of the SLR camera body in a 90° angle. It has to be made sure that there is no magnetic interference, e.g. by touching electrical parts. For this purpose, the app shows the magnetic field and provides a visual warning if the value is problematic.
6. Then, the left camera is aligned based on the computed deviation degree. By clicking *Left*, the achieved value is saved.
7. The same two steps (Step 5 and 6) have to be repeated for the right camera.
8. Now, both cameras are aligned and can be triggered. In our case, the infrared transmitter is used to synchronize the release.
9. For documentation purposes, a screenshot can be made. The StereoCompass was designed so that all relevant values are visible on the main window, incl. the longitude/latitude.

During the alignment of the left and right camera, it often makes sense to switch to *Finetune* mode. In normal mode, the compass often shows strong fluctuations as the precision of the StereoCompass is quite high, as it operates with two decimal places (main indicators) and four decimal places (small number at the bottom), respectively. In Finetune mode, only changes larger than the *Finetune Gyroscope Threshold* will be taken into account (default value: 0.1) while averaging over the last 20 measurements.

Three Examples

Figure 2 shows a photo taken from the island of Mainau from the opposing shore. As the distance from the local point to the

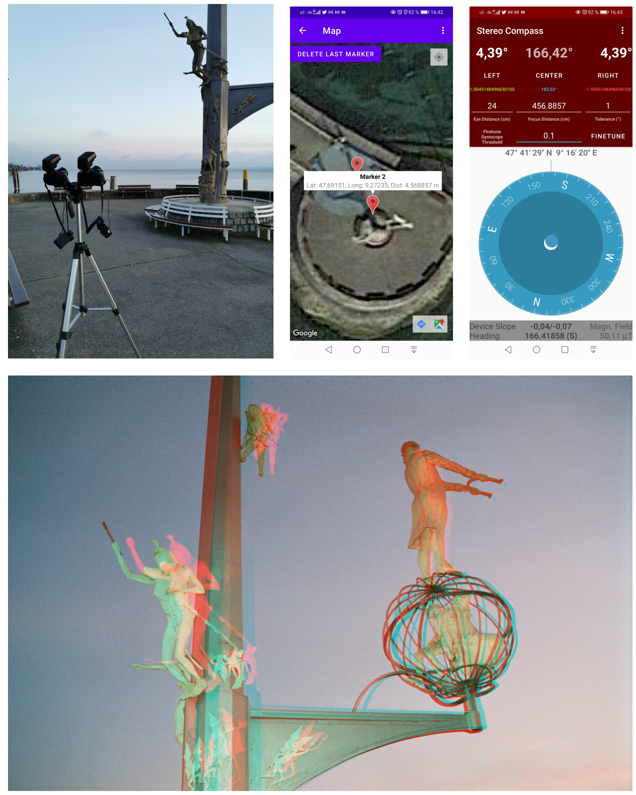

Figure 4. *The Magic Column of Peter Lenk in Meersburg: top-left: camera plus flash setup with single tripod and dual flash bracket; top-center: Google Maps distance measurement in – top-right: StereoCompass v. 1.0; bottom: photo in red/cyan anaglyph*

island was 4.8 km, the two SLR cameras were mounted on two different tripods. The screenshot shows the StereoCompass version 0.9 which did not provide an integrated map measurement. The object-camera distance was here still measured with the third-party Maps Measure app mentioned above. The distance between both camera lenses was 2.78 m. Obviously, the computed compass direction deviation is extremely low with +0.016° for the left camera and -0.016° for the right camera. The approach chosen for these far distances is to use the viewfinder of the two cameras.

A specific point is selected in the distance and focused by both viewfinders. Obviously, in these cases the StereoCompass will not strongly contribute to the physical alignment of the camera, but it can be used to plan and document the final camera alignment.

Figure 3 shows an image of the castle Meersburg. This time, a single tripod was used with the dual flash bracket. The maximum distance of 24 cm was set between both cameras. Using the integrated distance map of StereoCompass version 1.0, a distance of 132 m between the castle and the cameras was computed. The computed compass direction deviation is extremely low with +0.05° for the left camera and -0.05° for the right camera. The cameras were aligned using the previously-mentioned approach.

Figure 4 shows the Magic Column of Peter Lenk located close to the harbour of the city Meersburg. Again, a single tripod and dual flash bracket was used. In addition, two flashlights Minolta 3200i were mounted on top of the cameras and the receivers were attached to the camera strap. The distance between the camera and the column was 4.56 m, whereas the inter-lens distance was again 24 cm. The computed compass deviation was +1.5° for the left, and -1.5° for the right camera, respectively. The smartphone with the StereoCompass app can be physically aligned – using the previously-mentioned method – to the camera to optimize the orientation.

Discussion and Outlook

The StereoCompass app was initially developed with the idea in mind to enable the alignment of two SLR cameras to optimize the stereo effect by computing the compass direction deviation based on 1) the initial compass degree of the center point between both cameras, 2) the camera inter-lens distance, and 3) the focus distance between the camera center point and the object in focus.

Figure 2 showed an example where the computed value is very low and the fluctuations of the StereoCompass are actually larger than the compass direction deviation. In these cases, the StereoCompass still provides an appropriate tool to document the stereo composition of the taken scene as well as to plan the scene beforehand. For the alignment of the camera lenses below a computed compass deviation of +/-1.5° it is however recommended to use the viewfinders of both cameras and focus the same point of interest. This method turned out to work very reliable.

Figure 4 shows an example were it is possible to physically align the cameras using the smartphone.

On the other hand, the StereoCompass app helps the user to plan a camera setup and decide, where to place the cameras beforehand from home.

Another interesting future application case would be, based on the setup discussed in Figure 2, to place the cameras far apart to improve the stereo perception of a very distant object. For this purpose, the altitude has to be taken into account, to allow the alignment along the vertical axis also over longer distances, e.g., if the cameras are 10 m apart from each other. As Table 1 shows, the altitude is not implemented into the StereoCompass by now. This could be a future feature.

Although we were using here analogue photography, the same app could also be used in conjunction with digital cameras. The most important aspect if used for semi-professional stereo photography is that both cameras have to be synchronized. So if looking for camera gear, a camera type should be chosen which is supporting the synchronization.

Another interesting minor app feature might be to integrate measurement between two distant points, such as the distance between the two cameras. The inter-lens measurements in the current photo sessions were all performed using a simple tape measure.

Figures 5 to 6 show all photos discussed here in larger format, as well as one extra photo from the Munster in Konstanz.

Beyond stereo photography, the StereoCompass approach might be interesting in the context of *Immersive Design Engineering*-related software applications, as it might be an interesting approach to improve the stereoscopic vision in virtual environments [22, 23].

More information and the app can be found at:

`http://stereocompass.i2d.uk`

References

[1] LG Optimus 3D Launch, https://www.oneindia.com/2011/02/13/tech-lg-optimus-3d-launch-specs-price-review-aid0102.html. (last accessed on 2021-05-20).

[2] 3D TV is dead - The Independent (2017), https://www.independent.co.uk/life-style/gadgets-and-tech/news/3d-tv-dead-last-manufacturers-lg-sony-give-up-tech-trend-glasses-home-cinema-television-a7546091.html. (last accessed on 2020-08-09).

[3] ROKiT 3D Phone, https://rokitphones.com/us/phones/iopro3d/. (last accessed on 2021-05-20).

[4] Minolta 7000i - Wikipedia.org, https://en.wikipedia.org/w/index.php?title=Minolta_7000i&oldid=845817024. (last accessed on 2021-05-20).

[5] Minolta A-mount system - Wikipedia.org, https://en.wikipedia.org/w/index.php?title=Minolta_A-mount_system&oldid=1020316153. (last accessed on 2021-05-20).

[6] Neewer 11 inches/27.5 centimeters Dual Flash Bracket Tripod Mount for 1/4-inch Screw Camera Studio Video Light Stand External Flash Speedlite, https://support.neewer.com/product/neewer-11-inches-27-5-centimeters-dual-flash-bracket-tripod-mount-for-1-4-inch-screw-camera-studio-video-light-stand-external-flash-speedlite-hot-shoe-socket-not-included/. (last accessed on 2021-05-21).

[7] B. Sommer, C. Bender, T. Hoppe, C. Gamroth, L. Jelonek, Stereoscopic cell visualization: From mesoscopic to molecular scale, Journal of Electronic Imaging, 23(1), pp. 011007 (2014).

[8] B. Sommer, A. Hamacher, O. Kaluza, T. Czauderna, M. Klapperstück, N. Biere, M. Civico, B. Thomas, D. G. Barnes, and F. Schreiber. Stereoscopic Space Map – Semi-immersive Configuration of 3D-stereoscopic Tours in Multi-display Environments. Electronic Imaging, Proceedings of Stereoscopic Displays and Applications XXVII, 2016(5), pp. 1—9 (2016).

[9] FILM3D - Capture life's memories in 3D (iOS), https://apple.co/2qzsZlJ. (last accessed on 2021-05-20).

[10] Dazz Cam - Vintage Camera: Photo filters & Video effects (iOS), https://apple.co/3fZCDCV. (last accessed on 2021-05-20).

[11] Parallax: 3D Photo Editor - Aesthetic Effects & Animator (iOS), https://apple.co/3cZVDzs. (last accessed on 2021-05-20).

[12] PREQUEL: Aesthetic Editor - Photo Filters & Video Effects (iOS and Android), https://apple.co/2X7QIWm https://bit.ly/2ycUaq8. (last accessed on 2021-05-20).

[13] Focos - DSLR & Bokeh & Large Aperture(iOS), https://apps.apple.com/us/app/focos/id1274938524. (last accessed on 2021-05-20).

[14] 3DSteroid - Apps on Google Play, https://play.google.com/store/apps/details?id=jp.suto.stereoroid. (last accessed on 2021-05-20).

[15] Compass Calibration Tool – Apps on Google Play, https://play.google.com/store/apps/details?id=com.appire.compasscalibration. (last accessed on 2021-05-19).

[16] Compass 360 Pro Free - Apps on Google Play, https://play.google.com/store/apps/details?id=com.pro.app.compass. (last accessed on 2021-05-19).

[17] Just a Compass (Free & No Ads) - Apps on Google Play, https://play.google.com/store/apps/details?id=net.androgames.compass. (last accessed on 2021-05-19).

[18] Material Compass – Apps on Google Play, https://play.google.com/store/apps/details?id=compass.

it.dm.compass.free. (last accessed on 2021-05-19).

[19] Material Compass – Apps on Google Play, https://play.google.com/store/apps/details?id=com.gsnathan.compass. (last accessed on 2021-05-19).

[20] Maps Measure – Apps bei Google Play, https://play.google.com/store/apps/details?id=de.j4velin.mapsmeasure. (last accessed on 2021-05-19).

[21] Accelerometer Calibration Free - Apps on Google Play, https://play.google.com/store/apps/details?id=redpi.apps.accelerometercalibrationfree. (last accessed on 2021-05-19).

[22] M. Scalabrin, L. A. Ripamonti, D. Maggiorini, D. Gadia. Stereoscopy-based procedural generation of virtual environments. Electronic Imaging 2016(5), pp. 1-7 (2016).

[23] B. Sommer, C. H. Lee, M. Nat, V. S. Torrisi. Immersive Design Engineering. Electronic Imaging 2020(2) - Proceedings of Stereoscopic Displays and Applications XXXI, pp. 265-1-265-16 (2020).

Figure 5. *The photos discussed in this article in larger scale and red/cyan anaglyph stereo format: Top: The Mainau; Bottom: The Meersburg*

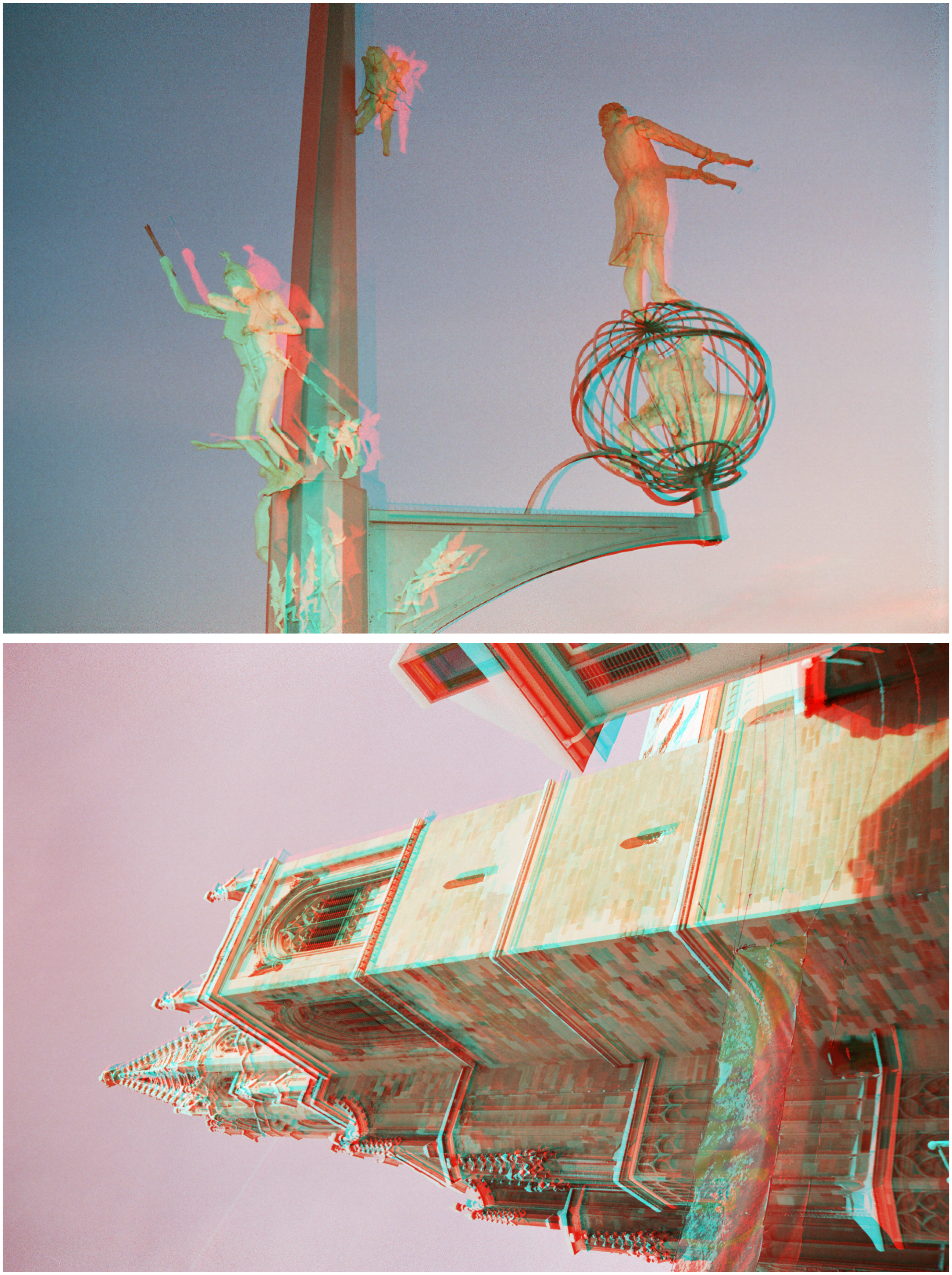

Figure 6. *The photos discussed in this article in larger scale and red/cyan anaglyph stereo format: Top: Magic Column; Bottom: The Munster in Konstanz*