Cross Sections Extraction Visualization Toolbar for ArcGIS Pro

User’s Manual

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# Introduction

The Cross-sections Extraction and Visualization add-in toolbar for ArcGIS Pro 3.1.1 is developed using the Python programming language (Python version 3.9.16) with `geopandas`, `rasterio`, ‘NumPy’ `matplotlib`, and GIS functions ‘ArcPy’ to streamline the extraction and visualization process. This is an automated tool for users to:

1. Extracting cross-sectional profiles from cross-sectional line data.
2. Collecting elevation data from a Digital Elevation Model (DEM) raster.
3. Calculating horizontal distances and elevations for points along the profiles.
4. Enabling users to specify output directories and the number of points.
5. Generating CSV files with the extracted data.
6. Creating PNG images to visualize cross-sectional profiles.

The tool location, graphical user interface, and application demonstrations are explained in the following sections. The tool has been tested in ArcGIS Pro 3.1.1, and 3.2.0. Install required packages such as rasterio, geopandas, NumPy, matplotlib in ArcGIS Pro using Package Manager as shown in the below figure.

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| A screenshot of a computer  Description automatically generated |
| Figure 1: Installing required packages in ArcGIS Pro |

# Tool Location

The tool can be found in ArcGIS Pro Toolbox and this manual can be downloaded from the GitHub page link provided (https://github.com/thapawan/CrossSectionsExtractionVisualization). Data of cross-section shapefile and DEM are also found in the GitHub repository. To open ArcGIS Pro, go to View then Catalog panel then Toolboxes, and click CrossSectionsExtractionVisualization.pyt that pops out CrossSectionsExtractionVisualization (Figure 2).

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| Figure 2: ArcGIS Pro Toolbox location |

In the Catalog Panel, inside Toolboxes (Figure 2), check “CrossSectionsExtractionVisualization.pyt” and click the dropdown menu. The “CrossSectionsExtractionVisualization” Toolboxes should appear (Figure 3).

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| Figure 3: Cross Sections Extraction Visualization toolbar |

# Application Demonstration

Users can dock the toolboxes named CrossSectionsExtractionVisualization from ArcGIS Pro, Catalog Toolboxes, as shown in Figure 3, and add the input files from Data folders: first Cross sections shapefile (Data\Shapefiles\Cross sections.shp) and second DEM raster file (Data\DEM.tif). Users can provide a number of points on each cross-section line. This is optional if a user is left empty; it will keep the default five points on each line. Finally, the user can define directories (folders) such as (Samples\Outputs) for Comma Separated Value File (CSVs) and Portable Network Graphics (PNG) (Samples\Outputs) in Figure 4. Here, users can give the same or different locations to store, users must provide input and output file locations to generate cross sectional profile plots of horizontal distance and elevation.

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| Figure 4: Cross Sections Extraction Visualization toolbar and filled parameters | |

After providing the required parameter user can click run to get CSVs and PNG that contain the number of points with horizontal distance and elevation, and a plot of each cross-sectional line as shown below Figure 5 and Figure 6. After the first cross-section appears like in Figure 5, you need to click close then it will display the second plot, repeat the same till the last cross-section, and then you will get a completion message on the bottom as in Figure 5.

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| Figure 5: Start the tool using run (right), first plot cross-section (left) |

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| Figure 6: Successful message (right) and end plot of cross-section (left) |

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| Figure 7: Summary Report |

# Disclaimer

The Cross sections Extraction and visualization Python toolbox for ArcGIS Pro 3.1.1 and 3.2.0 are provided "As Is" with no express or implied guarantees of any kind, including but not limited to merchantability, fitness for a particular purpose, and non-infringement.

# Future work

Currently, it provides CSVs and PNG files further extension is available in the GitHub repository with the folder name of CrossSectionsExtractionVisualizationExtension which tool tries to convert point to a line that has shapefile (.shp), raster (.tif) and save it in the ArcGIS Pro content.

# Detailed Instructions

It is a custom geoprocessing tool that performs the following tasks:

1. Takes input parameters:
   1. Cross Sections Shapefile (a shapefile containing cross-sectional lines)
   2. Digital Elevation Model (DEM) Raster (a raster dataset representing elevation data)
   3. Number of point between starting and ending points
   4. CSV Output Directory (a directory for saving CSV files)
   5. PNG Output Directory (a directory for saving PNG images)
2. Loads the cross-sectional lines from the provided shapefile as a GeoDataFrame using the `geopandas` library.
3. Iterates through each cross-sectional line in the GeoDataFrame and performs the following operations for each:
   * 1. Extracts the starting and ending coordinates of the line.
     2. Divide the line into a specified number of points (default: 5) and calculate the latitude and longitude of these points.
     3. Create a Pandas DataFrame containing latitude and longitude data.
     4. Converts the DataFrame to a GeoDataFrame, specifying the coordinate reference system (CRS).
     5. Calculates the horizontal distance (h\_distance) for each point from the starting point of the line.
     6. Extract elevation data for each point from the DEM raster using `rasterio`.
     7. Extracts h\_distance and elevation columns from the GeoDataFrame and stores them in a Pandas DataFrame.
     8. Saves the extracted data as a CSV file in the specified CSV output directory.
     9. Generates a plot of the cross-sectional profile, with h\_distance on the x-axis and elevation on the y-axis, and saves it as a PNG image in the specified PNG output directory.
4. If any errors occur during the execution of the tool, it reports the error message.
5. The `postExecute` method is called after the tool has been executed, but in this case, it does not perform any additional actions.

Note: The tutorial for using the tool is shared on my YouTube channel (learnsomethingtoday): https://youtu.be/J0KKxBf-vLI. For more details visit this GitHub page: https://github.com/thapawan/CrossSectionsExtractionVisualization.