RiTER Xsec User's Manual

Release 1.0.0

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ONE

INTRODUCTION

1.1 Abstract

RiTER Xsec provides a flexible tool for incorporating various innovations in channel topography in multi-natural river development, allowing detailed design of widening and slope gradients and immediate 3D deployment of the familiar cross-section-based work. and can be immediately expanded to 3-D. This makes it easy to edit the terrain, which contributes to increased efficiency and reduced costs. As a function of the iRIC software, it can also be used immediately to calculate river bed fluctuations.

The GUI functions include the ability to edit cross sections by displaying background grids, specifying aspect ratios, displaying water level lines, and displaying pre-edited geometry. In addition, there is the ability to display georeferenced or plan view lines on a cross section, extract and create river cross sections from 3D topographic data such as point clouds or DEMs, expand the ability to read river cross section data, and input and output topographic data in LandXML or PNG format. These GUI functions can be used with any iRIC solver.

The soil volume calculation function is a solver function of RiTER Xsec. It calculates the amount of cut and fill based on the mapped pre- and post-elevation mapped on the calculation grid. Because calculations are based on the elevations mapped to the grid, any geographic information that can be mapped to the grid in iRIC, such as transect survey data or point cloud data, can be used as input for calculations. Different types of geographic information can also be used for the elevation before and after the change, for example, mapping the topography before the change from transect survey data and mapping the topography after the change from point cloud data. In addition to calculating for the entire area where the grid is defined, it is also possible to calculate for a subset of the area. The amount of cut and fill for each cross section can be calculated and exported to a CSV file.

This manual describes the soil volume calculation function, which is a solver function of RiTER Xsec. For other functions on the GUI, please refer to the following table and refer to the iRIC software user manual.

A list of RiTER Xsec functions is shown in the Table 1.1.

Table 1.1: RiTER Xsec GUI features and iRIC software user manual reference locations

Function	Description	Reference
Cross-section editing function	Allows you to specify how to edit cross sections, specify aspect ratios, display reference cross sections, etc.	User Manual/Pre-processing Window/Geographic data/Editing [River Survey Data]/Edit Mode/Operation in River Cross Section Window
Setting the normal slope to snap to when editing a cross-section	The normal gradient to be snapped can be set in advance when editing a cross-section	User Manual/Common Functions/Option/Preferences/[River Survey Data] tab
Import hydraulic information	Imports water level information for each river survey data transect.	User Manual/Common Functions/File/Import/Hydraulic Data
Plane alignment reference function	Displays lines on a plan view on a transect.	User Manual/Pre-processing Window/Geographic Data/Editing [Lines]/Notes "[Polyline] on [River Cross-section Window]"
Georeferencing	Allows alignment of background images.	User Manual/Pre-processing Window/Background Image/Georeferencing
River cross section data (riv file) creation function	Create river channel cross-section data (riv file) from 3D topographic data such as point clouds and DEM.	User Manual / Pre-processing Window / Geographic Data / Editing [River Survey Data] / Create Mode
3D topographic data input/output functions	How to input/output topographic data in LandXML and PNG format	User manual/Common functions/File/Import/Geographic Data, User manual/Common functions/File/Export/Geographic Data

1.2 Intended primary use

1.2.1 Calculation of cut-and-fill volume for river channel construction

User calculates the amount of cut-and-fill soil generated when performing river channel excavation etc.

Because iRIC has a cross-section editing function for cross-section survey data, the following flow can be performed in a series of steps: channel design, calculation of flow capacity, and calculation of cut-and-fill volume.

1. Import the cross-section survey data of the existing river channel into iRIC.

2. Design the cross-section after construction, using the cross-section edit function of the cross-section survey data.

3. Map the cross section survey data to the grid and run solvers to check the flow capacity, such as Nays2DH.

4. Once it is confirmed that the designed channel has sufficient capacity, input the existing channel cross section data and the cross section data created in step 2 into RiTER Xsec, to calculate the amount of cut and fill to be generated by the construction work.

1.2.2 Confirmation of the amount of river bed fluctuation before and after a heavy rainfall event

When river flow is temporarily high due to heavy rainfall, river bed fluctuation occurs due to sediment transport.

If the topography before and after a heavy rainfall event has been surveyed using laser surveying or other methods, it is possible to calculate the increase or decrease in elevation and the accumulation of sediment transported based on the two point cloud data obtained from the survey.

1.2.3 Use as a template for development of terrain analysis tools

RiTER Xsec is developed in Python and its source code is publicly available.

PWRI provides the source code of RiTER Xsec under an open source license, which permits free modification by users.

By reading the RiTER Xsec source code, users can learn how to develop programs to read and analyze topographic data created with iRIC, and can apply the knowledge to develop their own topographic analysis tools.

PWRI hopes that users will develop and utilize various tools based on RiTER Xsec, contributing to the improvement of technical capabilities and productivity in civil engineering design sites.

1.3 Libraries used in RiTER Xsec

The following libraries are used in the development of RiTER Xsec.

- iRIClib: https://iric-solver-dev-manual.readthedocs.io/ja/v4_jp/06_about_iriclib.html
- Numpy: https://numpy.org/

HOT TO OPERATE

2.1 Creation of input data

2.1.1 Importing geographic data

Import geographic information for mapping to a grid. The geographic information to be imported is shown below.

- Elevation (before)
- Elevation (after)

The geographic information to be imported can be cross-sectional survey data, point cloud data, etc.

You can import the geographic data for "Elevation (before)" and "Elevation (after)", that you've prepared, or import the same geographic data for "Elevation (before)" and "Elevation (after)", and then use iRIC's function to modify cross-section survey data that you've imported to "Elevation (after)".

2.1.2 (Optional) Definition of areas to be aggregated

If you want to calculate the cut and fill volume in only some areas, define the areas to be aggregated.

By default, all areas are included.

If you want to exclude some areas, add polygon data to the "Target Area" in the "Geographic Data" section, and then add the polygon data to that section. Create a polygon enclosing the area you want to exclude from the aggregation, and specify "Not Target" as the value.

2.2 Creation of grid

Create a grid. Create a structured grid so the grid contains the area that the geographic data is definied, and it contains the area for that you want to calculate the cut-and-fill volume.

To create the grid, any algorithm that can be used to create a structured grid can be used, such as "Create grid from polygonal line and width".

Note: RiTER Xsec calculates the cut-and-fill volume in units of grid cells. Therefore, in order to perform accurate calculations, it is necessary to keep in mind that the grid cells should be small enough to match the resolution of the geographic information provided.

Once the cells become small enough, further reduction of the cell size will not improve the accuracy, but will only increase the computation time. Please adjust the cell size appropriately through trial and error.

2.3 Mapping grid attributes

Map geographic data to a grid.

Just after creating the grid, the mapping is executed automatically.

If you edit the geographic data after creating the grid, you must manually rerun the mapping.

2.4 Setting Calculation Conditions
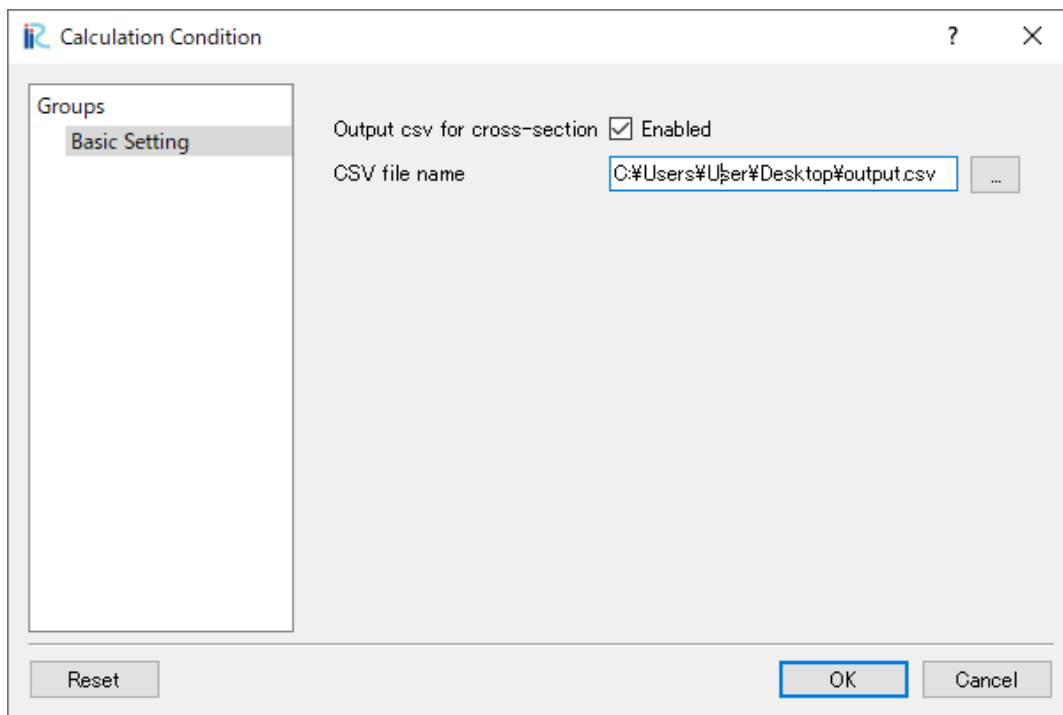
Set calculation conditions.

Figure 2.1: "Calculation Condition" dialog

The items of "Calculation Condition" is shown below:

- **Output csv for cross-section**: Check "Enabled" if you want to calculate and export to CSV the fill, cut, and balance (fill - cut) for each cross section (a row of cells with the same I in the grid).

- **CSV file name**: Specify the name of the CSV file to output the above information.

2.5 Running the tool

Select "Calculate" -> "Run" from the menu to run the tool.

2.6 Output result

Check the output results; RiTER Xsec produces the following three types of output

- Output to solver console
- Output to CSV file
- Output values per grid node

2.6.1 Output to solver console

List 2.1 shows an example of output to solver console.

List 2.1: An example of output to solver console.

```
1  Embankment: 182987.191 [m^3]
2  Cutting: 125869.706 [m^3]
3  Total Balance: 57117.485 [m^3]
4  C:\Users\User\Desktop\output.csv output.
```

The list of output values is shown below:

Embankment
Sum of fill volume (Unit: m^3)

Cutting
Sum of cut volume (Unit: m^3)

Total Balance
Total valance (Sum of fill volume - sum of cut volume) (Unit: m^3)

2.6.2 Output to CSV file

The output is only available if "Output csv for cross-section" is enabled in the calculation conditions.

Outputs the calculated fill, cut, and balance for each cross section (a row of cells with the same I in the grid).

List 2.2 shows an example of output to CSV file

List 2.2: An example of output to CSV file

```
1  I,Embankment,Cutting,Total Balance
2  1,0.000,0.000,0.000
3  2,0.000,0.000,0.000
4  3,0.000,0.000,0.000
5  4,0.000,0.000,0.000
6  5,2193.125,312.125,1881.001
7  6,2202.978,288.821,1914.157
```

(continues on next page)

```
8   7,2216.815,262.550,1954.265
9   8,2228.085,239.508,1988.577
10  9,2236.348,220.978,2015.370
```

2.6.3 Output values per grid node

Table 2.1 shows the list of output values per grid node.

The output values per grid node can be visualized using a two-dimensional visualization window, a graph window, etc.

Table 2.1: The list of output values per grid node

Name	Description
ElevationBefore(m)	The value read from " Elevation (before) "
ElevationAfter(m)	The value read from " Elevation (after) "
ElevationChange(m)	ElevationAfter(m) - ElevationBefore(m)
Fill_Cut	1 for positive ElevationChange, -1 for negative ElevationChange, 0 for no change

EXAMPLES

An explanatory video of RiTER Xsec is available on YouTube.

The links are as follows.

https://www.youtube.com/watch?v=OUx-DwpVOXo&list=PLjUrUSvJNya_XrXmc9f52fx8DyIMDX0Qg

3.1 video1，2：

横断ベースの地形編集で **3** 次元設計ができちゃう **!?** 　地形編集ツール「**iRIC / RiTER Xsec**」　**1** 基礎知識編

横断ベースの地形編集で **3** 次元設計ができちゃう **!?** 　地形編集ツール「**iRIC / RiTER Xsec**」　**2** 実践編

The following features were released before 2021.

1. Cross-section editing function

2. setting of snapping slope in cross section editing

3. importing hydraulic information

4. geo-referencing

5. creation of river survey data

6. importing water level information

7. planar alignment reference function

3.2 video3：

河道地形編集ツール「**RiTER Xsec**」〜新機能追加（**2023**）〜

The following features were released in 2023.

1. improved reading function of channel cross section data

2. soil volume calculation function

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