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 World Heritage Site

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Introduction

Applications of Remote Sensing for Archaeology

- Air Photo
- Satellite Image
  - Visible
  - SAR (Synthetic Aperture Radar)
- Geo Radar
<table>
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<th>Pattern of Human Settlement (1)</th>
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| Courtesy of Mr. Thiwa Supachunya |
Pattern of Human Settlement (2)

<table>
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<th>Cross Sector</th>
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<td>![Diagram 1]</td>
<td>![Diagram 2]</td>
<td>![Diagram 3]</td>
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<tr>
<td>Cross Sector</td>
<td>![Diagram 7]</td>
<td>![Diagram 8]</td>
<td>![Diagram 9]</td>
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</table>

Courtesy of Mr. Thiwa Supachunya
Aerial Photo: Start to use from World War I
Aerial Photo (II)

Phimai Temple 1954
Satellite Image (1) Landsat TM 30 M.
Satellite Image (2) Spin-2 1.5 M.
Satellite Image (3) Quick Bird 0.60 Meter
Satellite Image (4) Quick Bird 0.60 Meter
Identification of temple in Ankor area

Courtesy of JPL
AIRSAR (continue)

Identification of Baray in Phimai Area
SAR (5) SIR-C

Identification of missing great wall

Courtesy of JPL
SAR (6) SIR-C of Silk Road

Courtesy of JPL
Recon Satellites (CORONA)

1959-1972

**KH-1**
- Dates: June 59-Sep. 60
- Ground Resolution: 25 ft
- Notes: Single camera
- Frames: 1,432

**KH-2**
- Dates: Oct. 60-Oct. 61
- Ground Resolution: 25 ft
- Notes: Single camera
- Frames: 7,246

**KH-3**
- Dates: Aug. 61-Jan. 62
- Ground Resolution: 25 ft
- Notes: Single camera
- Frames: 9,918

**KH-4**
- Dates: Feb. 62-Dec. 63
- Ground Resolution: 25 ft
- Notes: Two cameras
- Frames: 101,743

**KH-4A**
- Dates: Aug 63.-Oct. 69
- Ground Resolution: 9 ft
- Notes: Two cameras
- Frames: 517,688

**KH-4B**
- Dates: Sep. 67-May 72
- Ground Resolution: 6 ft
- Notes: Two cameras
- Frames: 188,526

**KH-5**
- Dates: Feb. 61-Aug. 64
- Ground Resolution: 460 ft
- Notes: Global coverage, mapping camera
- Frames: 38,578

**KH-6**
- Dates: July 63
- Ground Resolution: 6 ft
- Notes: Panoramic camera
- Frames: <910
Case Study of Royal Road from Angkor

Objective

To identify the Royal Road from Angkor to Phimai and making Multi-media GIS Database of Archaeological Sites Along the way.
Landsat TM
ADEOS 16 m.

Phimai

Phanom Roong
AIRSAR Data (Phanom Roong)

R : G : B (P-TP : L-TP : CVV)
3D image from AIRSAR (Phanom Roong)
The Identification of Water Reservoir and Archaeological Structure at Phimai Historical Town using AirSAR Data

The Identification of Water Reservoir and Archaeological Structure at Phimai Historical Town using AirSAR Data

PLC composites image

Hill Shade Model

1:50,000 scale map
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3D view of temple in the middle of baray
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3D view of temple in the middle of baray
Previous Study (1)
Previous Study (2)

Courtesy of Dr. Suratsavadee Ittharath
Map of the History

Temple Sites of Khmer's Period in Thailand and Cambodia

- Phimai
- Phanom Rung
- Ankor
Old Map of Phanom Roong Area from 1917
Case of Sukhothai World Heritage Site

Objectives

- Determine remote-sensing and GIS research strategy in cooperation with expert working group to study the historic environmental condition at Sukhothai, Si Satchanalai and Kampaeng Phet World Heritage sites.
Data Sources

1. Landsat 7 ETM data of the path and row: 130-48, 130-49

2. Aerial photos of Sukhothai Historical Town of the year 1954, 1996

3. GlobeSAR data of the Sukhothai, Srisatchanalai and Kampangphet area

4. Maps from Fine Art Departments (10 Map sheets)
   1. 1:10,000 scale map of Sukhothai historical town
   2. 1:25,000 scale map of Pra Ruang road from Sukhothai to Srisatchanalai and Sukhothai to Kampangphet

5. Temple sites, in and surround Sukhothai Historical Town, recorded from GPS surveyed by Fine art Department

6. RADARSAT images cover Sukhothai and Kampangpet

7. 1:50,000 scale maps of Royal Thai Survey
Current Produced Dataset

1. Georeferenced satellite data: 1. Landsat ETM 2. GlobeSAR
2. Georeferenced aerial photos: 1. 1956, 2. 1993
3. GIS layers from 1:10,000 scale map of Sukhothai Historical Town
   3.1 Archaeological features, including buildings, walls, monuments.
   3.2 Hydrological features including modern and ancient waterways.
   3.3 Transportation features including modern roads.
   3.4 Transportation features including ancient roads.
   3.5 Historical information including locations cited in inscriptions.
   3.6 Elevation information (contour lines) that will be used to generate Digital Elevation Model of the city and surrounding.
4. GIS layers from 1:25,000 scale maps of Pra Ruang Road which includes
   4.1 Pra Ruang Road Layer
   4.2 Current Road Layer
   4.3 Contours of the surround
5. GIS layer of temple sites, in and surround Sukhothai Historical Town, recorded from GPS surveyed by Fine art Department.
ข้อมูล Landsat ETM บริเวณอุทยานประวัติศาสตร์สุโขทัย
ข้อมูล GlobeSAR
Mosaicing of ETM data
Mosaicing of RADARSAT data
Landsat ETM and RADARSAT Composite
Site Positions from GPS Recording
3D Model of Sukhothai and Surrounding
Hydrological Comparison Study between Sukothai and Angkor
Sukothai Hydrological System
Elevation Contour Lines Analysis
Aspect Analysis
3D view from ASTER
Current Finding

- Land Use Change Analysis
- Population Distribution Analysis
- Ancient Sukhothai Hydrological System
- Comparative Study on Ancient Sukhothai City Planning
Land Use Change Analysis
Population Distribution Analysis
Ancient Sukhothai Hydrological System
Comparative Study on Ancient Sukhothai City Planning
Phitsanulok GIS Database Development
Case Study of Ayuttaya World Heritage Site

Objectives

• Comparative Study for the Evolution of Ayuttaya, Hanoi, and Osaka, which are the cities along the ocean silk road
Ayuttaya Multi-temporal GIS
Osaka Multi-temporal GIS
Conclusions

• The dataset produced can be utilized for various applications
• The ongoing work can support similar research work
• New collaborators are welcome