

CSC400 ITRG Miniproposal

Image Reconstruction for Multi-camera System

Haitian Zheng

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1 INTRODUCTION

The multi-camera system uses multiple small aperture, portable and low-price cameras to capture multiple images from different viewpoints. Using the complementary informations exhibit among the captured images, a well-designed image processing algorithm can reconstruct a high-definition image by fusing information from different cameras. Comparing with traditional imaging devices which typically use a single, large aperture camera, the multi-camera system can achieves comparable/better image quality with sacrificing good traits such as portable, easy-to-install and economical. Because of that, multi-camera system becomes increasingly popular for many industrial-level product, including AR/VR devices, smart phone, and surveillance system. Designing better reconstruction algorithm for the multi-camera system can, therefore, impact the imaging industry by further improving imaging performance or by further reducing the space/hardware/budget needed for such systems.

2 PROBLEM STATEMENT

We consider the problem of constructing an high-definition image using a set of images captured by the multiple cameras. There exhibits two general challenges for this problem: First, since the input images are captured at different viewpoints, viewpoint disparity will lead to the missing of correspondence (also known as occlusion), which cause difficulties for cross-camera information fusion and image reconstruction. Second, the multi-cameras are usually of different configurations to provide complementary information. Therefore, the formats of image can be vastly different. For instance, images can be of RGB or greyscale, high-resolution or low-resolution. Different in-chip decoding algorithm may also cause chromatic aberration among images.

Overall, to improve the image reconstruction quality, two problems need to be addressed:

1. How to handle occlusion caused viewpoint disparity?
2. How to process image with formats discrepancies, including RGB/greyscale, high/low-resolution, color mode differences.

3 OBJECTIVES

The long-term goal of this research is to provide robust and practical on-chip algorithm for multi-camera system including smart-phone camera. Specifically, the study has the following sub-tasks:

1. Collecting multi-camera system datasets that well-generalize the real world scenario;
2. Designing new algorithm to improve the reconstruction quality of state-of-the-art results;
3. Designing on-chip algorithm that accelerates the efficiency of our algorithm.

We believe our long-term research will boost the understanding of image-restoration techniques for multi-camera system, and will make impact to the imaging industry.

4 METHODOLOGY

This research will first collect realistic imaging samples from a self-built multi-camera system. Next, the current state-of-the-art method including [1, 2, 3] will be reviewed. We intend to analyze the pros and cons of different approaches that are

taken. This research will focus on a data-driven approach called deep learning, since deep learning approaches are good at inferring missing information and fuse data of different kinds. To handle missing correspondence and occlusion, we will investigate research in finding robust visual correspondence, to handle different types of image formats, we will investigate image fusion/registration approaches.

REFERENCES

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