Digital Silk Road: Reviving Silk Road Using Massive Geospatial Data

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Data-centric approaches, regarding data as the primary target of research, are emerging in many disciplines as the data acquisition and storage costs keep a constant decrease. Data-centric approaches were first applied to science, where sensors and models can produce a vast amount of observation and simulation data. In contrast, humanities (and cultural heritage) are behind science in the application of data-centric approaches due to the difficulty of automatic and systematic treatment of the target. Firstly, the digitization of cultural heritage objects requires various technologies depending on the shape, media, fragility, and so on. Secondly, the description and analysis of cultural heritage needs to incorporate the knowledge of various domains, often in a qualitative manner. To solve this problem, we create an information infrastructure for studying cultural heritage in a data-centric approach to discover hidden structures in the massive amount of data. This approach, often called as digital humanities, consists of three steps, namely 1) digitization, 2) integration, and 3) interpretation. This presentation introduces two of our activities related to geospatial data, namely 1) digital excavation and 2) the revival of cities, and how three steps were applied in these activities.

The first activity, digital excavation, is for "digging into" heterogeneous digital resources to uncover hidden relationships. This research starts with the digitization of physical materials such as books, followed by image processing for extracting textual and graphic information. Old maps are especially important resources, so they are geometrically corrected for comparison with current maps and high resolution satellite images to identify geographical features on maps and images. The help of computers is a must in the process of finding hidden relationships, describing them in a reusable format, and storing them in the databases. This enabled a thorough inspection of resources, which has not been possible with manual inspection. We expect that this process can be further enhanced with a participatory mechanism where users worldwide can contribute their knowledge to the system so that more input from users can provide better output to users.

The second activity, the revival of cities, deals with the reconstruction of cities based on digitally-created models. Our current effort focuses on the citadel of Bam, Iran, where the largest mud brick structure was completely collapsed by the earthquake in 2003. Recent progress on image-based 3D modeling, such as laser scanning or structure-from-motion algorithms, cannot be applied to this site, because the buildings

are already gone by the destruction of the earthquake. Hence we collected heterogeneous data before and after the earthquake and established a data repository on Bam based on semantic Web technology, such as ontology and RDF (resource description framework). We then applied manual and semi-automatic methods for creating the 3D models of the old Bam city. In another activity, we tried the revival of the old Beijing city, China, from old maps and old photographs. Here a future challenge includes creating a virtual city model to understand the history of the city through data and simulation.

Digital Silk Road Project started in 2001, and most of our research outcome is accessible on the Website (http://dsr.nii.ac.jp/). We have been working with humanities researchers, and this is the core value of the project because all members have their own strength and weakness. Computer scientists can understand systems and algorithms, but cannot understand the meaning of cultural heritage. Humanities researchers know more about culture, but they are not used to the age of information explosion, where massive amount of historical materials can be analyzed with the help of computers.

Our approach initially received a suspicious view from humanities researchers, especially historians, who believe that the best way of doing research is to read a small amount of text critically to the detail and construct their own stories for interpreting history. However, they later recognize the effectiveness of our approach in the sense that comprehensive and systematic treatment of a large amount of resources can give a total view of history, which cannot be obtained from a traditional approach. Digital humanities, or data-intensive humanities, will change how we access and understand the vast amount of cultural heritage. They will enable researchers to understand culture from multi-disciplinary and multi-culture viewpoints, using not only famous resources but also orphan resources which are now hidden in the massive amount of resources but can be used after we search and link them. They will also give an impact on the general public through providing easier and richer access to our cultural heritage.

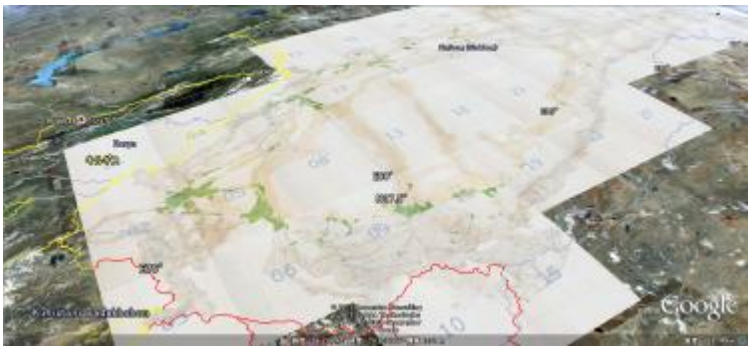

Figure: Geometric correction of Stein maps (in the early 20th century) on Google Earth.