# Non-Bias Scientific Imaging Archive for Urban Morphology Research

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**Abstract**

The paper discusses about non-bias scientific imaging archive for urban morphology research. Urban morphology studies the process and relative elements of urban development. Urban morphology research carries the sense of time from the past, current and the future of urban development. Imagery archive related to the scope of urban development studies is needed as scientific proof of record. Recording in the form of image can be one of the most comprehensive formats for urban morphology research.

Non-bias scientific imaging archive is also crucial for other social science industries. The industries that involve scientific imaging approaches are the industry of architectural and built environment, archaeology and geographical applications, engineering and mechanical, space and astronomy exploration, news and reportage industry, medical applications, military intelligence. The observation attempts to find out if the need of non-bias scientific imaging is one of the influential factors during decision making in precision based activities.

## 1. Introduction

Multimedia is any combinations of text, sound, image, video and animation (Mcgloughlin, 2001). Image takes a major role in the area of multimedia including video as motion-image and animated image subjects. Imaging content serves the two main purposes of aesthetic and information recording. Recording image information can be one of the most used methods in scientific applications. Images can be recorded using variety of methods, however sometimes recorded information can be biased. A recorded but biased image cannot be treated as useful technical reference, due to its characteristic of lacking reliable imagery information. To acquire non-bias imagery content, it takes higher challenges in various scientific and research approaches. The paper discusses the potential interest in the scientific imaging approaches, where non-bias imagery content will be treated as a reliable technical source of reference.

Planning process can be enhanced by using multimedia database system (Angelides et al, 2000) for build industry, when visual or image reference is one of the practical information for assessment. During the process of project planning, project requirement including image-visual content is normally given by the project owner as it must be able to trace the original requirements back to the source of that requirement (Brouse et al, 1992), this is to enable the involved project engineers or architects to work on the requirement given to the project accurately. Being able to trace the original source of requirement becomes a fundamental need of development planning in the build industry and as well as multidisciplinary areas of field and industry.

## 2. Background

Imagery content used in scientific imaging approaches are images that provides reliable imagery information to whom the imagery content may be needed in their related field of work or industry. Obtaining reliable imagery content in different field of work and industry may have different challenges, in term of technical and expectation. Imagery information is then being presented in various user interfaces according to need. The analogue film image recording method exhibits limited amount of imagery information due to the limitation of resolution and dynamic range. The digital RAW (Adobe, 2004) format on digital camera equipments offers greater possibilities for recollection of imagery information, having the option of using different types of post-processing method on a same source of image RAW file. Adobe (2004) introduced Digital Negative DNG specifications in 2004 allowing digital RAW image files to suggest further possibility to extract imagery information when future image post-processing technology is available. The situation of biased imagery content being recorded occurs easily due to the lack of knowledge and technique during the acquisition

process. The difficulties are including equipments, operational skills, technology and other external non-knowledge based factor. The environment obstacles to arrange the image archiving setup are including the difficulty of access and the uncertainty of geographical climatic condition, such example includes the limited available space inside an archaeology chamber, underwater shipwreck, and parallax error in aerial imaging.

For architectural and built environment, conventional photographic image archives are mostly limited to single angle. It enables the visualization for completed architectural project, and serves the purpose of reporting and documentation. It is arguable that the conventional single-perspective photo imaging can serve the purpose of the "aesthetic view" instead of "non-bias record". A landscape analysis using digital imagery demands highly accurate geometric registration of image (Campbell, 1996; Lillesand and Kiefer, 2000). Non-bias or less-bias image archive of architectural and built environment subjects can be treated as reliable references in the area of continuous research in urban morphology. The act of creating imagery archives of architectural and built environment subjects cannot be reversed due to time factor, as it becomes an absolute imagery record during the time of documentation. If the content archived is bias, it shall not be treated has a reliable source of reference during the historical study and future planning of urban development.

For archaeology and geographical studies, environment data including architectural, artifacts, cultural landscapes are useful references of research. To obtain the environment data, the method of data collection has to be non-bias allowing the potential future research to assess the subject accurately. Photographer Wes Skiles descended through 30 feet of the Bahamas Blue Holes during a cave-diving research operation, as a scientific activity to archive the subject and the archived imagery resources becomes the references in multidisciplinary research approaches (Andrew, 2010). Archaeology and geographical studies demand quantitative and qualitative imaging archives at the transition of time. Many historical sites are destroyed or may have received certain “act of modernization”, lacking of original non-bias imagery record suggests restoration is nearly impossible to achieve high level of originality. Restoration of ruined archaeology site may need high amount of reliable imagery reference, for planning and execution.

Satellite Imaging serves the purposes for urban morphology data analysis and interpretation (Shih, 2002), including areas of urban structural, mineralogy, agriculture, inhabitant segmentations. Hyperspectral image processing is one of the research tools of space and astronomy exploration (Plaza, 2009). The amount of quantitative imaging information captured and the position of the satellite during an archiving activity are important factors to assess the reliability of the captured content. Research suggests that a significant fraction of certain space imaging archive will be spectrally heterogeneous in urban imagery (Small, 2003). It comes to the understanding that there will be possibility of the archived space imaging data does not guarantee the accuracy of the areal fraction estimates. The camera instrument of Nikon D3 is used by NASA ISS Crew Earth Observations experiment and Image Science & Analysis Laboratory (NASA, 2010). Further research and development in the field of space and astronomy relies on the image references given the advances in image resolution increment and the improved dynamic range in camera recording technology.

News and reportage industry takes great responsibility to archive and report the news content on a non-bias based intention. Journalist photographer implements the method of interactive QuickTime Virtual Reality (QTVR) to archiving news and reportage content (Ayrton, 2011). The method of having virtual reality imaging archive approach in news and reportage industry is facing technical limitations that include blind spot, ghosting, motion duplication, and the issue of time needed to record a unit of virtual reality imaging archive. It can be an argument if the news journalism imagery content can be associated to non-bias scientific archive. The industry of news and reportage carries the role of as an assessor of content interpretation to the public.

Engineering and mechanical related industries involve precision-based activities. Mechanical upgrades in the manufacturing plant and factory are including expansion of plant area, new machine installation, machinery modifications, or upgrades of safety features. This has the similar need like the build industry to archive the process of before, during and after the mechanical progress or upgrade is performed. The image archive serves the purpose for evaluation for skate holders and engineering perspective.

In medical industry, non-bias scientific imaging mostly goes to macro observation instead of viewing large plane of imagery content. To obtain medical related imagery content, different type of approaches will be considered for the concern of safety and the level or reach to the subject. Ultrasound and MRI are some of the imaging approaches being used for medical diagnostic. Ultrasound imaging is conventionally grey-scale (Abramowicz, 1997) where imagery information leads to different opinion of the assessors. It is being used as a tool of evaluation during medical diagnostic; especially it is safe for earlier diagnostic approach.

Military photography began with the English photographer Roger Fenton on 1855, photographs was made for the Crimean War under trying circumstances. During the 19th century, aerial and reconnaissance photography became possible (John, 2007). Andy Laws a former military imaging analyst for the RAF explains how biased imagery content can affect their analysis and judgement (Mike, 2010), that lead to the successful factors of US military Operation Geronimo. There are countries that operate civil imaging satellites whose image quality is comparable to the military class, including the ability to provide imagery in near-real-time, however there are many theoretical limitation. Satellite imaging is useful for the research of urban morphology and that extends to the interest of military approaches. Satellites that could take high resolution images had to be in low orbits (300e1000 km) and thus stayed in view of a single target for only a few minutes per orbit and only a few orbits per day (Norris, 2011). Capturing civilian use imagery content for urban morphology research does have obstacles to achieve the state of non-bias, including the issue of parallax error bias and resolution details.

**Figure 1:** A construction site of high rise commercial building located near MidValley, Kuala Lumpur, Malaysia.

**Figure 2:** A construction site of fly-over ramp located near Seri Kembangan, Selangor, Malaysia.

Figure 1 and Figure 2 are examples of previous works. These digital images are conventional photography obtained using digital camera. Both images were obtained with RAW format using the equipment Kodak Pro/N at 14 megapixels, and being processed using the raw processor program available from Adobe. It was being observed that the images are unable to exhibit some parts of the imagery details at the areas of highlight clipping and shadow depth. Some of the imagery information was not being able to be recorded due to the extreme contrast ratio of lighting condition within the real-world scene. If these images were being used as research data of urban morphology, they may not be capable of recording and presenting sufficient imagery information accordingly.

## 3. Experimental using High Dynamic Range Image (HDRI) for Extended Imagery Information

This experiment is a preliminary test conducted as part of the author's postgraduate research preparation. The experiment made image samplings from two real-world scenario using the methods of conventional photograph compare to the High Dynamic Range Image (HDRI), this aims to observe imagery information being archived in term of luminance visibility. The Nikon manufactured D3X is used for the image acquisition, for both conventional photography and multiple image sequence needed for HDRI. The conventional photograph acquired does not receive any process of image manipulation. The HDRI process is accomplished by having the multiple image sequence from the similar equipment, then virtually being combined into the high dynamic range image renderings using the tone mapping post-processing method, the method being used is still being tested progressively for further optimization and effectiveness. The visual comparisons in Figure 3(a) and 3(b) observes the dynamic range details for overexposed highlight image area. The visual comparisons in Figure 4(a) and 4(b) observes the dynamic range details for underexposed shadow image area.

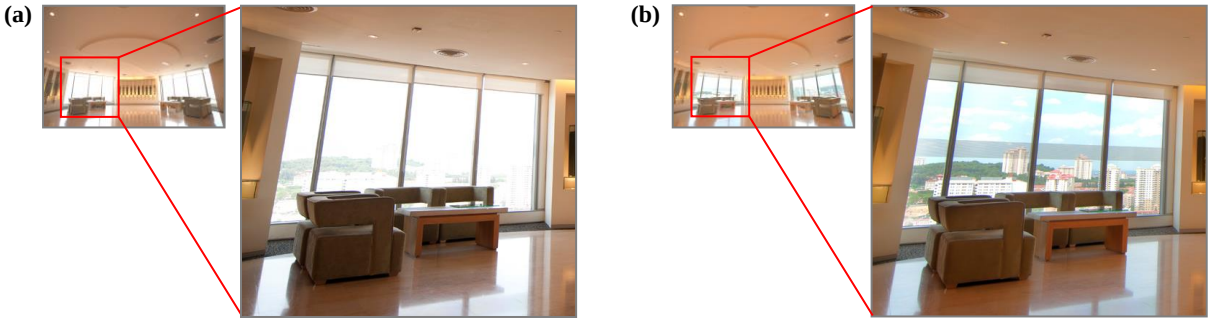


**Figure 3:** (a) Conventional Photograph Image, overexposed highlight area imagery details not being preserved. (b) HDRI, extended dynamic range of imagery details being preserved in the overexposed highlight area.

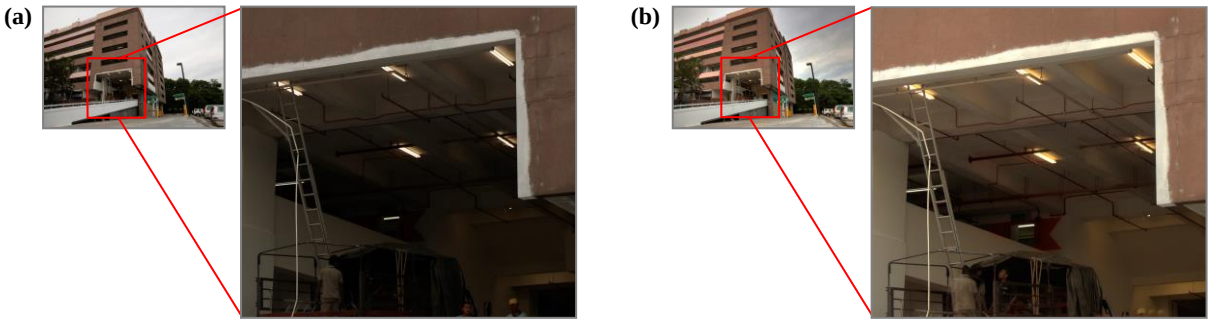


**Figure 4:** (a) Conventional Photograph Image, underexposed shadow area imagery details not being preserved. (b) HDRI, extended dynamic range of imagery details being preserved in the underexposed shadow area.

This preliminary experimental test observes the comparison of the image archive using conventional photography and the High Dynamic Range Image (HDRI) as table 1 presents, observation shows different level of photographic imagery information can be obtained when using two different imaging approaches.

Table 1: observation of experimental using HDRI for extended dynamic range imagery information

| **Conventional Photograph** | **High Dynamic Range Image** |
|---|---|
| Figure 3(a) of interior is not capable of capturing the overexposed highlight clipping imagery information. | Figure 3(b) of interior is able to capture the extended dynamic range for the area of overexposed highlight clipping imagery information. |
| Figure 4(a) of construction site, unable to capture the underexposed shadow area of dynamic range, imagery details is not clearly visible. | Figure 4(b) of construction site, underexposed shadow area of dynamic range is comparatively visible, displaying greater clarity of imagery information. |

## 4. Experimental calculation of Photogrammetric Parallax Error of Satellite Imaging Simulation

This experimental is a simulation calculation based on a projected scenario of satellite imaging. This aims to identify the presences of potential vision parallax error during a simulated satellite imaging acquisition. The figures 5(a), (b), (c) present a simulated scenario given a projected calculation to observe the angle perception from satellite imaging towards the image-recording arrangement of earth surface topography.

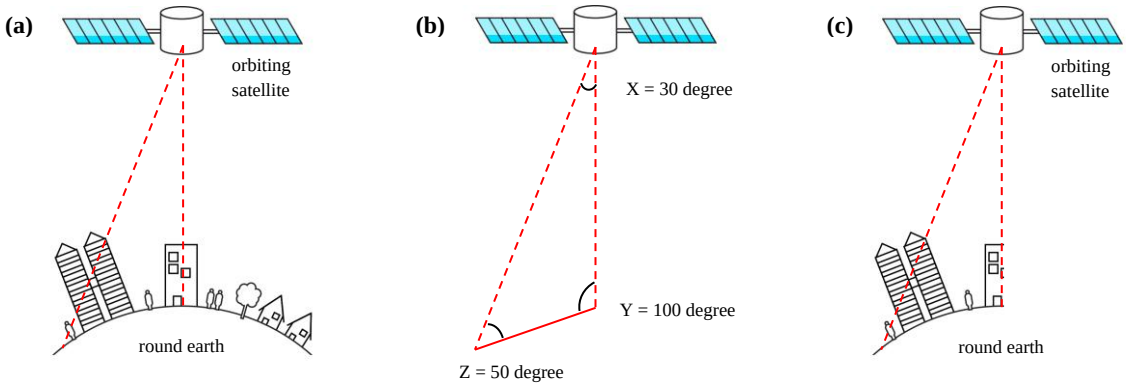


**Figure 5:** (a) Simulation, satellite imaging setup from straight top-up perspective. (b) Simulation of a projected calculation of angle perception. (c) A simulated photogrammetric parallax error of satellite photo imaging.


**Figure 6:** Singapore location, Google Earth, example of a photogrammetric parallax error of satellite imaging rendering. (accessed 16 July 2011).

This experimental calculation of photogrammetric parallax error of a satellite imaging simulation, suggests obtaining symmetrically parallel angle of topography elements (buildings, land structure, vegetation) from satellite imaging is nearly optically impossible, table 2 presents that three hypothetical factors being observed. Photogrammetric parallax error can be one of the easy detectable issues presences in the stitching process of using multiple sources of satellite images for combining into one larger scale of map image, an example of photogrammetric parallax error is being shown at Figure 6, source referenced from Google Earth.

Table 2: hypothetical factors observed during the experimental calculation of Photogrammetric Parallax Error of Satellite Imaging Simulation

| **Factor(s)** | **Hypothetical Factors Observed** |
|---|---|
| Factor 1 | Geometrically round surface of earth, resulting vision perspective is not parallel |
| Factor 2 | Camera lens perspective and angle coverage by the satellite, optically having parallax error |
| Factor 3 | Due to the nature of orbiting, the positions for both satellite and earth change continuously |

## 5. Discussion

The imagery archive of urban morphology research can be obtained from the distanced or up-closed. Manual, automatic or semi-automatic interpretation of satellite images becomes an important and complex task in computer vision for land use change detection (Saheb et al, 2008). Infrared thermal imaging technology has been used for many successful scientific approaches (Tim, 2002), a research funded by BBC where infrared images of NASA satellite which were taken by satellites orbiting 700 kilometres above the earth revealed the below-ground structures of Egyptian pyramids (Discovery News, 2011).

Archived imagery content of urban morphology can be presented in various forms of visualization interfaces, from the conventional single perspective image to virtual reality 360 degrees. Zebra Imaging first introduced the visualization possibility of holographic prints in 2007 (Zebra Imaging, 2007) on a non-digital printed interface approach, this sets higher research possibilities for the on-going advances of image visualization methods in both digital and non-digital approaches.

**Several issues and research questions are raised**

High Dynamic Range Imaging (HDRI): this method allows a greater dynamic range of increased luminance from the darkest shadow to brightest highlights in photo archives. The HDRI approach seems to be capable to record the expanded imagery information in term of luminance comparing to the default setup of the digital camera equipment being shown in the experimental. Can the extra imagery information of HDRI be treated as an improved approach towards non-bias scientific imaging compare to the conventional photograph imaging?

Photogrammetric Parallax Error: visually the angle perception of topography image from satellite (or aerial) imaging, may encounter parallax error especially when more than two satellite captured map-images containing different angles of urban structure such as buildings are being used for combining into a larger map, and this assumption was verified by the photogrammetry calculation simulation. The parallax error may also exist in the virtual reality 360 (VR360) spherical imaging, related to the author's postgraduate research. Potential study may be conducted for computing optimization or to overcome such issue.

## 6. Conclusion and Implications

The paper suggests that accurate, reliable and non-bias scientific imagery content has high influence during the analysis and decision making process of urban morphology research. Portraying, classifying and understanding the landscapes (Gospodini, 2006) of urban morphology, suggest the interpretation comes from the various sources of imagery references. Photogrammetry technique involves the measurement of projective geometry of earth surface topography, by technically and visually having assessment from two or more photographic map images obtained from satellite or areal, as it is difficult to obtain imagery archive at the state of non-bias. Advances and further research about the approaches to obtain more accurate imagery content will help to overcome the obstacles and limitations of having non-bias scientific imagery archive for urban morphology research, which sets a greater expectation to have high accuracy image archives.

The paper implies the high need of having non-bias scientific imaging achieve for urban morphology research, as the approach of non-bias scientific imaging achieve involve the process of acquiring to presenting the imagery content.

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