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مركز الشبكات وتكنولوجيا المعلومات قسم التوثيق الإلكتروني





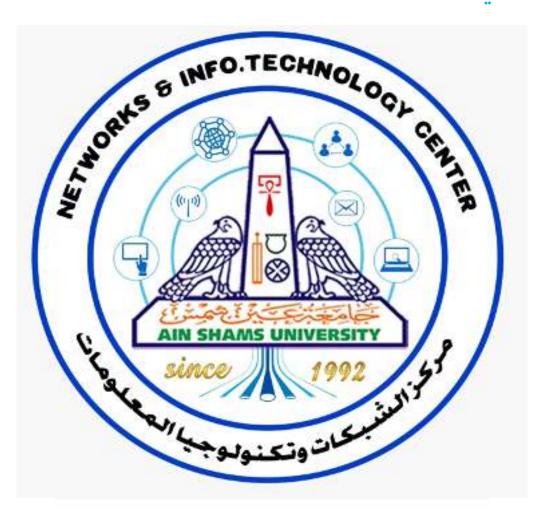


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التوثيق الإلكتروني والميكروفيلم قسم

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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

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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 multilayer 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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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 **Continuous Reference Stations CORS ESA** Egyptian Survey Authority Universal Transverse Mercator **UTM** Root Mean Square Error **RMSE**

AGE Automatic Ground Control Extraction

 $\begin{array}{lll} \Delta E & Delta \ Easting \\ \Delta N & Delta \ Northing \\ SD & Slandered \ Deviation \\ Err-X & Error \ in \ X \ Coordinate \\ Err-Y & Error \ in \ Y \ Coordinate \end{array}$

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 orthorectified 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 multilayer 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.