

High resolution imaging: Capture, storage and access

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INTRODUCTION

Photographic images are a key asset in many areas of research and resolution is often a limiting factor to their research and archive value. In cases where higher resolution is necessary one quickly realizes that it is not possible to simply purchase a camera with an arbitrarily high resolution sensor. One solution to acquiring higher resolution images is to take a number of photographs and, using a range of algorithms in computer graphics and machine vision, combine those photographs into a single high resolution composite image. The process is scalable, the higher the resolution required the more photographs need to be taken. Such images have the advantage of capturing/recording in a single image the detail (zoomed in) as well as the context (zoomed out) of an object or place.

The software solutions are still maturing but they involve such algorithms as feature point detection [1] to find corresponding points between image pairs, image warping to correct for perspective [2] and other parameters that may differ between the images, and finally edge blending to hopefully seamlessly stitch the individual photographs together. These techniques have already been employed across a range of diverse disciplines including astronomy (for example, deep field images from the Hubble Space telescope), aerial mapping in geography, imaging in archaeological recording and optical microscopy. In recent times the hardware and software solutions have made the capture of such images more accessible to non-experts with non-specialist hardware. Higher resolution camera sensors have also made it easier to achieve even higher resolution compositions. As such these often very large image files are becoming more commonplace which is raising questions on how they are best stored and accessed. For example, it is often no longer possible to load a single image into memory and even many of the prevalent image file formats cannot store such large images.



Figure 1. Gigapixel image of Beacon Island, the entire island captured from multiple view points forming a rich representation of the island at a particular date/time. In collaboration with WA Maritime Museum and Archaeology UWA.

IMAGE TYPES

There are a number of image types and projections that can result from this high resolution photographic acquisition, the following will be presented and discussed:

- Panoramic imaging [3], often full 360 degrees horizontally and with a variable vertical field of view that may range from a few degrees to the full 180 degrees. See figure 1.
- Rectangular field of view imaging, also often referred to as gigapixel [4] photography.
- Image mosaicing [5]. This includes the more challenging cases where the camera may not be in a single fixed position.
- Planar rectilinear scan [6] photography of essentially 2 dimensional objects. See figure 2.

Various methodologies and practice from the author and collaborators experience will be presented. These will include practical examples from projects coordinated through iVEC at The University of Western Australia in marine archaeology, geology, heritage site capture and rock art. Best practice on how to capture the individual photographs will be described along with challenges and relative merits of the different approaches.

CHALLENGES

There are a number of challenges that arise when dealing with the resulting high resolution images. These include

- The format by which such images are stored and/or archived. Many popular image file formats place limits on the maximum number of horizontal or vertical pixels. The uncertainty around some of the specialised and/or proprietary image formats raises questions of future support.
- Accessing and exploring these images require techniques not generally supported by databases, simple image software or online image viewers. The images cannot in general be loaded into memory and usually need to be viewed using hierarchical variable resolution techniques [7].
- Interacting and studying these images can benefit from high resolution graphical displays that can leverage the human visual system as well as requiring specific software and data structures to present the images at interactive rates. The displays include recent 4K single panels or projector based displays as well as tiled arrangements.
- Given the success of capturing valuable research images using these techniques, the question arises as to whether they can be applied to the combining of photographs of a historic nature that were captured without this process in mind.

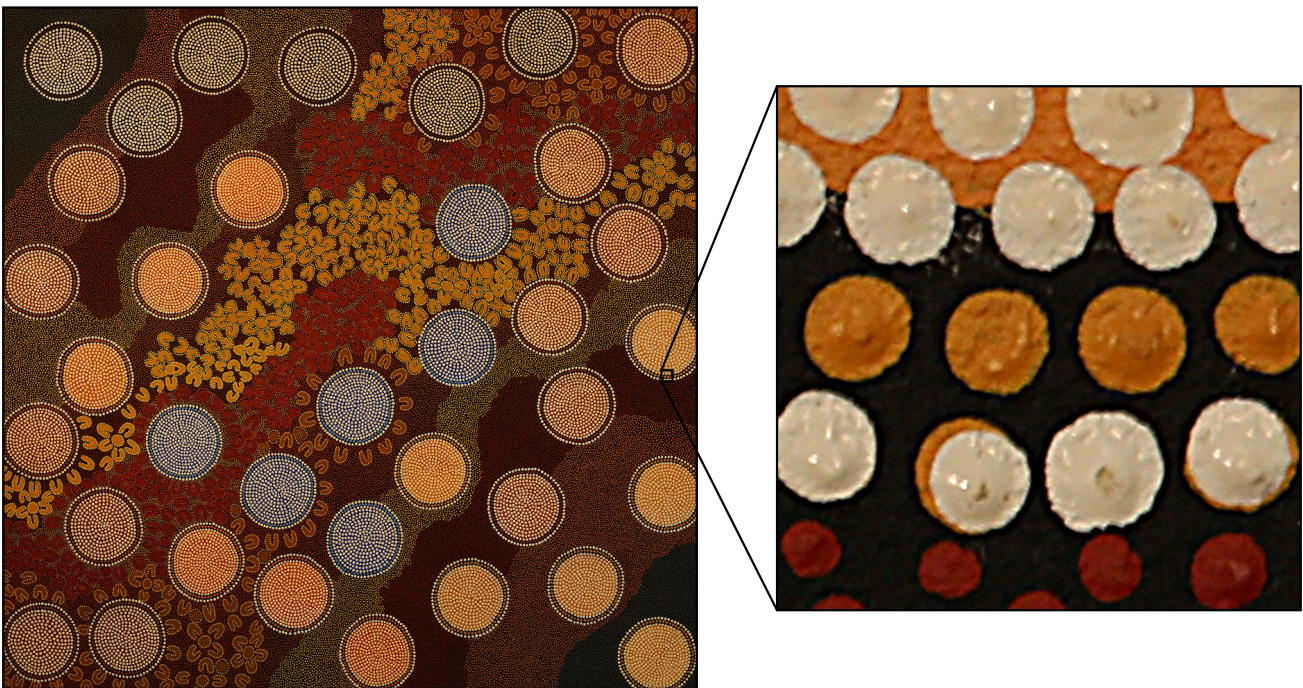


Figure 2. Indigenous dot painting photographed at 1GPixel. Features are readily detected that cannot be observed/noticed in the 1-to-1 original, for example the repainting of some of the dots shown above. Margaret Whitehurst "SKA Satellites in the Murchison".

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ABOUT THE AUTHOR

Paul Bourke, Director of the iVEC facility located at The University of Western Australia (UWA), and Visualisation Researcher at the University, provides scientific visualisation services to researchers within the University and to the other iVEC partners. Throughout his career, at various organisations, he concentrated on architectural, brain/medical, and astronomy visualisation. Of particular interest are novel data capture and display technologies and how they may be used to facilitate insight in scientific research, increase engagement for public outreach and education, create immersive environments, and enhance digital entertainment.

The iVEC facility located at the University of Western Australia. The facility hosts supercomputing resources on the campus and acts as an interface to the other supercomputing and data capabilities provided by iVEC. The facility also hosts display systems in support of visualisation, conferencing system, high end workstations and a video production unit.