Statigraphic creation of Landscape-A Review

Finite element modelling in MATLAB

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1.Abstract— *Stratigraphic simulation is a modelling methodology that can be used for the purpose of exploration of geological areas. It helps to understand the details of sedimentation rocks, foreland basins, changes in sea – level, aquifer, elevated areas, country rock, crest etc. In this system we have concentrated on stratigraphic creation of landscape of elevated areas.*

The stratigraphic view that gets generated through various resources are not very precise with respect to the 3D modelling. The View lags certain area depth, elevation and resolution. The Stratigraphic view of landscape that our system generates uses Finite Element Modelling.

Finite element modelling serves as an aid for the creation of high resolution landscape view of elevated areas. The system generates a model that describes the geological aspects of areas which are of major use to geologist.

Keywords- *Stratigraphic, Finite Element Modelling, Landscape, Latitude , longitude, altitude, 3d modelling, 2d modelling, photogrammetry*

2. INTRODUCTION

2.1 OVERVIEW

The system generates the 3d Model of a given landscape. The main focus of the system is to convert a 2d image into 3d model with absolute precision. It optimizes the accuracy of visualization of stratigraphic landscape. The system converts the 2d satellite view into accessible 3d model. The system focuses on generation of geological model based on the amalgamation of latitude, longitude and elevation of data sets.

The datasets are collected from Google earth by tracing the paths throughout the study area, The KML file is generated and is further converted to GPX file from where the Longitude, Latitude and Altitude is retrieved and is given as an input in MATLAB in the form of Excel file. Processing the file generates the MATLAB 3-D model.

This model is further merged with the Photogrammetry model through Finite Element Modelling and the Augmented Reality 3-D model is generated.

2-d model is less suited to concept design and is harder to explore alternative ideas because here the focus is on individual drafting entities, rather than facilitating the consideration of alternative design options. Whereas 3-d model removes design ambiguity and is highly appropriate for rendings and simulation.

The benefit of being able to visualize a model better in 3d provides the ability to create photo realistic renderings that isn't easily possible within 2d design modelling due to inability of adding 3d imaging onto a flat view of product.

Editing the components separately is the main advantage of 3-d design modelling as it provides higher level of accuracy and the ability to see how components line up against each other which is not possible in 2d design model , as it comes to the potential issue of components not fitting or lining up due to only being able to see all the components in 2d perspective.

2d modelling is usually difficult to use for prototyping . It is unreliable as well as unsuitable for rapid prototyping. While on the other hand , 3d modelling provides an ease of prototyping and leverging existing 3d models to evolve into new concept design is also straightforward.

2.2 MOTIVATION

The systems generating 3D models of the geographical areas are very less and are not of greater accuracy, though generated would lack knee details. It's very important for the geologists to get a precise and accurate 3D model for experiment learning and research purpose. The Stratigraphic view of elevated areas serves as an aid for various construction activities. It's very difficult for the people to visit elevated areas and get an geographical overview of those areas, getting an explicit Stratigraphic view will help them to carry out further studies of those areas.

It is difficult to do a geographical research only on the basis of 2d view or orthographic view. So the 3d modelling comes into picture. This model will be highly efficient for studies and research purposes. Since it gives the complete 360 degree view, it is possible to assume things with greater certainty. While in case of 2d modelling technique, the assumptions are uncertain due to lack of absolute view.

2.3 ANALYSIS

2.3.1 Finite Element Modelling

FEM is an approximation method that divides a complex problem space or domain into many small and simple parts (finite elements), the behavior of which can be described by relatively simple equations. To solve the problem, FEM breaks down a large system into smaller, simpler parts called finite elements. This is achieved by a specific spatial discretization in spatial dimensions, which is achieved by constructing a grid of objects. This is a numerical solution space with a finite number of points. Finally, the finite element method formulation of the boundary value problem leads to a system of algebraic equations.

2.3.2 Orthomosaic:

An orthomosaic is similar to Google Earth, but much more detailed. It's a huge, map-quality image with a lot of detail and resolution that's created by stitching together a lot of smaller images called orthophotos. One of the most common applications for an orthomosaic is to obtain a current perspective of a vast region of land. Orthomosaics are also very valuable for construction companies. They may get regular

updates on their construction sites, and they can take use of the orthomosaics' accuracy for exact measurements.

2.3.3 KML File:

A file with the .KML file extension is a Keyhole Markup Language file. KML files use XML to express geographic annotation and visualization by storing locations, image overlays, video links and modeling information like lines, shapes, 3D images and points.

2.3.4 Google Earth:

Google Earth is a computer software that creates a three-dimensional picture of the Earth using satellite photos. The programme maps the Earth by superimposing satellite photos, aerial photography, and GIS data onto a three-dimensional globe, allowing users to view towns and landscapes from multiple perspectives. Google Earth is a Web Map Service client that can display many types of imagery overlaid on the earth's surface.

2.3.5 Waypoints

A waypoint is a reference factor that allows us recognize in which we're and in which we are going. Whether we're walking, driving, sailing, or flying, waypoints assist us locate our way. Way-factors are units of coordinates that become aware of a factor in bodily space. A waypoint is a factor of reference that may be used for region and navigation. Waypoints may be the precise range and longitude of a region, a famous constructing or herbal feature.

2.3.6 GPX File

GPX, or GPS Exchange Format, is an XML schema designed as a not unusualplace GPS facts

layout for software program applications.It may be used to explain waypoints, tracks, and routes. The layout is open and may be used with out the want to pay license fees. Its tags save location, elevation, and time and might on this manner be used to switch facts among GPS gadgets and software program packages.GPX documents save 3 forms of facts:

- Waypoint - Includes GPS coordinates of a point. It may additionally consist of different descriptive information.
- Route - Includes a list of track points, that are waypoints for flip or level factors, that cause a destination.
- Track - Includes a listing of factors that describe a path

2.3.7 Matlab

MATLAB is a programming and numeric computing platform used to analyze data, develop algorithms, and create models.

MATLAB combines a desktop environment tuned for iterative analysis and design processes with a programming language that expresses matrix and array mathematics directly. It includes the Live Editor for creating scripts that combine code, output, and formatted text in an executable notebook.

2.3.8 GPS Visualizer

GPS Visualizer is a web application that creates maps and profiles from geographic data. It is free and smooth to use, but effective and extraordinarily customizable. Input may be withinside the shape of GPS data (tracks and waypoints), using routes, avenue addresses, or easy coordinates. Use it to peer wherein you have been, plan wherein you are going, or speedy visualize geographic data (medical observations, events, commercial enterprise locations, customers, actual estate, geotagged photos, etc

2.3.9 Photogrammetry

Photogrammetry is a way to attain dependable information of real-global gadgets withinside the surroundings with the aid of using developing 3-D fashions from snap shots.2D and 3-D information is extracted from an photo and, with overlapping snap shots of an object, building, or terrain, transformed right into a virtual 3-D model. This permits shooting massive gadgets, even landscapes, that could in any other case be not possible to scan. As such, photogrammetry is frequently utilized by surveyors, architects, engineers, and contractors to create topographic maps, networks, or factor clouds.

2.3.10 GPS

The Global Positioning System (GPS) is a satellite constellation that provides extremely precise positioning, navigation, and timing (PNT) measurements throughout the world. Precision agriculture, driverless vehicles, maritime or aerial surveying, and defence applications have all benefited from GPS, which was one of the first satellite positioning systems.

3. LITERATURE REVIEW

3.1 Solid meshing of 3D geological model in finite element analysis: a case study of East Azerbaijan, NW Iran

Proposed a system whose main aim is solid meshing of 3D geological body that includes topography for study of finite element analysis. Idealization of finite element analysis is done by following the procedure of shape function definitions from linear plane to solid elements . Both finite difference (FD) and FE methods are used to solve these model equations present in the system. The study includes the definition of solid meshes for 3D model considering topography which process topographic loads besides the dynamical analysis. This study deals with 3D building of geological block diagram and solid meshing with consideration of topographical loads. The shape functions in this research is majorly concerned with linear elements.

The study area used for this research was western Alborz-Azerbaijan structural zone (Nabavi 1976) in northwestern Iran. Since this area has a history of destructive earthquakes and also includes many important elevations that are suitable to creating 3D geological block diagram. As a result, an ideal solid mesh based on such a geological block diagram can be responsive to topographic differences in stresses.

3.2 Finite element model (FEM) visualization and post-processing tool for OpenSees

Proposed a system to analyze and design structures that can survive the effects of earthquake . This system is of major use in the field of geological surveys of earthquakes as it provides a powerful solver with many standards and constitutive material models, finite element types, boundary conditions, and analysis capabilities. FeView is developed to address the generated limitations by incorporating a GUI connection. For the purpose of research and development Feview was used. The changes in the surface post earthquake can be analyzed using the 3d models developed using this system.

The 3d models are designed on the basis of the surface before and after the earthquake. Both the before and after images are analyzed and compared and the 3d model output is then obtained. The precision is obtained by applying finite element modelling on the given images.

3.3 Finite Element Modelling in Structural and Petroleum Geology

The work presented in this thesis lies on structural geology, geomechanics and various numerical methods. These 3d models are defined to represent an idealisation of the geological reality and to allow the

understanding of the assumed phenomenon. At first the method which has been used for simulating geological processes is the called analogue modelling. This modelling includes the creation of 3d models using finite element modelling , based on similarity rules between the three fundamental physical units, by this models can be defined at reduced geometric and time scales. The basics about the finite element formulation used in this work, includes finite strain aspects. Special care is given to the formulation of structural and petroleum geology. By this model the simulation of models with high strain localisation level is carried out with the help of the developed re-meshing algorithm and finite element modelling which in turn gives them precise information.

4. PROPOSED METHODOLOGY

In this thesis, an augmented reality based approach and suitable finite element modelling technique are proposed to develop the research solutions.

A system needs to developed that would create a definite model of the provided elevated and elongated area. Input would be a MATLAB model that needs to be merged with photogrammetry model and that would undergo finite element modelling generating the explicit 3-D model.

4.1 Collection of Data

The data collection refers to a plan for gathering data, information from field situation and is a process of measuring and analysing accurate data from a variety of relevant sources.

The study area is selected from google earth, the entire area is covered by collecting the data points and tracing the path by connecting them. At the end, the KML file is generated consisting of raw

data including latitude and longitude. For generation of 3-D model the combination of latitude, longitude and altitude is required and therefore will be filtered out from the raw data.
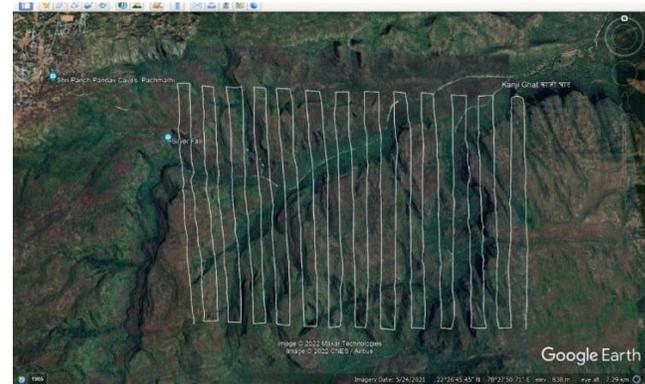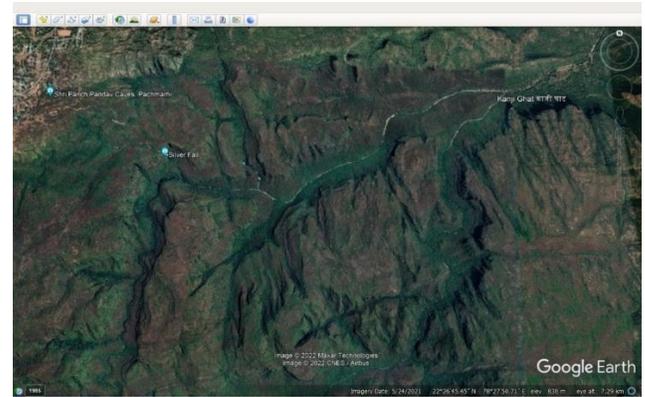


4.2 Processing of Datasets

The KML file generated provides information about the Longitude and Latitude but the Altitude needs to be fetched further.

The KML file is converted to the GPX file by online GPS Visualizer to collect the altitude. The GPX file is further processed to fetch the details related to longitude, latitude and altitude.

The GPX file is processed through MS Excel, which consists of raw data in tabular format. The final required latitude, longitude and altitude is filtered out in tabular format from that MS Excel file.
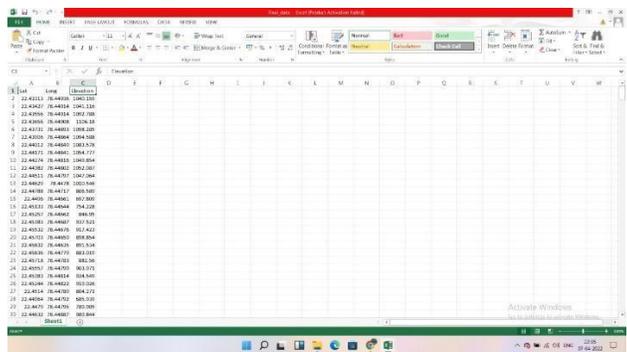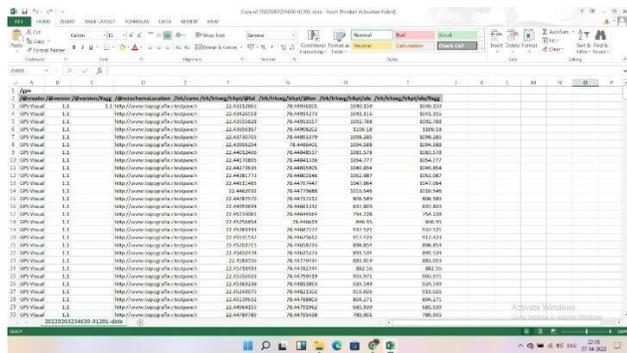
problem finally results in a system of algebraic equations.
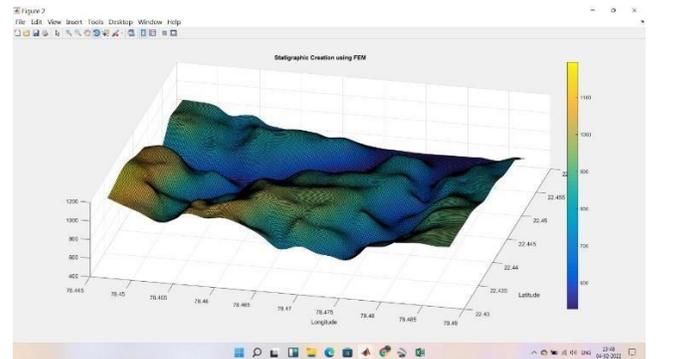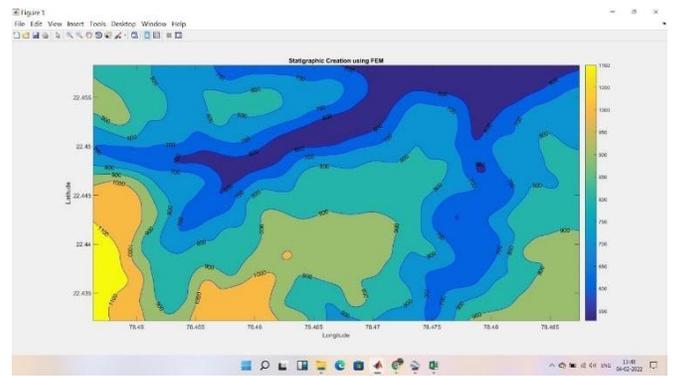
4.3 Generation of MATLAB Model

The Excel file consisting the details of latitude, longitude and altitude needs to be accessed further thrice in MATLAB to retrieve the latitude, longitude and altitude respectively. The information is interpolated in MATLAB and thus the input MATLAB model is generated.

The MATLAB generated model describes the various geographical aspects of the area but lags the augmented reality view aspect of the area. This aspect will be taken care by orthomosaic and photogrammetry. Equations The FEM is a general numerical method for solving partial differential equations in two or three space variables (i.e., some boundary value problems). To solve a problem, the FEM subdivides a large system into smaller, simpler parts that are called finite elements. This is achieved by a particular space discretization in the space dimensions, which is implemented by the construction of a mesh of the object: the numerical domain for the solution, which has a finite number of points. The finite element method formulation of a boundary value
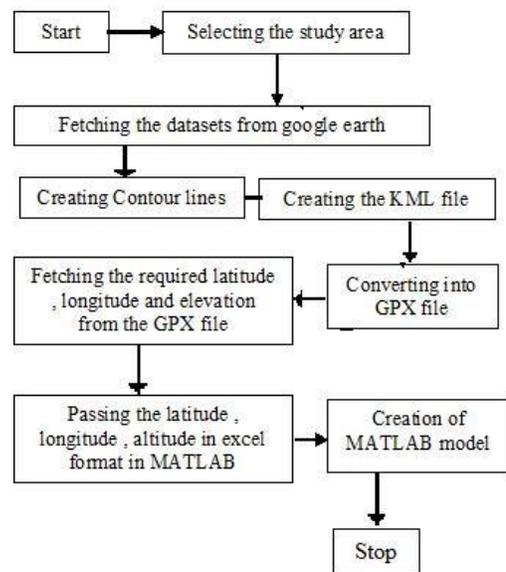
4.4 Generation of Photogrammetry Model

The designing of Orthomosaic model through Photogrammetry is done by capturing the high resolution real images of the areas. Minimum 100-200 images are imported into Creating Reality software.

The imported images are further made aligned in the system, all inputs are registered and enhanced through alignmnent. The resolution of the images are updated to High resolution. Creation of a complete 3-D reconstruction with texture or vertex colours using all inputs are done.
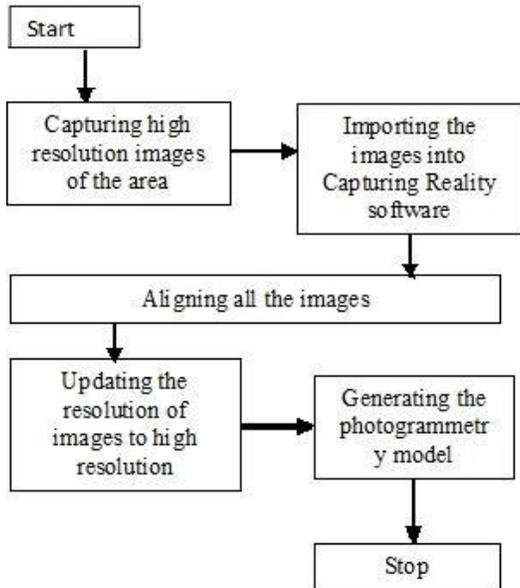

## 4.5 Merging of MATLAB and Photogrammetry Model

The MATLAB model and Photogrammetry model is provided as an input to Finite Element modelling which further processes the two models and generates the precise 3-D model .

The finite subdivides the infinite study area into finite smooth areas and further processes those areas to generate the accurate 3d geological model. The finite element modelling includes certain functions required for interpolation of input model details, and further perform the calculation and generates the required 3d model by merging the input models.

5. EXPERIMENTAL RESULTS

These are some of the experimental results of the project . The 2d images given as input are converted into 3d images to give the maximum absolute view .
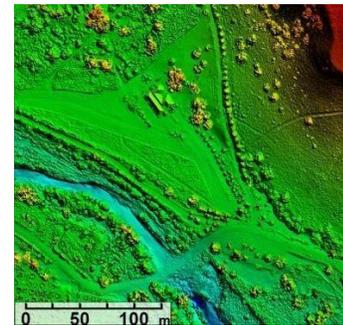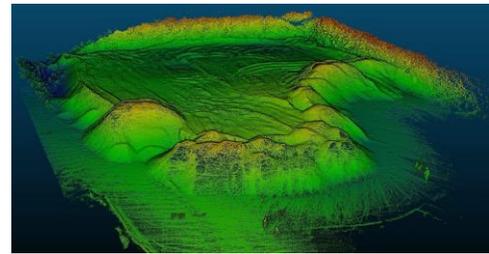
6. CONCLUSION

Integration of finite element modelling can increase the efficiency of 3-Dimensional modelling and visualization upto 80-90% optimize. This integration of 3-Dimenstional finite modelling can be used in various mining, geology and construction industry perspective.generates the required 3d model by merging the input models.

7. ACKNOWLEDGEMENT

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