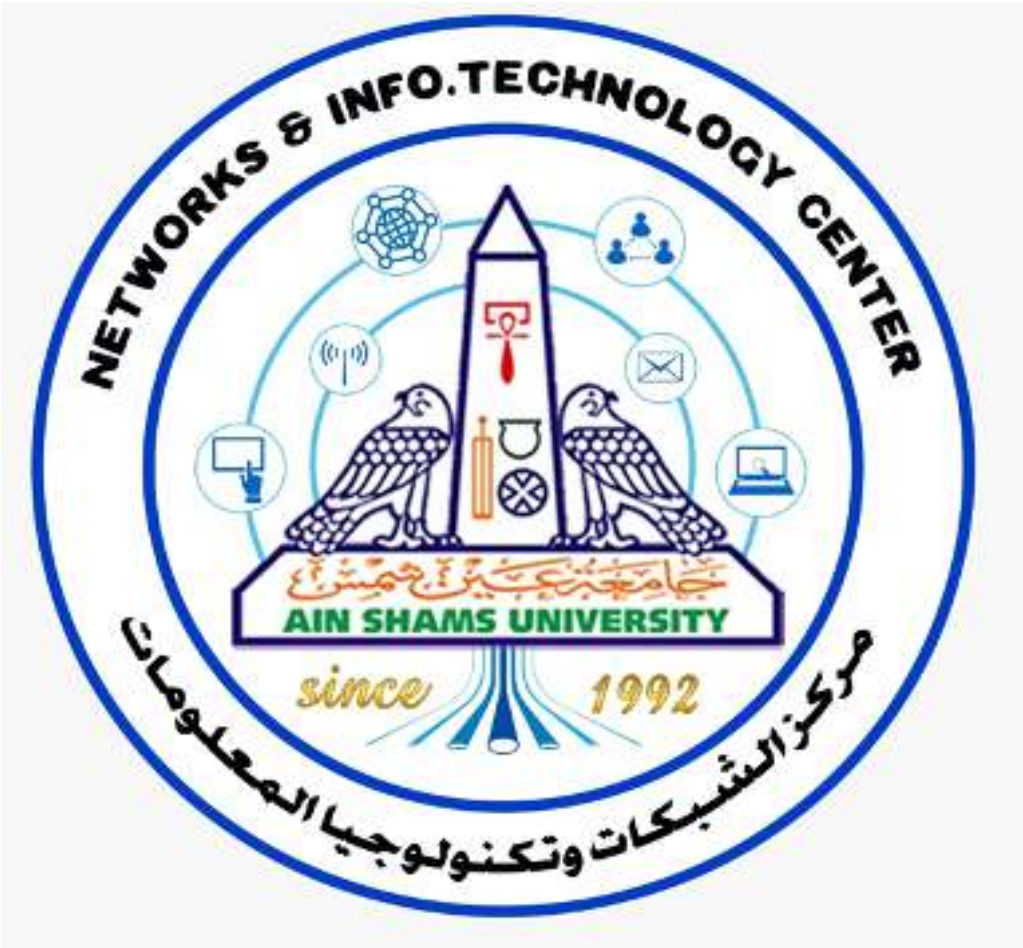
Mona Maghraby

بسم اللّه الرحمن الرحيم

مركز الشبكات وتكنولوجيا المعلومات

قسم التوثيق الإلكتروني



Mona Maghraby

جامعة عين شمس

التوثيق الإلكتروني والميكروفيلم

قسم

نقسم باللّه العظيم أن المادة التي تم توثيقها وتسجيلها

علي هذه الأقراص المدمجة قد أعدت دون أية تغيرات

NEW HYBRID TECHNIQUE FOR GEOMETRIC CORRECTION OF HIGH RESOLUTION SATELLITE IMAGERY

By

Ahmed Abdo Nasr Habib

A Thesis Submitted to the
Faculty of Engineering at Cairo University
in Partial Fulfillment of the
Requirements for the Degree of
DOCTOR OF PHILOSOPHY
in
CIVIL ENGINEERING – PUBLIC WORKS

FACULTY OF ENGINEERING, CAIRO UNIVERSITY
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Title of Thesis:

New Hybrid Technique for Geometric Correction of High Resolution Satellite Imagery

Key Words:
Remote Sensing; High Resolution Satellite; Rational Function Model; Artificial Neural Networks; Geometric Correction.

Summary:
An Artificial neural networks (ANN) MATLAB software was developed with multi-layer perceptron (MLP) technique to derive the geometric correction coefficients. The Artificial neural network training was done using the deduced control points in a way that, image coordinates were used as input and the ground coordinates as output till reaching stabilization state of the neural network parameters. A change in the nature of the distribution of errors has been noted, as a result of the numerical stability of the neural network. A new technique was developed using neural networks to predict the earth coordinates of a set of new regular image points in the same area of the deduced random point's data set and a new DDSM model. The RFM model was reused by implementing regularized points to reach the final model coefficients between satellite imagery space domain and ground space domain. The new technology improved accuracy by reducing the planimetric error by 39% and the elevation error by 45% of the error recorded when using traditional RFM model.

Disclaimer

I hereby declare that this thesis is my own original work and that no part of it has been submitted for a degree qualification at any other university or institute.

I further declare that I have appropriately acknowledged all sources used and have cited them in the references section.

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Signature:

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Nomenclature

HRS	High Resolution Satellite
RFM	Rational Function Model
DSM	Digital Surface Model
DDSM	Dense Digital Surface Model
ANN	Artificial Neural Networks
MLP	Multi-Layer Perceptron
GCPs	Ground Control Points
GIS	Geographic Information Systems
RPCs	Rational Polynomial Coefficients
CCD	Charged Coupled Device
GSD	Ground sampling distance
GPS	Global Positioning System
IMU	Inertial Management Unit
CORS	Continuous Reference Stations
ESA	Egyptian Survey Authority
UTM	Universal Transverse Mercator
RMSE	Root Mean Square Error
AGE	Automatic Ground Control Extraction
ΔE	Delta Easting
ΔN	Delta Northing
SD	Slandered Deviation
Err-X	Error in X Coordinate
Err-Y	Error in Y Coordinate

Abstract

This thesis introduces a new technique to improve the geometric correction of high resolution satellite (HRS) imagery data in order to achieve better geometric accuracy of extracted information.

The research begins by matching the satellite images to be adjusted with an ortho-rectified imagery data produced from digital aerial photogrammetry works of the same area in order to deduce dense control points. The corresponding point heights were corrected using a dense digital surface model (DDSM).

The traditional geometric correction was done using the commonly used Rational Function Model (RFM), implementing the previously deduced random distributed points. Although the RFM model is geometrically stable, there is a relative error due to the numerical instability resulting from the irregular distribution of control points.

An Artificial neural networks (ANN) MATLAB software was developed with multi-layer perceptron (MLP) technique to derive the geometric correction coefficients. The Artificial neural network training was done using the deduced control points in a way that, image coordinates were used as input and the ground coordinates as output till reaching stabilization state of the neural network parameters. A change in the nature of the distribution of errors has been noted, as a result of the numerical stability of the neural network.

A new technique was developed using neural networks to predict the earth coordinates of a set of new regular image points in the same area of the deduced random point's data set and a new DDSM model.

The RFM model was reused by implementing regularized points to reach the final model coefficients between satellite imagery space domain and ground space domain.

The new technology improved accuracy by reducing the planimetric error by 39% and the elevation error by 45% of the error recorded when using traditional RFM model.

The use of the designed ANN software as an intermediate step in the produced hybrid model has solved two significant problems which were, the necessity of well-distibuted control points as well as, providing another source of elevation data.

The produced satellite orthophoto can be used in updating maps of scale between 1:2500 and 1:5000.