

User guide for *FluvialCorridor* toolbox

Extraction of inflection line

Toolset name : *DISAGGREGATION PROCESSES*

Tool's name : *Polyline disaggregation*



How to cite : Roux, C., Alber, A., Piégay, H., 2013. Polyline disaggregation guideline for the *FluvialCorridor* toolbox, a new ArcGIS toolbox package for exploring multiscale riverscape at a network scale. Sedalp (Sediment Management in Alpin Basins) and CNRS (UMR5600).

***FluvialCorridor* package for ArcGIS**
Version V01 - 2014

CNRS - UMR5600 Environnement Ville Société
Alpine Space Program - Sedalp

For each use of the *FluvialCorridor* GIS package leading to a publication, a report, a talk presentation or any other document, please refer to the following paper :

Roux, C., Alber, A., Bertrand, M., Vaudor, L., Piégay, H., submitted. "FluvialCorridor" : A new ArcGIS package for multiscale riverscape exploration. Geomorphology.

I. Concept and methods

In order to characterize fluvial corridors thanks to a set of metrics, it is necessary to create entities which do not necessarily have a physical reality. It is the case of the inflection line, used during a set of planimetric metrics assessment such as the streamline sinuosity or the half-amplitude of bends.

The inflection line of a curve is defined as the line passing through its inflection points. An inflection point is located when the sign of the angle β changes (Fig. 1A). The method used into the *Polyline disaggregation* tool is the same than the one developed by Alber and Piégay (2011). This tool can be run over a linear network or just a single line.

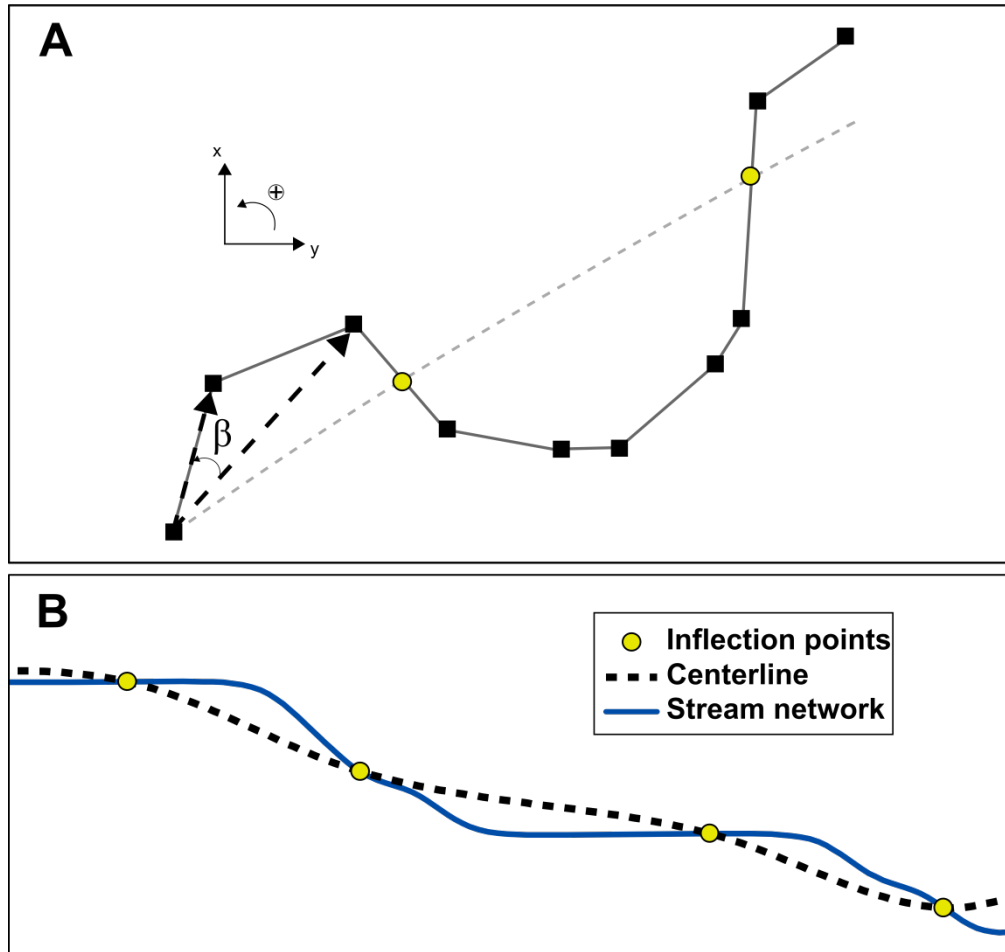


Figure 1 (A) Theoretical scheme of the inflection points and inflection line extraction. (B) inflection line axis extracted with the *Polyline disaggregation* tool of the *FluvialCorridor* package from the stream network of the Guil river (French southern Alps).

Extraction of the inflection line and inflection points has been done with a GIS software (ArcGIS 10.0) thanks to a vector layer of a hydrographic network (extracted with the *Stream network* tool).

General algorithmic framework

The algorithmic scheme developed for the *Polyline disaggregation* tool is presented in the Fig. 2.

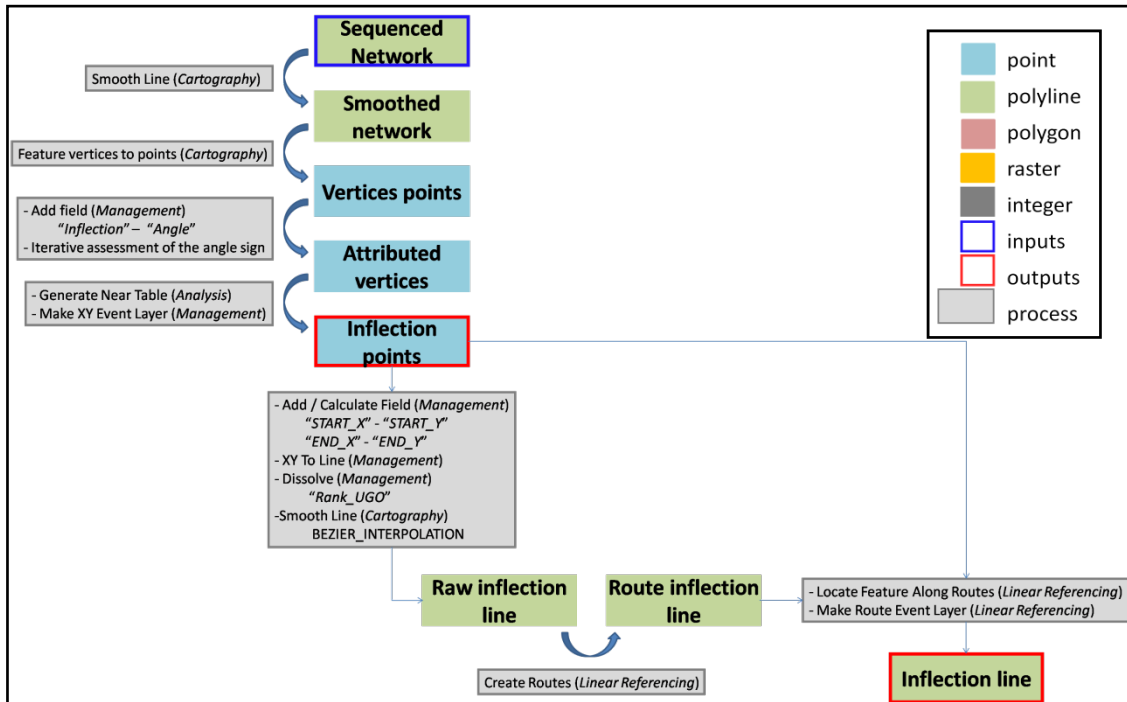


Figure 2 General algorithmic framework of the *Polyline disaggregation* tool

Creation of the two outputs (i.e. inflection points and inflection line) is based on a very geomatic framework :

1. Firstly, the input network is smoothed thanks to the “*Smooth Line*” ArcGIS tool. By flattening small sinuosity, this step enables to remove fluctuations and noise generated during the network extraction.
2. The smoothed network is then converted into a set of points. Each vertex is attributed with two fields more : “*Angle*” and “*Inflection*”. At this step of the process, each point includes the orientation and ordination information : “*Order_ID*”, “*Rank_UGO*” and “*Distance*”.
3. Thus, the angle between 3 consecutive points is calculated from upstream to downstream and stored into the new field “*Angle*”. Secondly, if there is a sign difference between two consecutive angles, the field “*Inflection*” (initialized at “0”) is set at “1”.
4. According to the first step of smoothing, inflection points (“*Inflection*” = 1) are not necessarily located onto the original network. Therefore they are projected onto the network thanks to a proxy table generated with the *Generate Near Table* ArcGIS tool (Fig. 3B). This shapefile includes the final set of inflection points.
5. This set of points is then used to create the inflection line. In that way, they are linked with straight lines with the *XY To Line* tool (Fig. 3C). Those lines are merged thanks to the “*Rank_UGO*” field and each UGO is smoothed with the Bezier interpolation method.
6. The last step is the segmentation of the inflections lines at inflection points. So inflection lines are converted in routes and, with the set of inflection points, segmented thanks to the *Locate Features Along Routes* and *Make Route Event Layer* ArcGIS tools.

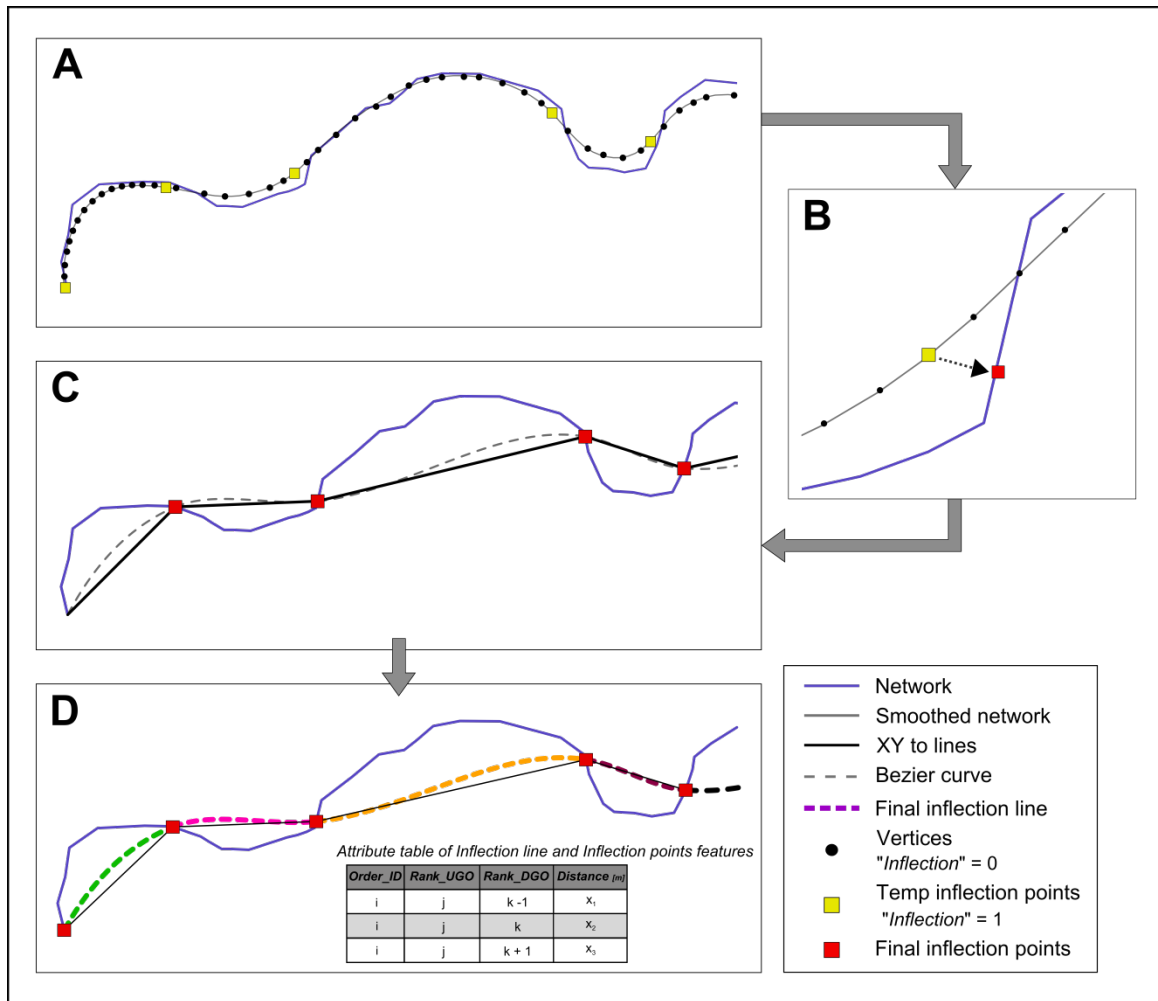


Figure 3 Process involved into the *Polyline disaggregation* tool. (A) Smoothing the input network in order to erase small fluctuations and converting into points. Angle between 3 consecutive points is iteratively assessed to extract inflection points. (B) Snapping the resulting inflection points onto the input network. (C) Connecting each points by straight lines, which are then smoothed by a Bezier interpolation. (D) Splitting the Bezier curves with inflection points.

Note : a sequenced input is required

Whatever the input is an entire network, a centerline network or just a simple segment or reach, it must be first sequenced. As this tool used the orientation and ordination fields "Order_ID", "Rank_UGO" and "Distance", this is a mandatory requirement.

II. Screen user interface

II.1. Startup screen

Into the screen user, several fields have to be filled (Fig. 4). Be careful that a green mark in front of a field is not a guaranty that this field is not optional. Into *Centerline*, if a field is available, that means that it **must be filled**.

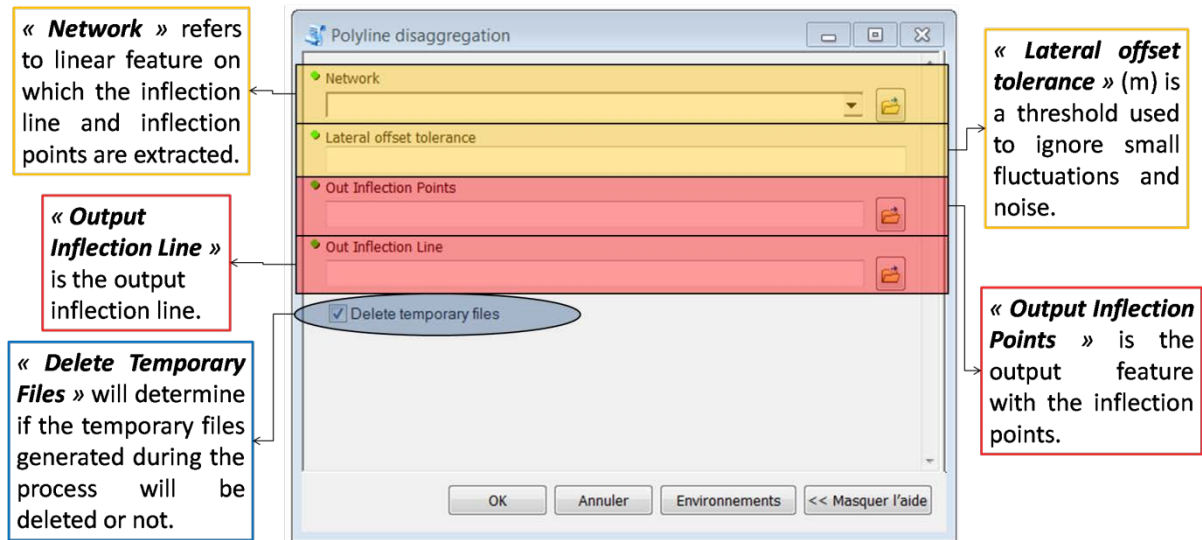


Figure 4 Screen user interface of the *Polyline disaggregation* tool.

The *Polyline disaggregation* tool does not required a lot of input parameters. In a first hand, the user must provide the sequenced linear input. Then, the “*Lateral offset tolerance*” refers to the threshold used to smooth the linear input and thus ignore the noise or the little fluctuations. Finally, “*Output inflection points*” and “*Output Inflection line*” refers to the pathname directory of the two output shapefiles.

II.2. Management of temporary files

Temporary files created during the compilation are managed thanks to the ArcGIS default geodatabase (%ScratchWorkspace%). If the user does not modify this geodatabase in the general environment proprieties, its path must looks like C:\Documents and Settings\<user>\My Documents\ArcGIS\Default.gdb. With the box “*Delete Temporary Files*”, the user has the choice to keep or erase temporary files.

ANNEX 1

List of temporary files created during the *Polyline disaggregation* tool

Name	Description
<i>SmoothedLine</i>	Linear input smoothed with the “ <i>Lateral offset tolerance</i> ”.
<i>ToPts</i>	Conversion of “ <i>SmoothedLine</i> ” into a set of points.
<i>NearTable</i>	Near table between “ <i>SmoothedLine</i> ” and “ <i>ToPts</i> ”.
<i>PtsForInflLine</i>	Temp shapefile of the set of inflection points. It is used to create the final inflection line.
<i>PtsForSplitting</i>	Temp shepafile of the set of points. It is used to split the Bezier curves.
<i>InflToLine</i>	Set of straight lines linking the inflection points.
<i>Dissolve</i>	“ <i>InflToLine</i> ” lines merged with the “ <i>Rank_UGO</i> ” field.
<i>Bezier</i>	Bezier interpolation curves of the straight lines included into “ <i>Dissovre</i> ”.
<i>BezierRoutes</i>	Conversion of “ <i>Bezier</i> ” lines in routes.
<i>InflectionPtTABLE</i>	Table used to create the final shapefile of the inflection points.
<i>PtsForInflLineDisaggregationTABLE</i>	Table used to split the “ <i>BezierRoutes</i> ” curves.
<i>InflectionPt</i>	Output shapefile of the inflection points.
<i>InflectionLine</i>	Temp output shapefile of the segmented inflection lines.