

Developing Automated Methods to Improve Modeling for River Channels and Features

Getting a more accurate picture of our underwater surfaces

Bottom Line

This study helps build automated methods for a custom Geographic Information System (GIS) interpolation tool that can be used by non-GIS professional engineers and scientists to support hydraulic modeling efforts.

Better, Faster, Cheaper

More accurate underwater mapping can help provide more accurate channel hydraulic data and modeling, for example, determining channel velocities and the flows when discharges may overtop channel banks and flood adjacent lands.

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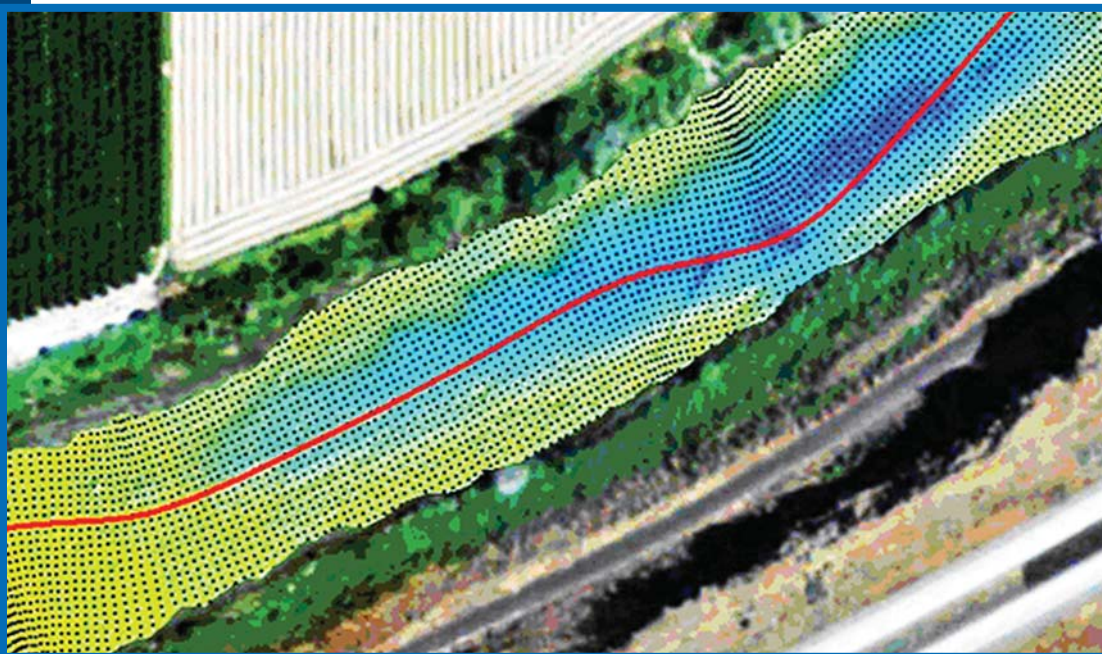
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Problem

Mapping the underwater depths of rivers or lakes (bathymetry) is vital to Reclamation's modeling efforts to support detailed hydraulic studies of river systems, flow, and ecosystems. The most critical input to any hydraulic model is the geometric representation of the channel and floodplain surface.

Reclamation engineers and scientists routinely perform numerical modeling to support hydrodynamic, sediment transport, vegetation, riparian habitat, and geomorphic analyses. These modeling efforts typically require a continuous bathymetric surface representation that is spatially interpolated from a collection of surveyed points acquired with sonar and Global Positioning System (GPS) equipment mounted to a boat or raft. Bathymetric representations of a river are usually produced by collecting a set of channel bottom elevation points and then interpolating the elevation values into a continuous bathymetric surface.

More accurate interpolation of river channel bathymetry will result if the interpolation relies on data points that are aware of their location in reference to riverflow direction. However, there is no existing method to transform these separate data points into a coordinate system that is aware of riverflow direction before interpolation, and then return interpolated results to a Cartesian coordinate system.



Mapping the riverbed: a continuous bathymetric surface model constructed from interpolated data points oriented in the direction of riverflow.

Solution

This study provides an automated technique that:

- Transforms surveyed bathymetric point data from a surveyed coordinate system to a system that references each point to its position on the riverbed (longitudinal distance along, and lateral distance from, a linear river thalweg—the lowest depth of the river).
- Performs an appropriate interpolation on the transformed data.
- Transfers the results of the interpolation back to the coordinate system of the input data.

Results and Application

This effort produced a custom tool that functions inside the ESRI ArcGIS ArcMap 10.x software and is designed for use by non-GIS professional engineers and scientists. The tool uses an interpolation method that produces predictive bathymetric surface measurements in the form of interpolated points that show the spatial relationship of input survey points to riverflow direction.

The interpolated bathymetric points can be integrated with breakline features and terrestrial elevation data to create a surface model that contains both wetted and non-wetted features. These surface models can be used to support two-dimensional (2-D) hydrodynamic modeling efforts that require continuous elevations, which encompass floodplains and other areas outside the wetted river channel.

The tool uses standardized interpolation techniques that include identifying and reducing global lateral and longitudinal elevation trends. As such, the tool is designed to be used for river reaches that are morphologically similar and areas where the pattern and density of bathymetric survey are consistent. The tool is useful only in single-channel environments. It is not designed to work in braided channels or in areas of stream confluence.

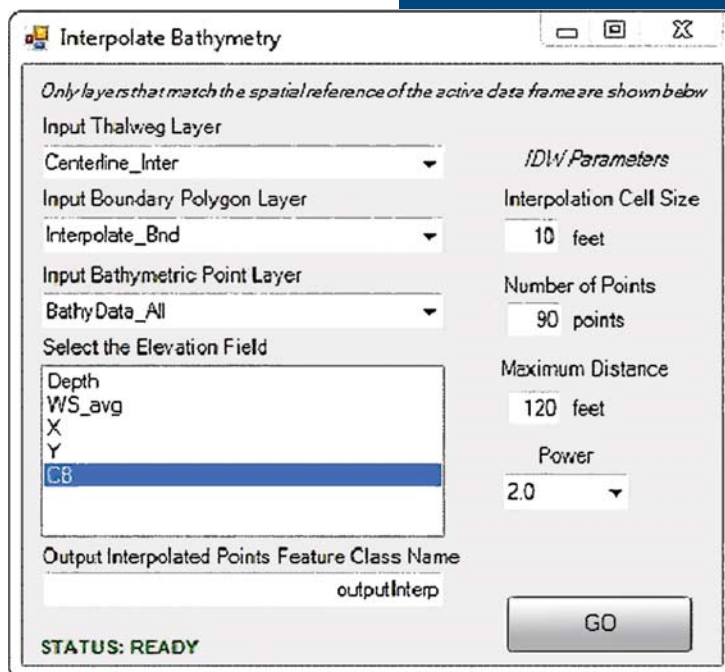
The accuracy of the interpolated bathymetric point features depends on the quality, density, and collection pattern of the bathymetric survey. The accuracy and usefulness of the interpolated elevation values output from this tool will be related to how well the spatial arrangement of bathymetric survey points is able to capture the entire longitudinal and lateral definitions of the channel.

Future Plans

This GIS interpolation tool will be used in future modeling and planning analyses as part of the suite of sediment and river hydraulics modeling tools used in the Sedimentation and River Hydraulics Group in Reclamation's Technical Service Center.

“The new GIS bathymetric tool is being used by the Sedimentation and River Hydraulics Group within Reclamation’s Technical Service Center to make better surface models for 2-D hydraulic modeling efforts. It gives us more accurate representations of the channel and provides a new window onto riverbeds.”

Jennifer Bountry
Hydraulic Engineer,
Reclamation’s Technical Service Center



User interface for the GIS interpolation tool.

More Information

www.usbr.gov/research/projects/detail.cfm?id=2834