Southeast Asian Studies, Vol. 46, No. 4, March 2009

Application of Geo-Informatics to the Study of the Royal Road from Angkor to Phimai

Surat LERTLUM* and SHIBAYAMA Mamoru**

Abstract

Geo-informatics technologies are utilized in the conservation and management of cultural heritage and in related studies. For example, remote sensing (RS) and Geographical Information System (GIS) technologies are utilized as tools for archaeological analysis together with conventional methods. Around the world, RS and GIS technologies have been used to assist archaeologists to pinpoint and identify archaeological sites. With reference to these applications of geo-informatics, the Living Angkor Road Project came up in 2005 with the concept of integrated studies based on interdisciplinary collaboration in an archaeological study in Thailand and Cambodia [Lertlum *et al.* 2007]. In this project, archaeological and anthropological knowledge was used together with geo-informatics, information and geo-physics technologies to identify, pinpoint and study the ancient road from Angkor in Cambodia to Phimai in Thailand that is described in the inscription of the Pra Khan temple in Angkor, Cambodia.

Application of geo-informatics to this project revealed the following results: (1) Application of GIS/RS confirmed the hypothesis proposed by archaeologists based on the Pra Khan inscription that an ancient road once ran from Angkor in Siem Reap area of Cambodia to Phimai in Nakorn Ratchasima, Thailand. In particular, parts of the ancient road were clearly recognized by analyzing the archaeological sites found standing along a line on satellite images and aerial photographs. (2) Buildings and facilities related with the ancient road, such as ancient bridges, ancient industry sites, and *dharmshala*s (rest-house chapels), were newly discovered through the same analysis. (3) Predictions and assumptions derived from RS/GIS methodologies were verified by field surveys conducted by specialists in archaeology, anthropology, and informatics. In other words, RS/GIS methodologies also could be used to decide an area of field survey in advance. This approach in area studies exactly corresponds to one of the proposed methodologies of Area Informatics [Shibayama 2005].

This paper describes the role and significance of geo-informatics in the study of the royal road from Angkor to Phimai, presents new findings obtained from application of geo-informatics in archaeological studies, describes how GIS/RS technologies were applied, and discusses effectiveness of applying the satellite image ASTER[1)] and SRTM[2)] elevation data in the project.

Keywords: Angkor, archaeology, area study, geo-informatics, Phimai, remote sensing and GIS, royal road

* Chulachomklao Royal Military Academy, Thailand
e-mail: surat@ait.ac.th
** 柴山　守, Center for Southeast Asian Studies, Kyoto University
e-mail: sibayama@cseas.kyoto-u.ac.jp

1) ASTER (Advanced Spaceborne Thermal Emission and Reflection Radiometer): It can be used for geological survey, resource exploring, and monitoring global warming, acid rain, and so on. Resolution is 15 m. Scanning width is 60 km. Scanning interval is 16 days.

2) SRTM (Shuttle Radar Topographic Mission): The SRTM is digital elevation data produced by NASA originally. URL: http://srtm.csi.cgiar.org/Index.asp

I Introduction

Geo-informatics technologies have recently been utilized effectively in many applications to area studies in various fields of analyses, such as land use/land cover change, urban studies, movement of human activities, archaeological and historical studies on conservation, preservation, management of cultural heritage, and in other related studies. For example, in archaeological and historical studies, GIS/RS can be used as tools for archaeological analysis. In various cases around the world, geo-informatics technologies in the form of RS and GIS have been used to assist archaeologists to pinpoint and identify archaeological sites. Examples include the discovery of a buried section of the Great Wall of China by analyzing SIR-C[3] radar data from the space shuttle [Associated Press 2009]. It had never been imagined before how geo-informatics technologies could effectively assist the conventional methods of archaeologists. The application of SIR-A[4] to the lost city of Ubar [Blom *et al.* 1997] and AirSAR at Angkor are two of the best-known studies [Lertlum *et al.* 2001a].

From 2005 to 2008, the Living Angkor Road Project (project leaders: Surat Lertlum (Thailand) and Im Sokrithy (Cambodia)) was conducted by researchers from Chulachomklao Royal Military Academy, Silpakorn University, Prince of Songkla University, Fine Arts Department of Thailand and researchers from APSARA Authority,[5] Cambodia with funding support from the Thailand Research Fund (TRF). This project involved detailed studies of the royal road from Angkor to Phimai, its utilization, the people who lived and used the royal road, and the culture that has now disappeared. The most advanced technologies in the project were technologies of RS, GIS, geo-physics, and information technology and these were employed together with conventional archaeological methods. Also, in order to share information and data effectively among collaborating scholars, an information sharing system which includes gathering and retrieval functions was newly developed. In addition, it was considered that the data derived from the project could be further utilized in related works in the fields of land use planning and urban development related to cultural management, tourism, and so on.

Even though the application of geo-informatics to cultural studies is still a new field of study, it is proving to be an indispensable adjunct to conventional methods of cultural studies. However, the ways in which geo-informatics is applied to cultural studies might vary from case to case and location to location.

This paper illustrates how geo-informatics was applied to study the royal road from Angkor to Phimai and the results which were newly obtained. Also, the role and significance

3) SIR-C (Spaceborne Imaging Radar-C): The SIR-C is part of an imaging radar system that was flown on board two Space Shuttle flights (9–20 April, 1994 and 30 September-11 October, 1994). The USGS distributes the C-band (5.8 cm) and L-band (23.5 cm) data. URL: http://eros.usgs.gov/products/satellite/sirc.php

4) SIR-A: See above footnote 3). The SIR-A used an L-band SAR HH-polarized system, which was capable of 40 m resolution in images whose swath widths were 50 km (31 mi).

5) APSARA Authority: Authority for the Protection and Management of Angkor and the Region of Siem Reap, URL http://www.autoriteapsara.org/en/apsara.html

of applying geo-informatics to the archaeological studies are introduced.

II Geo-spatial Data Processing in Cultural Studies

From the view point of data availability, the geo-spatial data that can be utilized for cultural studies is quite different from that employed in other applications, such as census analysis, measured data analysis, and so on. In other words, it is difficult to separate the gathering and processing of data in terms of phases of input, processing, and output, which is the general pattern of information processing. The informatics specialist must understand the meaning of data and the story of the past in order to analyze it appropriately. Therefore, data that can tell us about the past can be utilized only in collaborative work between informatics specialists and archaeologists. In most of cases, archaeological studies treat events that occurred before any geo-spatial data was recorded or produced. The best solution in this kind of study is to utilize the oldest data available, such as old aerial photographs, old maps and ancient documents [Lertlum 2003a]. This is probably the most valuable information that we can acquire when we need to study further back in time. In addition, in the current situation, high resolution satellite images such as QuickBird and IKONOS are also available, but at a high cost. The utilization of existing aerial photographs is still an alternative way to analyze a target area with comparable results to high resolution satellite images [Lertlum and Moore 2005].

In utilizing old aerial photographs for area studies, the most effective way is to integrate the old aerial photographs with other materials, such as current aerial photographs, satellite images, and the GIS database with geo-referencing information [*ibid.*]. This is the critical point of utilizing old aerial photographs. Since old aerial photographs generally lack geo-referencing information, such as latitude and longitude at the corners of the photograph, it is difficult to map them onto other materials accurately. Therefore, the main issue with old aerial photographs lies in geo-referencing them accurately with other material in terms of position and scale. To solve this issue, the geo-referencing information from current aerial photographs, satellite images, and/or the GIS database can be used for integrating the old aerial photographs. For example, Fig. 1 illustrates a sample of geo-referencing of old aerial photographs with an image of Landsat ETM[6] for the Angkor area. The technologies mentioned above also were applied in the project.

III Use of Geo-informatics for Area Studies in a Multi-disciplinary Approach: The Study of the Royal Road from Angkor to Phimai

In this research, archaeological and anthropological knowledge together with geo-informatics,

6) Landsat ETM: Landsat with the Enhanced Thematic Mapper sensor. The ETM instrument included an eighth band with a spatial resolution of 30 m. This data can be applied for land use mapping, geology, hydrology, environmental monitoring, and so on.
URL: http://landsat.gsfc.nasa.gov/about/

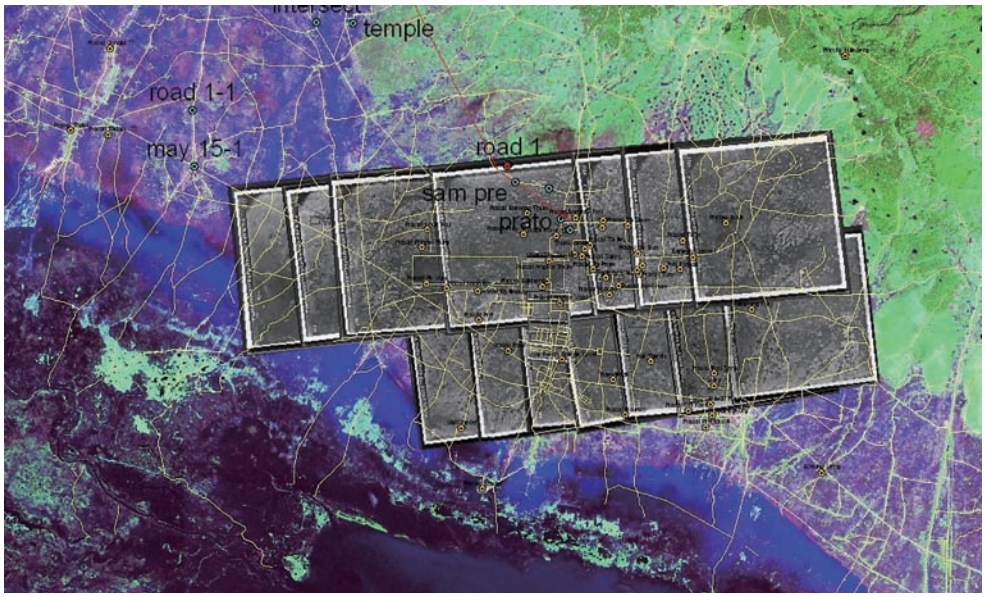


Fig. 1　A Sample of Geo-referencing of Old Aerial Photographs with Image of Landsat ETM (2002) for the Angkor Area

geo-physics and information technologies was utilized to identify and pinpoint the ancient road from Angkor to Phimai that was described in the inscription about Jayavarman VII, the great king of Cambodia. From archaeological and historical studies, we had learnt that during his reign, the Khmer empire expanded to cover most of Southeast Asia. The Pra Khan inscription mentions that Jayavarman VII built infrastructures for travelers, such as 17 *dharmshala*s (rest-house chapels) along the royal road from Angkor to Phimai [Cœdès 1941].

This research aims to study the details of this ancient road, its utilization, the people who lived along and used the road, the ancient industries along it, and the cultures that have disappeared or that have continued to flourish. The most advanced technologies were applied in the field of RS, GIS, archaeology, anthropology, geo-physics and information technology. Information systems were also developed to gather data from this study for scholars to use. In addition, the data derived from this project can be further utilized for related works in the fields of land use planning related to cultural management, tourism, and so on.

The steps taken in this study were as follows:

(a) Review of previous studies about the royal road from Angkor to Phimai to identify in general the science and technologies that can be utilized, and what results can be expected from the proposed study.
(b) Preliminary analysis to utilize the result to develop a GIS database for field survey planning.
(c) Conducting field surveys.

(d) Conducting geo-physics experiments.
(e) Conducting archaeological excavations.
(f) Developing GIS database from field surveys together with other related data for integrated analysis.
(g) Integrated analysis with all information.
(h) Proof of assumptions from the results of the integrated analysis.

The following explains how we utilized geo-informatics for this study. Section III. 1 explains how we applied geo-informatics at the beginning of the study in making survey plans (step (b)). Section III. 2 explains how we applied geo-informatics to the data from surveys (steps (f) and (g)).

III. 1 *Utilization of Remote Sensing and GIS for Survey Planning*

In order to start the research work according to the proposed plan [Lertlum *et al.* 2007], existing archaeological data related to the royal road as gathered. Then, the GIS database was implemented to make a preliminary study of the royal road from all related geo-informatics data, including old maps, aerial photos, satellite images, and location databases of all archaeological sites in the study area. A buffer zone[7] was created around the linked path connecting the already known *dharmshala*s. Next, the database was used to make plans for a field survey. From analysis of this database, some parts of the royal road could be identified based on assumptions and knowledge about the pattern of the royal road, especially, in

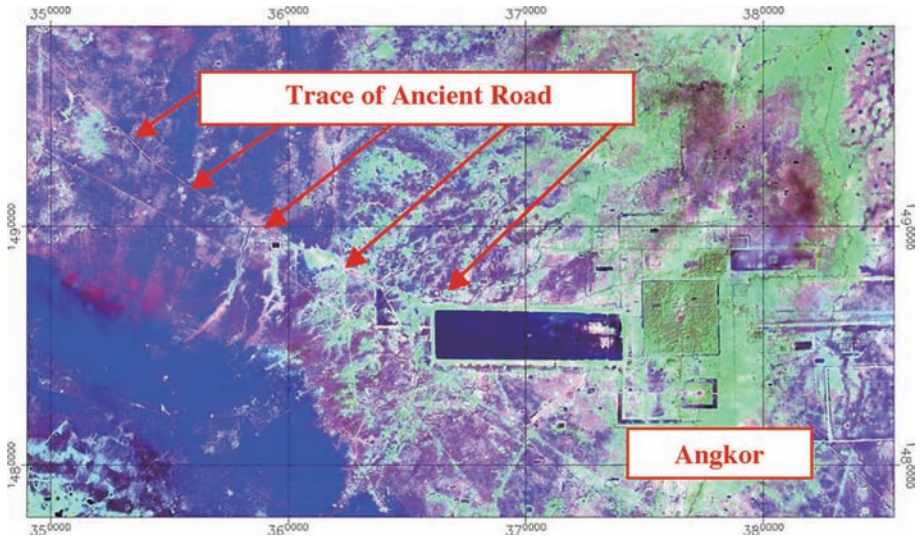


Fig. 2 Ancient Road Running West from Angkor over Landsat ETM (2000)

7) Buffer zone: One of functions which provided by GIS technologies. This function allows users to specify appropriate buffer area from the original point, line, and polygon.

Cambodia, where the landscape has not changed greatly, but confirmation from the surveys was needed.　The following items are the phases that were carried out:

(1) The topographic properties such as surrounding landscape, waterways, and the linear pattern of the ancient road that can be identified from satellite images or aerial photographs, as shown in Fig. 2, were listed as common properties of the ancient road.　This process was done manually since the classification process could not separate between the patterns of the ancient road and current roads.　In this case, we utilized the ancient road from Angkor to the west as our sampling site (the ancient road running west from Angkor to Sadok Kok Thom temple near the Thai border).　The ancient road can be recognized, as shown by the arrows.

(2) The locations of all the previously identified *dharmshala*s along the royal road from Angkor to Phimai were utilized together with aerial photos and satellite images.　In particular, old

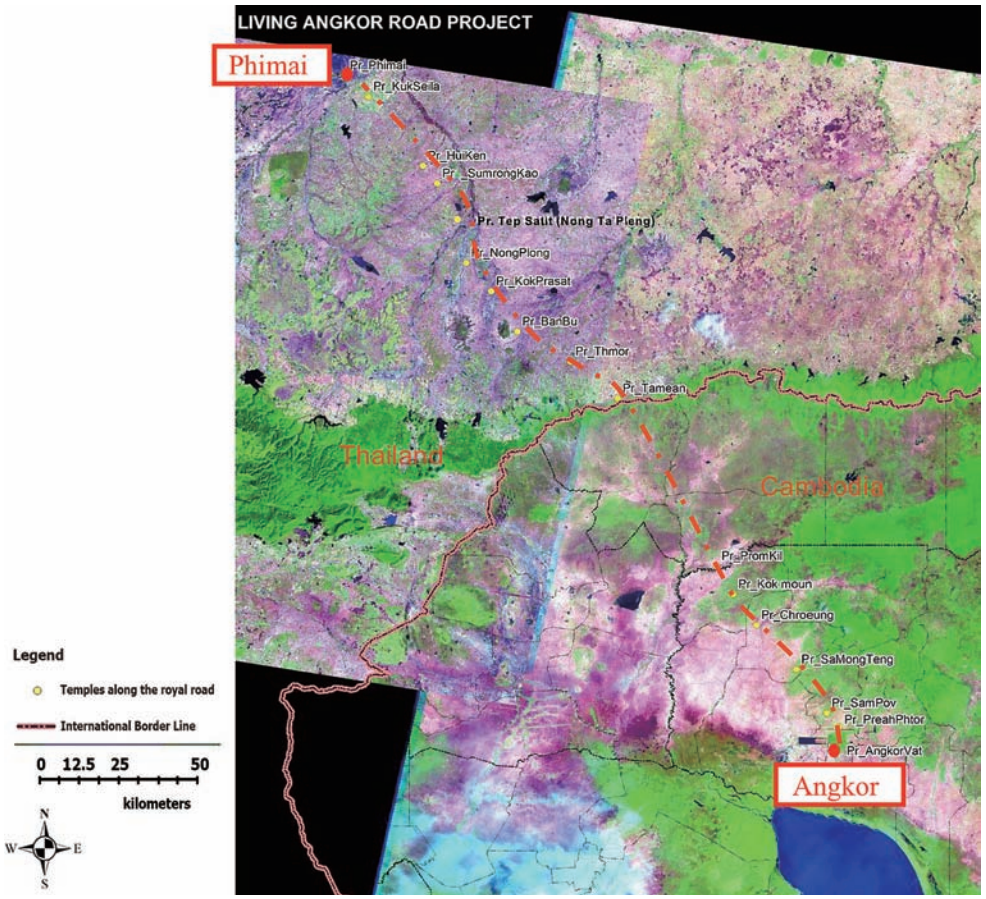


Fig. 3　*Dharmshala*s (yellow dots) along the Royal Road on Landsat ETM (2000)
Note: Pr stands for *Prasat* (stone temple).

aerial photographs, (World Wide series from U.S. Army taken in 1954 and the Williams-Hunt collection taken during World War II) which show little disturbance of the landscape were geo-referenced and overlaid. Such satellite images and aerial photographs were used together with the information from step (a) to trace the royal road and plan field surveys. In addition, the patterns of the landscape around the known *dharmshala*s along the royal road, a sample of which is shown in Fig. 3, were compared. We found that all the *dharmshala*s are located near a water structure or waterway.

(3) Man-made structures along the royal road were identified. For example, water structures, ancient laterite bridges (see Fig. 14), and ancient communities in a 1-km buffer zone on both sides of the road were explored from satellite images, aerial photographs, archaeological data, and previous survey data. This was easily performed using a function in the GIS. This result also was used for planning field surveys. Fig. 4 shows the landscape of the ancient community of Muang Fai from an old aerial photograph (World Wide series: 1954). Muang Fai is an important ancient city of northeast Thailand. From the buffering process, Muang Fai lies within the 1-km buffer zone of the royal road. This information is also very important for illustrating the relationship of the royal road to the ancient communities in the area.

(4) To identify two missing *dharmshala*s, the information about the characteristics of locations selected for *dharmshala*s from (2) together with the topography of the surrounding were compared with the possible locations of the two missing *dharmshala*s. The next step was to investigate whether the possible locations located near ancient communities, ancient waterways, and whether the distance was within the average distance between *dharmshala*s (calculated to be approximately 15 km from the known locations of *dharmshala*s in Cambodia). As a result, the possible locations of the two missing *dharmshala*s were located and identified by field surveys, as shown in Figs. 5 and 6. One rest house is Prasat Kok Phnov in Figs. 5 and

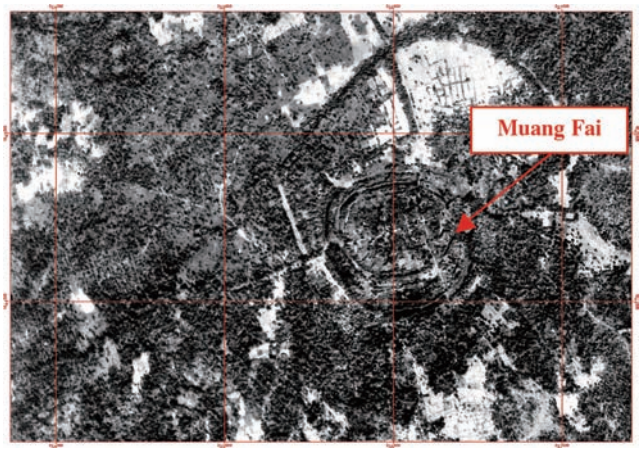


Fig. 4 Ancient Community Muang Fai in 1954 Aerial Photograph

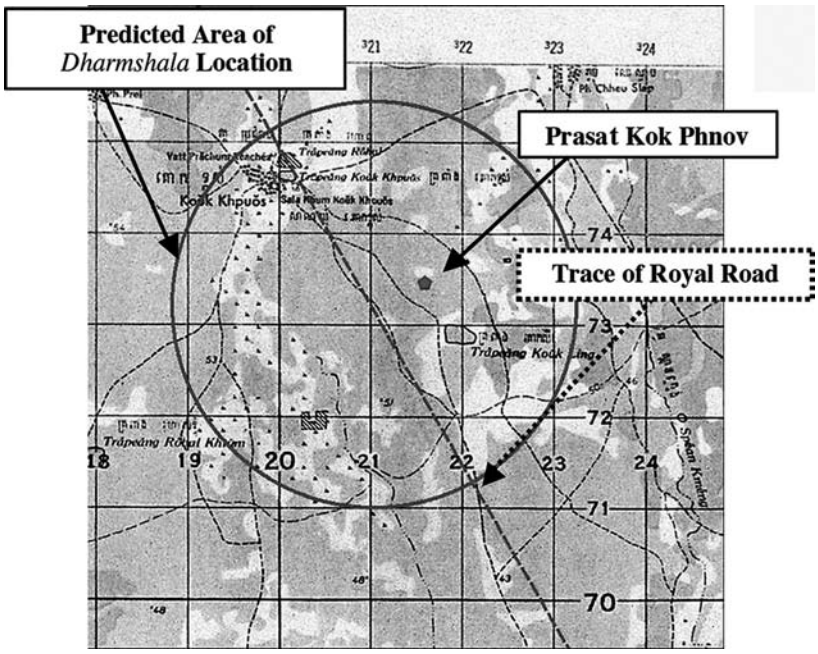


Fig. 5　Location of Prasat Kok Phnov and the Predicted Area (Circled)
(Topographic map 1 : 50,000)

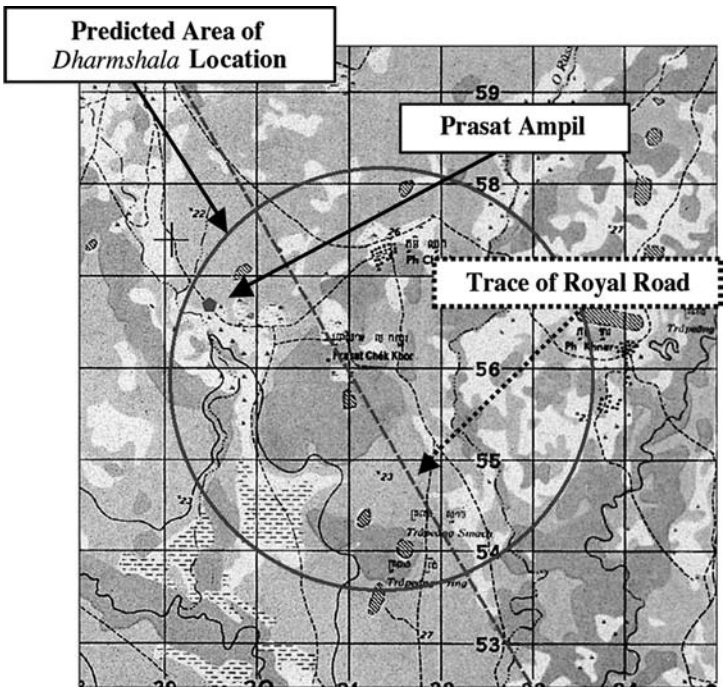


Fig. 6　Location of Prasat Ampil and the Predicted Area (Circled)
(Topographic map 1: 50,000)

13(b); the other is Prasat Ampil in Figs. 6 and 13 (a). These processes required manual interpretations from the experts of the factors listed above, since the criteria were too complex for any available GIS software.

(5) To identify the royal road passing Dong Rek mountain, the integrated activities of GIS analysis and interviews in the local community were conducted. The location of the royal road

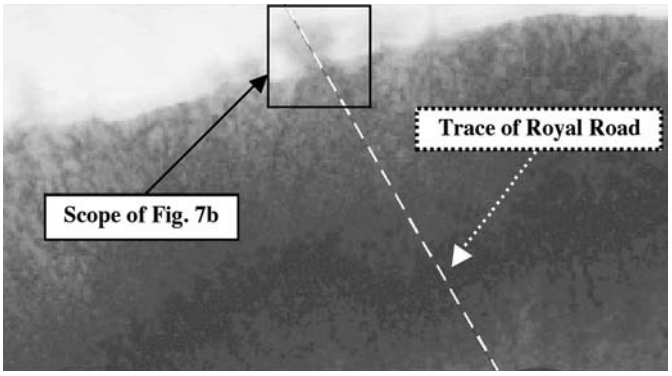


Fig. 7a Elevation in the Area of the Royal Road Passing over Dong Rek Mountain
[SRTM data (90 m. resolution)]
Note: dark gray->light gray: low->high elevation

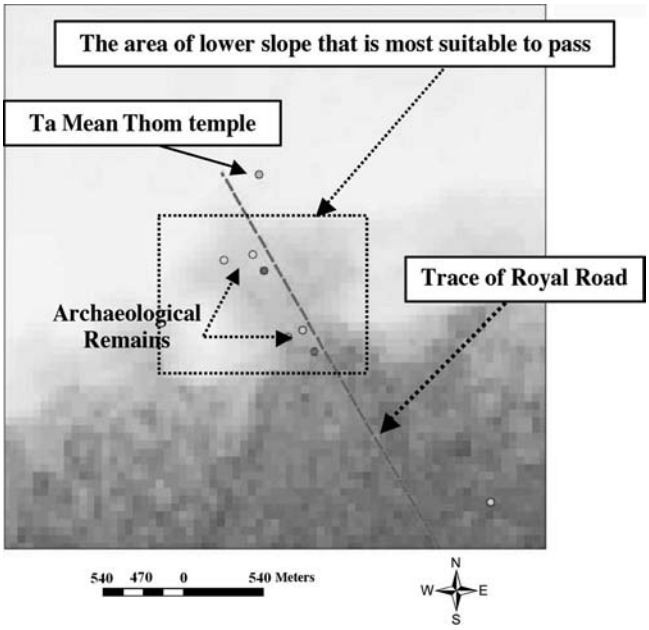
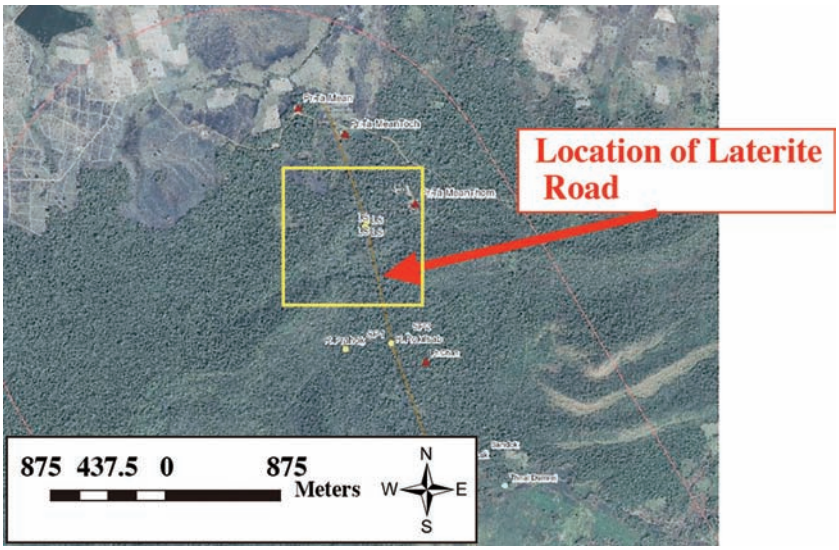


Fig. 7b Detail of Royal Road Passing over Dong Rek Mountain
[SRTM data (90 m. resolution)]

pass through Dong Rek mountain was first approximated by analysis of the elevation data (SRTM), as shown in Fig. 7, to identify the lowest slope area in the vicinity of the royal road crossing the Ta Mean pass. This prediction was based on location data of the Ta Mean *dharmshala* on Dong Rek mountain and related information. The location of the pass was

(1) Scenery of the Road

(2) Shoulder of the Road



(3) Road in Satellite Image (IKONOS, 2003)

Fig. 8 Road over the Dong Rek Mountain

confirmed by the field survey. To find the approximate location of the pass, we used the result of SRTM analysis of the slope and aspects of the area surrounding Ta Mean *dharmshala* onward to the Cambodia side of the royal road. From the slope and aspects of the area, we found that the lowest slope area is located on the southeast of Ta Mean *dharmshala* and Ta Mean Thom (an important Khmer temple southeast of Ta Mean). Since the area was thought to still contain many land mines, the next step was to interview members of the local community about the history of the pass and in what direction that their ancestors had used the pass over the mountain. The result of the interviews corresponded with the result from our analysis. Their ancestors had used the path on the southeast of Ta Mean *dharmshala* to cross the Dong Rek mountain. We then surveyed the path on the southeast of Ta Mean *dharmshala*. As a result, we discovered that the ancient road over the pass was constructed of laterite, as shown in Fig. 8.

III. 2 *Analysis of Survey Data*

After the surveys, the information and data collected from all fields of study, including locations of archaeological sites, archaeological samples, topographical situation, and location of ancient communities, were integrated and analyzed. In this study, experience had shown that RS and GIS technologies alone cannot be utilized effectively in archaeological research. In order to achieve the aim of a project to identify and study the details of the royal road from Angkor to Phimai, a multi-disciplinary approach is the most significant and suitable. The results of the analysis are as follows:

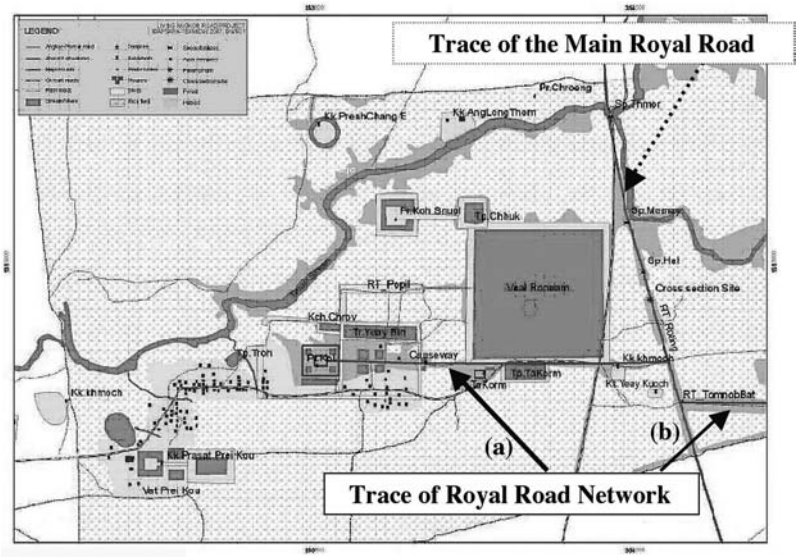


Fig. 9 Sample of the Network of Ancient Roads to Ancient Communities in Cambodia
Source: APSARA authority, Cambodia

(1) Identifying the Ancient Road Network

From the field surveys and RS/GIS and archaeological analyses, we learned that the ancient road was not a single road, but it consisted of a network of ancient roads to ancient communities and ancient industries. By utilizing GIS analyses, we identified the function of these small ancient roads. The result of this part of the study illustrates the effectiveness of GIS analyses. Fig. 9 illustrates a sample of the network of ancient roads in Cambodia, where there are two small ancient roads connecting the royal road to nearby ancient communities.

(2) Identifying the Relationship between Ancient Industry and the Royal Road

The relationship between ancient industry and the royal road was identified by mapping the ancient industry sites from the surveys in the buffer zone of the royal road. From the mapping, ancient industry sites, such as ceramic kiln sites and iron smelting sites, were found to be concentrated in the vicinity of the royal road. The highest concentration of ancient industry sites along the royal road from Angkor to Phimai are located in Ban Krud, Burirum Province, Thailand near the border with Cambodia. Part of this area is illustrated in Fig. 10. In

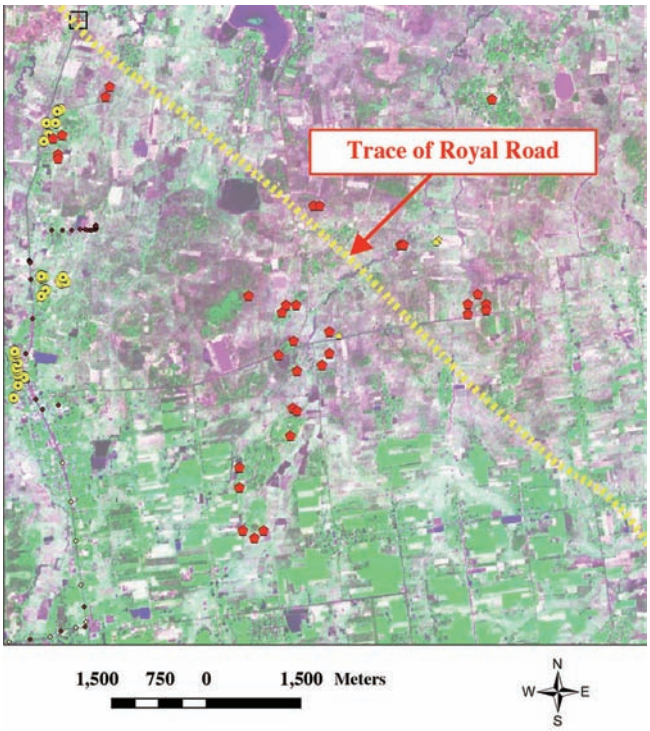


Fig. 10 The Relationship between Ancient Industry and the Royal Road in Ban Krud, Burirum Province, Thailand with Landsat ETM (2000) as Background

Note: The red dots are ceramic kiln sites. The yellow dots are iron smelting sites.

addition, the artifacts collected during the surveys could be identified as products from these ancient industry sites. The mapping of these ancient industry sites was valuable evidence the royal road was used for transporting goods between Angkor and Phimai.

(3) Remote Sensing for Geology Analysis of Ancient Industry Sites

In the case of the iron smelting industry, we utilized the ASTER satellite images to analyze the raw material that was used for the iron smelting process. Archaeological analysis of the iron smelting sites in Ban Krud, Burirum Province, Thailand, in the buffer zone of the royal road, as mentioned in (2), indicated that the raw material for the iron smelting industry must be laterite with sufficiently high iron content. We utilized the ASTER images of the area to calculate its geological index.[8] In this case, we calculated the geological index from the ratio of band 4 and 5 from ASTER. A high index value indicates the concentration of laterite. From the calculation, it was considered that the area was once rich in laterite, as shown in Fig. 11. The light color in Fig. 11 means a high density of laterite. However, we could not use this analysis alone to prove assumption about the geology of the area, since the geological index from ASTER can be affected by the land cover. We then also performed a geo-physics analysis of the studied area, including the study of magnetic anomaly and rock types, which also indicated that the area was rich in laterite. From these studies, it was concluded that one reason that the area was selected for setting up ancient industry sites was because of the presence of the raw material to produce iron.

In terms of the environment, the satellite images and aerial photographs show that the area was formerly dense forest, providing an important source of firewood. In addition, analysis of SRTM showed that all the ancient industry sites that we identified were located on the high ground of an ancient flood plain, as shown in Fig. 12.

IV Discussion: Geo-informatics in Cultural Studies

This paper has described one application of geo-informatics technologies to cultural studies through a case study of the royal road from Angkor to Phimai. In a multi-disciplinary study, the important point in the research process is for researchers to understand the approaches that were selected. In each participating discipline, the environment and methodology for research differs. Therefore, researchers have to take into consideration how to apply geo-informatics technologies to cultural studies. The environment of the landscape together with the objective and the data available are the most important elements to be considered before a study can be conducted. On the other hand, in most cases, geo-informatics technology alone cannot be applied to research, especially in cultural studies. Related fields of research need to be utilized in order to accomplish the mission of the project in the form of a multidisciplinary

8) Characteristics of geological components. The satellite image ASTER can be used for sensing the geological characteristics.

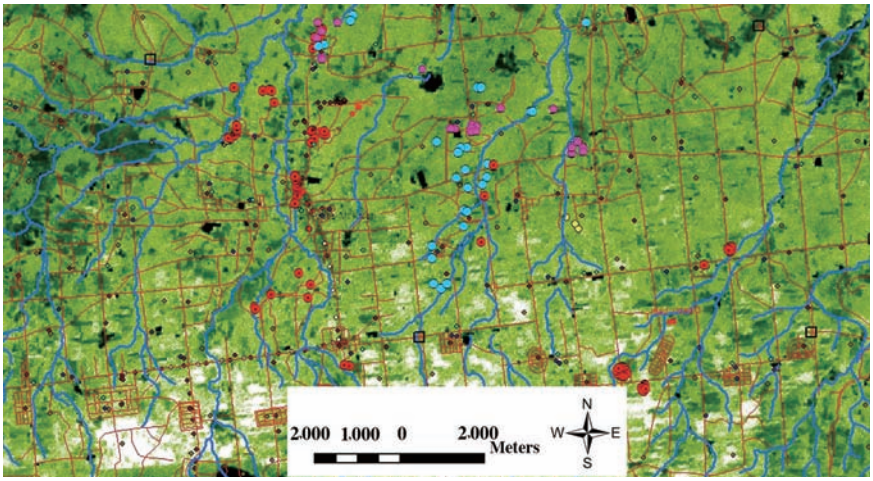


Fig. 11　ASTER Geological Index of Ban Krud Area with Ancient Industry Sites
[Geological Index (Channel 4/5) image]
Note: dark green->medium green->light green: low->medium->high laterite content
The red dots are iron smelting sites.　The blue and purple dots are ceramic kiln sites.

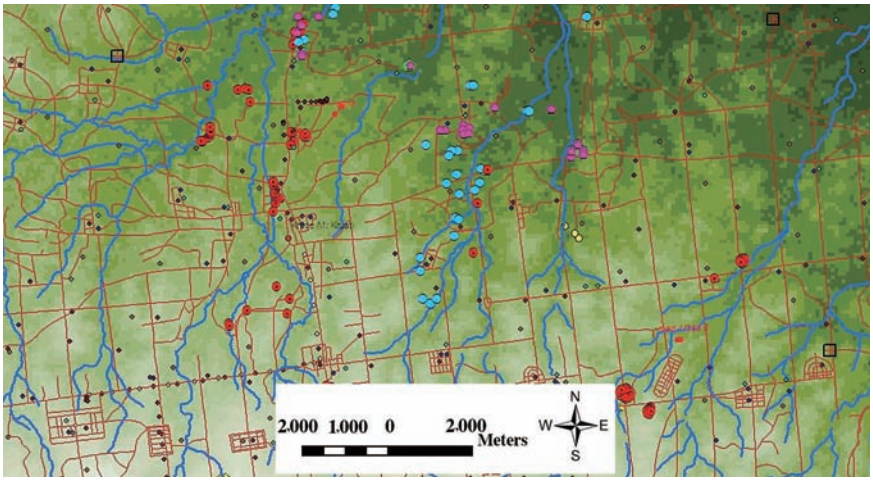


Fig. 12　SRTM Image of Ban Krud Area with Ancient Industry Sites
Note: dark green->medium green->light green: low->medium->high elevation
The red dots are iron smelting sites. The blue and purple dots are ceramic kiln sites.

approach.

In the present study, we discovered several features of the ancient road.　The most important items are as follows: (1) Two missing *dharmshala*s were identified, as shown in Fig. 13.　(2) Ancient laterite bridges were found along the ancient road in Cambodia, as shown in Fig. 14.　(3) Ancient industry sites were confirmed along the ancient road in both Cambodia and Thailand, as shown in Fig. 15. (4) Ancient communities were identified along the ancient road in both Cambodia and Thailand.

(a) Prasat Ampil

(b) Prasat Kok Phnov

Fig. 13 Identified Missing *Dharmshala*s

Fig. 14 Identified Ancient Bridges

Fig. 15 Field Survey in One of Ancient Industry Sites
Source: APSARA authority, Cambodia

We have also developed information servers[9] to contain all the information from this research project, so that other scholars can access this information. In addition, we have developed 3D models of *dharmshala*s, *arogyashala*s (hospital chapels), and ancient bridges that will be utilized in the simulation of ancient life along this ancient road. This simulation will be used as a learning tool for the younger generation in the near future.

In the second phase of this study, which was started in 2007, we studied the details of ancient communities and ancient industry sites along the royal road, the results of which can be utilized for eco-tourism purposes in the area along the royal road, especially in the area at the border of Thailand and Cambodia.

V Conclusion

The application of GIS/RS in this project has confirmed the hypothesis proposed by archaeologists based on the Pra Khan inscription that an ancient road once ran from Angkor in Cambodia to Phimai in Northeast Thailand. In particular, part of the ancient road was clearly recognized by analyzing the archaeological sites standing along a line on aerial photographs and satellite images. In this research, archaeological and anthropological knowledge together with geo-informatics, geo-physics and information technologies were utilized to identify and pinpoint the ancient road from Angkor to Phimai. The target area of a field survey could be estimated in advance more accurately using GIS/RS technologies compared with other materials such as archaeological maps and archaeological documents. Moreover, the features extracted and estimated by RS/GIS methodologies were verified by field survey conducted by specialists in archaeology, anthropology and informatics.

References

Associated Press in Beijing guardian.co.uk, Monday 20 April 2009
http://www.guardian.co.uk/world/2009/apr/20/great-wall-china-discovery

Blom, R.; Zairins, J.; Clapp, N.; and Hedges, G.R. 1997. Space Technology and the Discovery of the Lost City of Ubar. In *Proceedings of IEEE Aerospace Conference*, 1–8 Feb, 1997, Vol. 1, pp. 19–28.

Cœdès, G. 1941. La stèle de Práḥ Khằn d' Aṅkor. *Bulletin de l'É cole française d'Extrême-Orient (BEFEO)* 41 : 255–302.

Lertlum, S. 2003a. Remote Sensing and GIS for Archaeological Applications in Thailand: Case Studies of Royal Road from Angkor to Phimai, the Study at Sukhothai World Heritage Site, and Ayuttaya's Multi-temporal GIS Database. In *Proceedings of Nara Digital Silk Road Symposium*, Nara, 10–12 Dec, 2003.

————. 2003b. *Final Report on the Application of Remote Sensing and GIS for Research Study at Sukhothai World Heritage Site*. Submitted to UNESCO Bangkok Office, Sep, 2003.

Lertlum, S. *et al*. 2007. *The Final Research Report, Living Angkor Road Project*. Submitted to Thailand Research Fund, Feb 2007. (in Thai)

Lertlum, S.; and Moore, E. 2005. Williams-Hunt Aerial Photograph Collection. *Muang Boran Journal* 31(2): 38–42.

9) Living Angkor Road Project, URL: http://larp.crma.ac.th/, http://larp.su.ac.th/

Lertlum, S.; Murai, S.; Honda, K.; and Tantatsanawong, P. 2001a. The Identification of Historic Roadway and Human Settlement of Khmer Empire Using Remote Sensing/GIS and the Development of Historical and Archaeological Multi-Media GIS: Case Study of the Royal Road from Angkor to Phimai. In *Proceedings of Digital Silk Road Symposium, National Institute of Informatics*, Tokyo, 11–13 Dec, 2001.

————. 2001b. Application of AirSAR for Archaeology Study: Case Study of Combination of P, L, and C Bands to Identify Ancient Water Reservoir in Historical Towns in Phimai Area, Nakornrathchasima, Thailand. In *Proceedings of ISPRS Workshop on Virtual Reality and Recreation of the Past*, Ayutthaya, 26 Feb–1 Mar, 2001.

Shibayama, Mamoru. 2005. Area Informatics Approach for Exploring Thang Long-Hanoi Historical Heritage: Thang Long-Hanoi Project. In *Proceedings of International Symposium on Area Informatics and Historical Studies in Thang Long-Hanoi*, CSEAS, Kyoto University, 1–2 Oct, 2005.