

RESEARCH PROPOSAL

Spatial Narratives of the Silk Road: Hexi Corridor (Gansu Corridor)

1. Project Summary

This project seeks to bridge the gap between Geographic Information Science (GIS) and Chinese material culture by applying high-precision spatial analysis and digital modeling to archaeological sites along the ancient Silk Road (partially passing through Gansu Province). Focusing on the Hexi Corridor (Gansu corridor), which carries thousands of years of cultural and economic exchanges. The research will utilize remote sensing, 3D geometry reconstruction, and different data models to analyze the distribution and preservation of cultural relics. The project aims to transform static historical artifacts into interactive digital entities that reveal the "material traces" of civilization over time.

2. Project Description

The ancient Silk Road is not merely a path of commerce but a repository of material culture that has persisted through centuries. With the rise and fall of civilizations, they leave behind material fragments that require structured, spatial interpretation to be fully understood. This project focuses on the Gansu Province section of the Silk Road, utilizing GIS technologies to "identify" the archaeological sites through a technological yet humanistic lens.

Research question(s):

1. How can spatial thinking and remote sensing reveal previously unidentified patterns in the distribution and degradation of Silk Road archaeological sites?
2. In what ways can Digital Twin frameworks and linked data models (RDF/SOSA) provide a "Single Source of Truth" for the multidisciplinary study of Chinese relics?
3. How does the integration of 3D geometry and spatial context enhance our understanding of the "materiality and time" of individual cultural artifacts?

Relevance and significance:

Traditional studies of the Silk Road often focus on philology or history; however, contemporary humanities increasingly require scholars who can bridge the boundaries between science and art. This project relates to the state of the field by building upon initiatives like Digital Dunhuang, moving from simple digitization to complex, interactive spatial analysis. It contributes to scholarship by introducing computational geometry (such as snap-rounding and triangulation) to ensure the mathematical and topological integrity of digital cultural heritage models.

Methodology:

1. Data Collection: Utilizing remote sensing data and geospatial web standards (OGC APIs) to monitor cultural landscapes.
2. 3D Modeling: Applying Easy3D and C++ based geometric algorithms to reconstruct the 3D geometry of relics with high precision.
3. Semantic Integration: Implementing linked data models (RDF/SOSA) to connect sensor-based environmental monitoring data (e.g., moisture/temperature at a site) to the digital BIM/IFC representation of the structure.
4. Spatial Analysis: Using Python and SQL to perform interpolation and runoff modeling to assess the impact of environmental factors on site preservation.

Challenges, pitfalls, and limitations:

A primary challenge is the potential gap in my formal training in classical archaeology and art history. I will address this through coursework within the Leiden Institute for Area Studies (LIAS). Technical challenges include data acquisition in remote Gansu regions and ensuring bandwidth for real-time monitoring systems in areas with limited infrastructure.

3. Chapters

1. Introduction: Bridging Geomatics and the Humanities.
2. The Spatial Distribution of the Silk Road: A Remote Sensing Analysis of Gansu's Landscapes.

3. Digital Twins of the Past: 3D Reconstruction and Topological Integrity of Cultural Relics.

4. Semantic Heritage: Utilizing Linked Data and SSN/SOSA for Multi-Domain Relic Interoperability.

5. Conclusion: The Future of Digital Material Culture Studies.

4. Work Plan

- Literature review in Chinese Studies and LIAS coursework to bridge knowledge gaps.
- Fieldwork in Gansu Province; data acquisition via remote sensing and 3D scanning of selected relics.
- Development of the Digital Twin framework and spatial data processing using Python/C++.
- Final analysis, report writing, and contributing to activities and events.

5. Ethical Issues

Research will comply with the guidelines, focusing on cultural heritage sensitivity and the secure handling of geospatial data related to non-excavated or vulnerable archaeological sites.

6. Related Materials

[1] Shi, Y., Guo, M., Zhao, J., Liang, X., Shang, X., Huang, M., ... & Zhao, Y. (2024). Optimization of structural reinforcement assessment for architectural heritage digital twins based on LiDAR and multi-source remote sensing. *Heritage Science*, 12(1), 1-19.

[2] Herlé, S., Blankenbach, U. D. I. J., & Bill, U. D. I. R. (2021). A GeoEvent-driven architecture based on GeoMQTT for the Geospatial IoT. *Geoinformations-systeme* 2021, 25.

[3] Hulsewé-Wazniewski Foundation. Hulsewe Wazniewski - Home. (n.d.). <https://www.hulsewe-wazniewski.nl/>