How To Compute Slope and Length between Cross Sections

by Tim Whiteaker

This document describes how to compute slope and length between cross sections in a geodatabase. The procedure starts with a geodatabase called LowerMississippi.gdb, which contains several feature classes depicting flowlines and cross sections for a portion of the Lower Mississippi River. Key feature classes are in the CrossSection feature dataset. The key feature classes and attributes include:

1. Point - Stations along a cross section
	1. CSID - cross section ID
	2. POINT\_Z - elevation in feet
2. Line - Transect lines showing the location of a cross section
3. MFlowLine - NHDPlus flowlines for the Lower Mississippi River
4. XSIntersect - Points where features in (2) intersect (3)
	1. CSID - cross section ID
	2. HydroID - unique feature ID; presumably from some other source; need to recompute
	3. NextDownID - feature ID of next downstream feature; presumably from some other source; need to recompute

Note that XSIntersect is already participating in a geometric network named CrossSections\_Net, but that network was not built properly, so the network will need to be deleted. In addition to the presence of network build errors, the flowlines were not split at XSIntersect points, which hampers network tracing tasks that we’ll need in this workflow.

This procedure requires the Arc Hydro tools.

From this starting point, the steps to compute length between cross sections are:

1. Delete CrossSections\_Net.
2. Use the **Add Field** tool to add the following fields to XSIntersect, all of field type Double:
	1. Min\_XS\_Z - minimum elevation in cross section (ft)
	2. LengthDown - stream length to river outlet (ft)
	3. LengthDsXs - stream length to next downstream (‘Ds’) cross section (‘Xs’) (ft)
	4. SlopeDsXs - slope to next downstream cross section
3. Attribute XSIntersect with minimum cross section elevation.
	1. Run the **Summary Statistics** tool on **Point** to find the minimum **POINT\_Z** value, grouping results by the **CSID** case field. Name the result Point\_Statistics.
	2. Use the **Add Join** tool to Join the result to **XSIntersect** using the **CSID** key field.
	3. Use the **Calculate Field** tool to compute **Min\_XS\_Z** as **[Point\_Statistics.MIN\_POINT\_Z]**.
	4. Use the **Remove Join** tool to remove the join.
4. Use the Arc Hydro **Assign HydroID** tool to assign **HydroID** to **XSIntersect**, overwriting existing HydroIDs.
5. Use the **Split Line at Point** tool to split **MFlowLine** at **XSIntersect** points. Use a search radius of **1 foot** just in case some XSIntersect points are not spatially coincident with MFlowLines (strange, since presumably the points were created by intersect transect lines with the flowlines, but I had to do it). Save the result at **FlowlineSplit** in the same feature dataset as XSIntersect.
6. Restart ArcMap. I don’t know why, but I had to do this in order to create a geometric network without a versioning error.
7. Use the **Create Geometric Network** tool to build a geometric network in the **CrossSections** feature dataset with only the **FlowlineSplit** and **XSIntersect** feature classes. Set **XSIntersect** as a **Sink**. This probably isn’t necessary, but can be useful if we can’t set flow direction based on the digitized direction later.
8. I had one network build error. XSIntersect point with ObjectID = 97 is less than a foot away from a line endpoint, and the line wasn’t split there. So, delete the network, restart ArcMap, start an edit session and split the line at that point. Then stop editing and rebuild the network.
9. Use the **Set Flow Direction** tool to set the flow direction to **WITH\_DIGITIZED\_DIRECTION**. You can check that this worked by using the Utility Network Analyst toolbar to display flow direction arrows or run a network trace.
10. Compute length in feet for each FlowlineSplit feature.
	1. Use the **Add Field** tool to add a **LengthFt** field of type **Double** to **FlowlineSplit**.
	2. Use the **Calculate Field** tool on **FlowlineSplit** to compute **LengthFt** as the following expression, with the **PYTHON\_9.3** expression type chosen: **!shape.length@feet!**

Note: For this case we could just use the Shape\_Length field since the projected coordinate system units for FlowlineSplit are in feet, but adding the LengthFt is illustrative of what you would do had this not been the case.

1. Compute NextDownID for XSIntersect. You’ll have to add a HydroID field to the generic junctions before Arc Hydro will let you compute NextDownID.
	1. Add the **generic junctions** to ArcMap. Mine were called CrossSections\_Net\_Junctions.
	2. Use the **Add Field** tool to add a **HydroID** field of type Long to the **generic junctions**.
	3. Use the Arc Hydro **Find Next Downstream Junction** tool to compute NextDownID for **XSIntersect**.
2. Use the Arc Hydro **Calculate Length Downstream for Junctions** tool tocomputeLengthDown for XSIntersect.
3. Use the **Feature To Point** tool to make a copy of XSIntersect. Name the result **XSCopy**.
4. Use the **Add Join** tool to join the **copy** to the original **XSIntersect**. Use **NextDownID** as the Input Join Field and **HydroID** as the Output Join Field. **Uncheck Keep All Target Features**.
5. Use the **Calculate Field** tool to calculate LengthDsXs on XSIntersect to be [XSIntersect.LengthDown] - [XSCopy.LengthDown]
6. Use the **Calculate Field** tool to calculate SlopeDsXs on XSIntersect to be
([XSIntersect.Min\_XS\_Z] - [XSCopy.Min\_XS\_Z]) / [XSIntersect.LengthDown]
7. Use the **Remove Join** tool to remove the join.

With these steps completed, you now have slope and length between each cross section.