UNIVERSITI TEKNOLOGI MARA

# AN EVALUATION OF LOW-COST DIGITAL PHOTOGRAMMETRIC SYSTEM AND GIS FOR FLOOD MAPPING AND SIMULATION

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# ABSTRACT

Photogrammetry has been widely recognized as an important method of acquiring digital topographic information for Geographical Information System (GIS). Scanned aerial photographs are an integral part of digital photogrammetry from which it is possible to produce ortho-rectified images, ortho-images, digital elevation models (DEM), map overlays and other products which can be used as data source for various applications such flood analysis and management in a GIS.

The objectives of this study are to evaluate the suitability of low-cost digital photogrammetric system (desktop publishing scanners and accuracy of digital photogrammetric products) for generating high accuracy topographic information and to demonstrate how these products can be integrated into a GIS for flood analysis and management. The geometric accuracy (i.e. the magnitude of image distortion and the pattern of distortion) of two different types of Desktop Publishing (DTP) scanners i.e., Canon A4 format scanner and Mustek Scan Express A3 format scanner (two scanners of this type are used) are analyzed. The choice of these scanners was based strictly on their availability within the Department of Surveying Science and Geomatics, Faculty of Architecture, Planning and Surveying, UiTM, Shah Alam. To evaluate the geometric accuracy, a calibrated grid plate (used to calibrate stereo-plotting machines) with a regular grid of 1 cm grid is used. The accuracy assessments of three different digital photogrammetric products i.e. manually generated height points, automatically generated heights and ortho-images generated in a low-cost digital photogrammetric system (i.e. Desktop Mapping System) are carried out. Planimetric and height points generated from ADAM PROMAP analytical plotter are used as the basis for comparing the accuracy of digital photogrammetric products. Ground survey methods which include levelling and Global Positioning System (GPS) are used to determine the ground control points (GCPs) of the study area. Taman Tun Dr. Ismail (TTDI), Shah Alam has been selected as study area.

Findings from this study have shown that the magnitude of image distortion of the three scanners tested differ from one another (including images scanned in two scanners of the same model). Although Canon scanner is the cheapest, the geometric accuracy is found to be better than Mustek Scan Express scanners. The accuracy of manually generated points is much better than the automatically generated height points. The planimetric accuracy of automatically generated orthoimage in a low-cost digital photogrammetric system is low and not suitable for large scale mapping applications. Manually generated height points can easily be integrated into GIS and can be used to generate DEM and later be used to simulate the extent of flooding within the study area.

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# INTRODUCTION

## 1.1 Introduction

Problems associated with floods are diverse and extremely complicated. Floods inundate built-up areas, endanger lives and prolonged high flood stages delay road and highway traffic. Flood interferes with efficient drainage and economic use of lands for agricultural or industrial purposes (Ghosh, 1997). Floods also cause damage to drainage channels, bridges, roads, sewer outfalls and other structures. They further interfere with navigation as well as hydroelectric power generation. In short, floods cause severe strain and hardship to the community. Apart from loss of human lives, economic losses associated with flood can run to several millions of Ringgit.

Significant component of floodplain or flood risk mapping involves building an accurate digital terrain representation of the study area. Reliable and accurate datasets such as Digital Terrain Models (DEMs), detailed topographic maps, digital orthophotos or othoimage mosaics are required to visualize and model the flooded areas. There are several existing methods to generate height data to simulate the potential flooded areas. Such methods include field surveying (tacheometry and levelling), aerial photogrametry, remote sensing, satellite altimetry and Light Detection and Ranging (LiDAR). Light Detection and Ranging (LIDAR), has been developed for constructing high-resolution height data with very high standard of accuracy. Nevertheless, these datasets are quite expensive. Field survey through levelling and traverse survey is an ordinary method to measure height data. However, this method is also quite expensive and time consuming. Because of that, photogrammetry has shown itself to be a vital source of generating accurate and reliable height data for flood risk mapping.