

# Digitization of River's Using ArcGIS: A Review

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## Abstract

This review paper dictates the digitization of streams of order 1<sup>st</sup> - 5<sup>th</sup> order using the software ArcGIS for doing the digitization work. This review paper covers the theories and methodology that covers this work. The data will be downloaded from USGS website the data needs to be downloaded as a “.tiff” files. This data needs to be processed in the ArcGIS software for generation of a digital elevation model. This DEM (Digital Elevation Model) will provide you with the elevation of the area and then from these elevations we have to extract the rainfall accumulation data using the tool in ArcGIS. After this the data will be processed to get the final streams order. This paper clears all the doubts that one might have regarding the digitization and DEM generation.

**Keywords:** GIS (Geographical Information System), Streams, Geo-Referencing, Digitization, DEM (Digital Elevation Model)

## 1. Introduction

Progress in collecting data and storage methods has resulted in a huge amount of data stored in repositories, which is growing at an accelerated rate. Satellite photos, sometimes referred to as remote sensing images, are a crucial component of the growing and pertinent data that is collected and processed.[1] Humans have developed remote sensing satellites as a result of its desire for more affordable and effective methods of earth observation. The spatial information archives with the highest rate of growth are those based on images from remote sensing. Remote sensing photographs come in a range of spatial and spectral resolutions, from 1-meter panchromatic images to the upcoming generation of polar-metric radar imagery satellites. In order to do an effective and efficient earth analysis, it is necessary to comprehend pertinent facts. Image repositories contain valuable information, but because of their volume and complexity, it is difficult—generally impossible—for humans to extract strategic data from them without the right tools.[1] Large archives of Remote Sensing images are readily available, necessitating the use of the right tools to analyze this data.

An extensive remote sensing database is a compilation of landscape photos that provide a unique chance to comprehend how, when, and where alterations have taken place globally. In 1972, LANDSAT-1, the first operational remote sensing satellite, was launched. Remote sensing is the science of gathering data about the Earth's surface without actually being in contact with it, according to the Canada Centre for Remote Sensing.[1] In the applied sciences, remote sensing is the study of the Earth's surface through the use of gadgets known as remote sensors, which are carried by Earth observation satellites or airplanes used for remote sensing.

Digitization is a process in which the tool called shapefile are used and the polyline feature of this tool is needed for our work. Then we have to finalize the coordinate system from the catalog that appears below the name. From there the selection of “WGS 1984 UTM Zone 44N” once this is done, then go to the editor’s tab from there the start editing, we have to check the create features tab for confirm the type of the shapefile created. Once that s checked out then we can do the digitization of the streams and after finishing the task we have to save edits and then stop editing.

A lot of geographic data is available in formats (such as historic maps, other paper maps, and image files like JPG, PNG, etc.) that are not readily connected with other GIS data.[2] These kinds of data must be aligned with already-existing geographically referenced data in order to be used in GIS ("pin it to Earth"). Another name for this procedure is georeferencing.

## 2. Geographical Information System (GIS)

A Geographic Information System (GIS) is a collection of computer-based tools used for specialized objectives that include gathering, storing, accessing, processing, and displaying geographical data from a discipline-specific domain. While CAD software may accomplish comparable tasks, geographical analysis and display of data are where GIS really shines, rather than data processing and storing capabilities. [4] Examining geographic patterns in data and noting correlations between geographical features are aspects of spatial analysis. Spatial analysis techniques can range from straightforward mapping following an analysis to more intricate models that use multiple data layers to simulate the real world. Thus, complicated spatial analytic operations (such as proximity analysis and buffering [4] on geographic data that would be too time-consuming, costly, and inaccurate to do by hand can now be completed by GIS software. [4]

Geographic Information System (GIS) has proven to be a useful tool in resolving many transportation-related issues.[4] Geographic Information System for Transportation (GIS-T) is the name of this specialized field of GIS that is especially well-suited for transportation applications. According to Miller and Shaw,[4] GIS-T is the term for the concepts and uses of using geographic information technologies to address transportation-related issues. One of the most popular GIS application fields is GIS-T, which has been applied to a wide range of transportation-related fields, including environmental impact assessment, hazard mitigation, intelligent transportation systems, traffic monitoring and control, infrastructure planning, design, and management, transportation safety analysis, travel demand analysis, and planning and operations for public transportation.[4]

## 3. Streams

Headwater streams, which are here classified as first- and second-order channels,[5] make up the vast bulk of a river network's channel length when taken as a whole.[5] However, these relatively small streams are likely to be ignored by legal protections extended to rivers and to be aggressively altered in connection with diverse land uses. A substantial body of research on the physical, chemical, and biological functions of headwater streams clearly indicates their importance to the entire river network.

Headwater streams are diverse, making it challenging to make generalizations about them despite their relatively small size. Headwater streams can be steep, highly turbulent channels that are narrowly constricted between valley walls in high-relief situations.

## 4. Geo-Referencing

An essential stage in the digitizing process is georeferencing. In this experiment, georeferencing basically

means matching an image file to an existing feature class. You can also align a map with "control points" that have co-ordinate values by using a certain procedure.[2] Because we will also be setting control points during this exercise, control points are included in quotations.

The georeferencing tool is the main tool we'll be using in the first portion of today. To access the georeferencing toolbar, click Imagery in the ribbon. "Georeference" falls within the group of alignment. As you get more accustomed to using ArcGISPro,[2] you'll notice that selecting a tool from a menu item—like in this case, "Imagery"—can cause that tool—Georeference in this case—to appear in the ribbon tool categories.

## 5. Digitization

Launch ArcMap from Start – Programs – ArcGIS - ArcMap. Click A New Empty Map from the window. Click the Add Data button to add mosaiced toposheet located, to your map. In the special reference add the WGS 1984 UTM Zone 44N. [3] Left- click to add vertices at every place where the boundary line traces are found. Notice there are lines attached to the cursor after the second vertex is digitized that would allow you to complete the polygon at any time. Figure below shows BLUE Vertices created at each click, [3] following the stream.

The issues faced during digitization are various, one need to select the type of the shapefile it might be a point, polyline, polygon and further the coordinate system need to be precise and accurate. According to the area and type of work. Finally man do the same mistake of closing the ArcGIS without saving the work and this causes a lot of problem. This basic key points will make the work smooth and better.

## 6. Google Earth

These days, GE and Virtual Earth are two areas where high resolution imagery is applied. On GE everyone can view the present study sites (as well as choose new ones), progressively gaining a spatial resolution that allows for the visualization of individual items. The remarkable accomplishment of GE in incorporating 2D satellite images into online mapping has evinced the substantial influence of remote sensing on online mapping and has introduced remote sensing applications into our everyday existence.[7] Online visitors can view earth photos at several scales, ranging from a region's overview to specific residences, trees, and even cars.

In order to integrate the existing earth pictures and DEM data for online mapping, new technologies are now being developed swiftly. The remarkable achievement of GE in incorporating two-dimensional satellite images into online mapping has evinced the substantial influence of remote sensing on online mapping and has introduced remote sensing applications into our everyday existence. Online visitors can view earth photos at several scales, ranging from a region's overview to specific residences, trees, and even cars.[7]

Microsoft's Virtual Earth has introduced a new online mapping tool that supports three dimensions. Additionally, GE has begun a push to add 3D elements to its 2D picture mapping. Nevertheless, the related 3D generation technologies necessitate the human extraction of 3D models of certain 3D objects (such structures and big buildings) as well as the gathering and pasting of ground photos onto the 3D models.[7] This kind of 3D technique is not feasible for creating 3D photographs of small objects (such trees and family homes), and it is expensive, time-consuming, and difficult to update. The application to surface-level environmental monitoring is likewise challenging.

## 7. Digital Elevation Model (DEM)

Information about elevation produced from TM (Topographical Map) is a valuable source of data, particularly for GIS applications. One of the most widely used and traditional methods for representing elevations in TM is the use of contours.[6] TM could be incorporated into a GIS directly in raster format or through the vectorization process as digital data. Planimetric coordinates and elevations are the most common types of digital topographical information that customers require. Raster data therefore falls short of user expectations for real-time practical engineering and geoscience applications. Therefore, it is necessary to analyze the transition from the TM to the DEM in the spatial coordinate system. DEM, or digital elevation mapping, is a three-dimensional computer depiction of a portion of the earth's surface created using modeling algorithms and sampling reference points (SRPs) on a local or worldwide scale.[6] These days, DEM are widely utilized in a wide range of applications, including radio communications planning, aviation simulation, civil engineering, mining engineering, visibility analysis, hydrological modeling, urban planning, and regular mapping applications.

**Different methods have been used to collect DEM data in the applications:**

1. Terrestrial topographical surveying.
2. GPS supported observation.
3. Photogrammetric measurement techniques.[6]
4. Digitizing the existing topographical map.

**In recent years, many techniques have become popular for elevation data collection such as:**

1. Orthophoto maps.[6]
2. Remote sensing images.
3. Lidar “light detection and ranging” technology.
4. Interferometric SAR (synthetic aperture radar) data.
5. Digital elevation databases.

### 7.1 DEM Processing:

1. Acquisition of Contour Map in Raster Image Format via Scanning Process.
2. Raster to vector conversion by thresholding, gray scaling, filtering, thinning, edge detection.
3. Contour line digitization as polyline in raster coordinate system.
4. Updating their height information and transforming the polylines' points to a ground coordinate system.
5. Form of the surface fitting 3D DEM input data file various input data sets with 100%, 50%, 25%, and so on for the number of sampling points.
6. Utilizing interpolation techniques to determine the surface of the land thin Plate Spline Variable grid size with smoothing and search ellipses.
7. Demonstration of DEM.

## 8. Conclusion

This paper provide a decent idea of ArcGIS software and DEM generation. The digitization of streams has been greatly improved by the combination of ArcGIS and Digital Elevation Models (DEMs). ArcGIS offers strong capabilities for visualization and spatial analysis, while DEMs give precise topographical data that is essential for mapping stream networks. Using techniques like stream burning, which adds mapped stream networks into DEMs for more accurate flow accumulation and drainage patterns, ArcGIS makes it possible to precisely delineate stream channels. ArcGIS-prepared DEMs are vital because they

offer elevation data required to produce precise topographic maps, which are critical for the investigation of stream networks. Applications requiring the most recent stream information benefit from ArcGIS Server's stream services, which also facilitate real-time data distribution.

## 9. Abbreviations and Acronyms

1. DEM : Digital Elevation Model.
2. GIS : Geographic Information System.
3. TM : Topographical Map.
4. GE : Google Earth.

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