



Mosaicing Multi-spectral Images of Heritage Paintings

Project Management and Software Development
for Medical Applications

General Info

Project Title Mosaicing Multi-spectral Images of Heritage Paintings

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Project Abstract

In this master thesis we propose using multispectral imaging as an aid to the restoration process of heritage paintings and also to help peel back centuries of de-coloration and layered impurities. To ensure that small enough details can be recovered, mosaicking will be employed to reconstruct a very high resolution image of the artworks in question.

Background and Motivation

Modern imaging methods like fluorescence x-ray imaging and multispectral imaging have been a great aid in this effort. The latter is a non-destructive technique that has been growing in the last years for painting investigation. Providing spectral and colorimetric characterization of the whole painted surface, it is suitable to document the conservation state of an artwork.

Filter-Wheel Multispectral Cameras

Filter-wheel multispectral cameras have a mechanically operated circular gantry (filter-wheel), holding several narrow band-pass filters. The motor rotates the filter wheel in order to select only a narrow band of the spectrum. Images are taken

with each filter separately, and fused together in post-processing.

However, due to the high sensitivity over a broader spectrum, the resolution of the sensor is considerably lower than that of a color digital camera in the same price range. Image mosaicing is a practical approach to solve this.

Image Mosaicing

Is a process that stitches multiple, overlapping images together in order to produce one large, high resolution composite.

Applying image mosaicing to multispectral imaging would produce very high resolution multispectral images of these artworks. Furthermore such a technique could facilitate higher image resolutions at the cost of an increased acquisition time.

Students Tasks Description

In short, the students task is to prepare a documented software package that produces high resolution mosaic images of paintings (assuming these are flat) using a multispectral camera.

The project will be split into following packages: acquisition, registration, stitching and post-processing and presentation. These work-packages will have some overlap as to offer the student time to assess the feasibility of each task, even before she/he focuses completely on it.

Acquisition

The acquisition package will task the student to acquire images of the artwork in question, while

covering its entire surface.

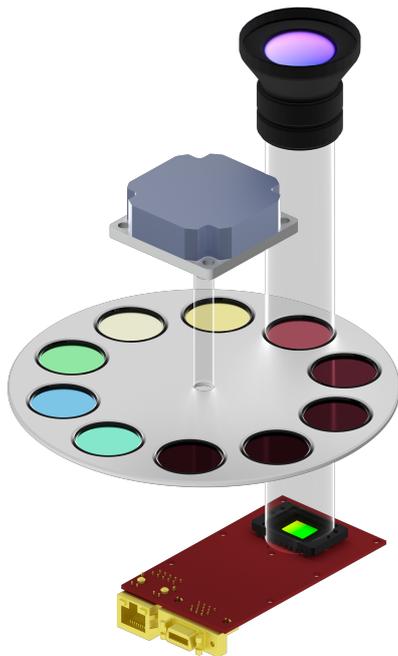


Figure 1: **Filter Wheel Multispectral Camera:** (top to bottom) lens, filter-wheel motor, filter-wheel with 10 filters and camera board with sensor.

Camera: as working with a multi-spectral camera is not as straight forward as working with a consumer digital camera, the student will start with the latter and incrementally integrate the former into his pipeline.

Registration

The registration package will involve calibrating the camera parameters and registering the views to each other. The students first task is to find out if the stitching package' automatic registration is sufficiently robust or if an additional calibration step is required.

If the separate extrinsic calibration is required, then the student will be instructed in the use of a standard camera calibration toolbox.

Stitching

The stitching package will involve the student integrating stitching software into the pipeline. Upon completion of this package the student should already be able to produce high resolution mosaic images of the artwork.

The Hugin Panorama Stitcher software package will be the initial choice for performing most if not all stitching tasks. Unlike its name implies,

Hugin is also designed to create a high resolution mosaic of a flat surface as well as panorama images.

Post-Processing and Presentation

In the final package, the student should correct the rotation and possible projection of the outputted image.

The post-processing and presentation package should teach the student the importance of presenting the results of her/his work in such a form that it can be used to others that want to use or continue her/his work.

Technical Prerequisites

The student should have basic knowledge on computer vision, camera models and registration.

Programming Languages: C++, Java and/or Matlab

Administrative Info

Working Time 10 hours per week for between 14 and 16 weeks.

Project Location AR Lab at the CAMP chair in Garching

Required Equipment

- Canon 600D DSLR Camera
- Document Photography Rig
- Desktop or portable computer with a minimum of 4 GB of RAM

Timeline and Milestones

- **Familiarize with the state-of-the art:**
duration: 2 weeks
- **RGB Mosaicing:**
duration: 2 weeks
- **Multispectral Acquisition:**
duration: 4 weeks
- **Multispectral Stitching:**
duration: 4 weeks
- **Documentation and Report:**
duration: 2-4 weeks weeks