# Using Mechanical Interpolation method for ortho-rectification to generate large scale image map from high resolution data

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**Key Words**

Photogremmetry, Rectification, Interpolation, Large Scale, Image Map, Surface Splines, Grid Mathod, Geospatial, High resolution data

**Abstract**

High resolution data has become an important source of data. Before they can be integrating into a GIS database, It requires processing for ortho-rectification to generate image map with high accuracy and low cost also easy operating.

Mechanical interpolation method for ortho-rectification, which different with traditional grid method for interpolation in photogrammetry, Introduction the interpolation is important that was named Mechanical Surface Splines. The main advantages of the surface splines are that the coordinates of the known points are not located in a rectangular array and the function may be differentiated to find slopes. Surface splines are a mathematical tool to interpolation a function of two variables, It base upon the small deflection equation of an infinite plate. Which were originally developed for interpolation wing deflection of aircraft. In 1972 by Harderand and Deamarais Contributed.

## I. Introducetion

High resolution data has become an important source of data. Before they can be integrating into a GIS database. It requires processing for ortho- rectification to generate image map. The mechanical interpolation is useful to get large scale image maps which as a plate for precise quantitative work to support geospatial decisions

The surface splines is a mathematical tool for interpolation a function of two variables. It is based upon the small deflection equation of an infinite plate. The main advantages of the surface splines are that the coordinates of the known points are not located in a rectangular array and function may be find slopes by differentiated. That first developed by Harderand and Deamarais for wing deflection of aircraft.

The surface splines is different with the traditional grid method for interpolation in photogremmetry. Now use it in surveying also had successful.

The closed form solution involves no function more complicated then logarithms. It is easy to operat by compute

## II. Mathematical Analysis

Because a linear spline is the solution of an equation based upon a small deflection of an infinite beam.

Thus the surface splinnes is a plate of infinite extent that deforms in bending only.

The differential eqution ralating bending deflection and loads of a plate is

$$D\nabla^4 W = P \qquad (1)$$

Deflections are speccified at N independent points $(x_i, y_i)$ i=1,N. the requires point loads $P_i$ at these points. The values of these loads must be determined to give the specified deflection.

The first step is to find the deflection due to a point load.

Introduce polar coordinates

$$X = r\cos\theta$$

$$Y = r\sin\theta$$

and determine the symmetric deflection due to a point load at the orgin.

Intergrating Eq. (1)

$$W(r) = A + Br^2 + (P/16\pi D)r^2.\ln r^2 \qquad (2)$$

In Eq.(2). A and B are undetermined coefficients. And P is the load.

The deflection of the entire spline Will be taken as the sum of solution of Eq.(2)

$$W(x,y) = \sum A + Br^2 + (P/16\pi D)r^2.\ln r^2 \qquad (3)$$

Where

$$r_i^2 = (x-x_i)^2 + (y-y_i)^2$$

The surface spines should become “flat” a long distance from the applied loads. and after deduced and combined

The closed form is;

$$W(x, y) = A+Bx+Cy+\sum_{i=1}^{N} F_i r_i^2 \ln r_i^2 \quad (4)$$

and use Eq.(4). The N+3 unknowns are determined from

$$\sum F_i = \sum X_i F_I = \sum Y_I F_I = 0 \quad (5)$$

Eq. (5) are recognized as the equilibrium Equations

The surface splines depends upon the solution of a system of linear equations

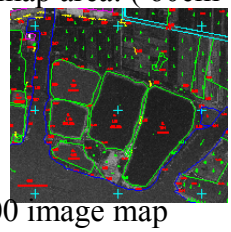
In order to use the surface splines three or more noncolineal points $(x_i, y_i)$ must be specifield

## III. Examples

Here are 2 examples, which are large size and beyond the custom without any splices, only five control points for rectifying. The map size is (60cm×70Cm, 60cm×200cm)

The operation is open and without any modification.

**1.** 1: 1000 made from old 1:8000 Photo map area: ( 60cm×70cm )



**2.** 1:500 image map mapping from high reesolution data. (60cm×200cm)

Ortho-rectification was examined by field surveying.

## IV. Conclusions

The example shows only five control points for rectifying by satellite images to generate 1:500 image map. and the map size is extremely large beyond to the custom.

If the number of the control points increase also the map size increasing large, and easy operating.

Other in civilion world the UAV gives low cost aerial imaging. Obvious the surface splines method is certainly useful as a tool to get large scale image maps for supporting geospatial decisions. For example in agricultrual the mapping system giving GIS solution to effectively operate agriculture and funding schemes to precisely record, measure and publish data.

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Splines and Variational Methods

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