Data Criticism:
A methodology for the quantitative evaluation of non-textual historical sources with case studies on Silk Road maps and photographs

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http://dsr.nii.ac.jp/
Digital Silk Road Project

- Digital Humanities: Collaborative work among informatics + humanities scholars.
- Databases and digital resources are publicly accessible on the Web.

http://dsr.nii.ac.jp/
Toyo Bunko Rare Books

- Digitization of 203 books, 59358 pages.
- Collection of relevant academic references.
- Manual input of captions and TOCs.
- OCR for full-text search (with errors).

http://dsr.nii.ac.jp/toyobunko/
[Q] A Map can be Used as Fact?
Evaluation of the Map

• Error is bigger along longitude than latitude (limitation of survey technology at the time).
• Error tends to be accumulative.
[A] It should be Criticized

Numerical data
Spatial data (map)
Visual data (photo)

Spatial / visual evidences for historical studies.

Data

Criticism
Inquiry

Historical Fact

Digital Tools: Computational Algorithms and Databases
Textual and Data Criticism

**Textual Criticism**
- Well developed.
- Qualitative.
- Human reading and interpretation.
- Textual media.

**Data Criticism**
- To be explored.
- Quantitative.
- Computational algorithm.
- Spatial and visual media or multimedia.
Case Studies on Data Criticism

1. Qianlong Map (Beijing)
   – Massive geometric correction.
   – Discovery of mis-arrangement.

2. Stein Map (Silk Road)
   – Maps and photographs as evidence.
   – Identification of “missing” ruins.

3. Grünwedel Map (Gaochang)
   – Interpretation of topological maps.
   – Rediscovery of the value of “untrusted” sources.
1. Qianlong Map (Beijing)
Massive Geometric Correction

Huge size = W 13 m x H 14 m
Many sheets = 203 sheets in total
Massive pixels = 29 billion pixels

- Control points + lines:
  We proposed a new geometric correction.

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Discovery and Digital Survey

- **Discovery**: 5 sheets have mis-arrangements due to improper reconstruction in the past.
- **Digital Survey**: Place-names were checked to make a comprehensive gazetteer.
2. Stein Map (Silk Road)

- Stein’s map “Innermost Asia” was registered and displayed on Google Earth satellite images.
Problem of “Missing” Ruins

- Oi-tam, ruined fort
- Bögan-tura
- Buluyuk (Shipang, Sassik-bulak, Kazma)
- Murtuk-ruins
- Yoghān-tūra
- Chīkkan-köl
- Bedaulat’s town, Bēsh-kāwuk, Kosh-gumbaz
- Yutōgh
• Some ruins were reported by 20\textsuperscript{th} expeditions, but are missing in recent survey reports.
Locating “Murtuk Ruins”

Based on error information of maps, our guess about the location of Murtuk Ruins is represented as  □

Estimated error: west-southwest 5.6 km
Wujiang-bulak (烏江不拉克)

「吐魯番地區文物普查資料匯編」『新疆文物』1988-3（普查）
「吐魯番地區遺跡調查報告」『アジア史研究』29号, 2005

烏江不拉克烽火台
烏江不拉克故城
烏江不拉克古墓
伯西哈石窟
Murtug
Anlage 2
Stein’s map and satellite images for the same area. Each source reports different ruins due to different conceptualization.
Photographs as Evidence

伯西哈石窟(烏江不拉克併塔)

Murtuk Ruins (M. B. I)

烏江不拉克烽火台

Murtuk Ruins (Ruined Shrine M. C. I)
3. Grünwedel Map (Gaochang)

How to use the previously “untrusted” map?
Inconsistencies in Gaochang Maps

Aurel Stein

Albert Grünwedel
Topological Map

Two Methods for Map Registration

Geometric Correction

All points are registered.
Shapes are distorted.

Single-Point Registration

Single point is registered (but no other points).
Shapes are not distorted.
Mappinning (Map+Pinning)
http://dsr.nii.ac.jp/digital-maps/mappinning/
Topological Interpretation

Where is ν and μ?
We have multiple candidates...

Search for a road in north of γ and ο, and a road between the inner wall to the wall gate.

Hypothesize the location of ν and μ (to be verified later).

Maps designed for navigation purposes should preserve the topology, not to get lost when visiting there again.
Error Distribution in Gaochang

- Composed of several regions with different error patterns.
- Grouping may be related to the table of contents.
- “Topology” is the key for reasonable interpretation.
Identification of Most Ruins

Linking expedition results to recent surveys may lead to new interpretations.
Linking Entities Across Sources

Textual criticism

Textual source A

Place name S

Textual criticism

Textual source B

Place name T

Geographic
And Visual Relationship

Place name U

Place name V

Data Source C, D, E...

Data criticism
Historical GIS and Map Criticism

- **Historical GIS**
  - Source
  - Criticism by human
  - Digital Tools (GIS)
  - Analysis of Digital Data

- **Map Criticism**
  - Source
  - Criticism by human and computers
  - Digital Tools
  - Analysis of Sources
Our Contribution

1. We proposed a basic strategy for the criticism of spatial / visual sources, especially maps.
2. Digital tools to be added into methodological commons in the area of data criticism.
3. Data criticism (or inquiry) can increase the value of previously “untrusted” sources.
4. Integration of visual and textual sources may lead to the discovery of new historical facts.
Data Criticism for Other Sources?

- Computational algorithms and databases help criticism and inquiry.
- Similar ideas can be applied to textual criticism?
Digital Silk Road Project

• Website
  – http://dsr.nii.ac.jp/

• Toyo Bunko Digital Archive
  – http://dsr.nii.ac.jp/toyobunko/

• Silk Road Maps
  – http://dsr.nii.ac.jp/geography/

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