Conflation: Edgematching Tools and Workflows

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Agenda

Conflation Overview and Edgematching Tools
Edgematching Workflow
  ➢ Demo: edgematching roads
Conclusions and Future Work
Conflation Overview and Edgematching Tools
When using multi-source spatial data together

Common obstacles in analysis and mapping:

- Spatial and attribute inconsistency caused by differences in data collection and modeling
- High cost to fix the problems
Conflation reconciles multi-source datasets and optimizes data quality and usability

Between overlapping datasets:
- Detect feature changes (differences) through feature matching
- Make spatial adjustment and attribute transfer

Between adjacent datasets:
- Detect and resolve feature conflicts and disconnections through edge matching and alignment

Ultimately:
- Maintain an unified and seamless dataset – enriched and up-to-date
- No longer live with various imperfect datasets
- Rely on the data to perform analysis and quality mapping with confidence
Highly automated geoprocessing tools

New and enhanced system tools

- Focusing more on linear features (roads, parcel lines, etc.)
- Aiming at high accuracy (not promising 100%)
- Providing information to facilitate post-processing

Improved workflows

Conflation Tools and Workflows: An Introduction
1:00pm – 2:00pm, Tuesday, Room 30D
2:30pm – 3:30pm, Wednesday, Room 29C

In ArcGIS 10.6.1 and Pro 2.2
Edge matching (EM) tools for adjacent datasets
Based on proximity, topology, and continuity analysis, as well as attributes

Generate Edgematch Links (GEL)
➢ From input features to adjacent features

Followed by Edgematch Features (EF)
➢ Connects features guided by the established links
Options for connecting features
Align Features

Based on proximity, topology, and similarity analysis, as well as attributes information
Edge Matching Workflows

Two adjacent, disconnected datasets
Conceptual, ideal workflow

Goal - make two adjacent line datasets properly connect
Example edgematching of adjacent datasets

Source features

Adjacent features

Together
Perfect results of simple data

The reality is more complicated ...
Conflation workflow in real world scenarios

- Preprocessing:
  - In same projection
  - Data validation
  - Selection of relevant features

- Conflation and evaluation:
  - Conflation tools
  - Workflow tools

- Postprocessing:
  - Queued review
  - Interactive editing
Supplemental Conflation Workflow Tools

Popular tasks:
- Transfer attributes
- Spatial adjustment
- Detect feature changes
- Edge matching

Focusing on tasks:
- Task specific tool set
- Enriched results to facilitate inspections
- Enhanced interactive tools (python add-in for ArcMap; SDK add-in for Pro)

This demo shows TA workflow in Pro 2.2...
Breakdown of the ideal workflow into sub-steps
Demo: edgematching roads

Two road datasets (an area in Alabama):

- EdgeRoads – 7576 features
- GISRoads – 3634 features

Both datasets:

- Contain roads that are within 1 km to borders
- Have inconsistent road names
GEL result

Generated 454 links; midpoints of links were created for visualization purpose. Borders were not in the process, but displayed for reference.
EM_CONF in output

- 100 (matched with no ambiguity)
- 50 (spatially matched with unmatched attributes)
- < 50 (spatially matched with some ambiguity and weak continuity)
GEL evaluation results

EM_CONF < 33: 134 links
Intersecting links: 33 locations
Potential missing links: 62 source dangle locations

It's time for inspection ...
Inspection and editing of edgematch links

Reviewed:
- 33 locations of intersecting links \( \text{NEAR\_DIST} \geq 0 \)
- 98 low \text{EM\_CONF} links \( \text{EM\_CONF} < 33 \) AND \text{REV\_FLAG IS NULL}
- 62 source dangle locations (near links)

Summary:
- 388 (~85%) of total 459 links were good (54 were flagged for recheck)
- 71 (~15%) of total links were modified, removed, or added

<table>
<thead>
<tr>
<th>OBJECTID</th>
<th>FREQUENCY</th>
<th>REV_FLAG</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>267</td>
<td>&lt;Null&gt;</td>
</tr>
<tr>
<td>2</td>
<td>5</td>
<td>Added</td>
</tr>
<tr>
<td>3</td>
<td>66</td>
<td>Good</td>
</tr>
<tr>
<td>4</td>
<td>46</td>
<td>Modify</td>
</tr>
<tr>
<td>5</td>
<td>55</td>
<td>Recheck</td>
</tr>
<tr>
<td>6</td>
<td>20</td>
<td>Remove</td>
</tr>
</tbody>
</table>
What happened to the SRC_FID and TGT_FID of the added or modified links?
Edgematch Features
Edgematic result

Review flagged locations ...
Edgematching of adjacent datasets workflow completed!

<table>
<thead>
<tr>
<th>Automated processing</th>
<th>Processing Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step1</td>
<td>6.52 sec</td>
</tr>
<tr>
<td>Step2</td>
<td>4.09 sec</td>
</tr>
<tr>
<td>Step3</td>
<td>2.15 sec</td>
</tr>
<tr>
<td>Total</td>
<td>12.76 sec</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Interactive processing (not counting final review)</th>
<th>QA Links</th>
<th>Time (2-3 review counts per minute)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Review Count (locations or feature groups)</td>
<td>~ 193</td>
<td>~ 1 - 1.6 hrs.</td>
</tr>
<tr>
<td>Edit Count (field values)</td>
<td>192</td>
<td></td>
</tr>
</tbody>
</table>
Examples of Align Features

Inconsistent bordering features

Before

After

Would ALIGN_TO_CENTERLINE be a needed option?
Aligning stream features between map sheets

Pre-selection

Before AF

After AF

Identical parts to be removed

Remaining affected features replaced

Would ALIGN_TO_CENTERLINE be a needed option?
Conclusions and Future Work

Thanks to:

- Department of Public Works (DPW), Los Angeles County, USA.
- Resource Management Service, LLC, Birmingham, AL, USA.
- SwissTopo, Switzerland
- All others who supported us along the way.
Edge matching can be done more efficiently now

It takes a workflow:

- Automated tools produce highly accurate results and evaluate the information.
- Minimal interactive review and editing are likely necessary. The time is worth-investing.

It brings new live and value to your data

- Improved data quality and usability
- Seamless analysis and mapping
- Extended data sharing and collaboration

Please send us your feedbacks and share your stories ... 😊
Future work

New tools and enhancements

➢ Continue improving feature matching
➢ Further enrich output to facilitate post processing
➢ Develop new tools or options for other feature types and scenarios

Integrated processing and inspection system

➢ Design of Conflation Manager for ArcGIS Pro is underway

Formalization of workflows

➢ Common scenarios (e.g. multi-scale data updating, linking features of different scales)
➢ Incorporation of other data sources (imagery, lidar, GPS)
➢ Contextual conflation (spatially related features)
Conflation Manager (ConfMgr)
Recent papers


   http://www.ucgis.org/assets/docs/AutoCarto-UCGIS%202018%20Proceedings.pdf (page 95)


➢ Lee D (2015), Using Conflation for Keeping Data Harmonized and Up-to-date, ICA-ISPRS Workshop on Generalisation and Multiple Representation, 2015, Rio de Janeiro, Brazil.  


   http://goo.gl/iOoSGV

   http://goo.gl/JKGJbo
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Questions & Answers