DIGITAL PHOTOGRAMMETRY FOR LAND REGISTRATION IN DEVELOPING COUNTRIES (Focused on Azerbaijan Case)

Korea Cadastral Survey Corp. Overseas Business Dep. Kyutae Ahn geohuman@gmail.com

Table of Contents

- Introduction
  - Research Design and Method
  - Research Methodology
- Research Methods and Results
- Conclusions and Remarks
- Q & A
Introduction

- **Research question**
  - Low Land Registration Rate (not covered by cadastre maps)
  - Affordable and Acceptable Cadastral Survey Method

- **Outline of research**
  - Identification of Land Parcel Boundaries using Digital Photogrammetric method

- **Research method**
  - Comparison of Aerial survey data and Reference map

- **Research data**
  - The Zira (settlement), on the Absheron Peninsula, in the Republic of Azerbaijan

---

Introduction

- **Research question**
  - The Property registries record legal ownership,
  - The Cadastre records physical characteristics and identifies boundaries.

- One of the obstacles to economic growth

- **Low Land Registration Rate (not covered by cadastre maps)**
- **Affordable and Acceptable Cadastral Survey Method**

---

Introduction

Research design and methods

• Comparison of Aerial survey data and Reference map

Field survey workflow (Reference)

- Geodetic Control Point
- Base Station Broadcasting
- Parcel Boundary Survey (RTK-GPS, T/S)

Comparison of Two Survey Results

Photogrammetric workflow

- Digital Camera (DIMAC WIDE)
- Memory
- GCP
- Ground Control
- DPW

Differences of Boundary Point Parcel Area

Digital sources

Paper sources

Archive system
Research Data

- Zira testfield
  - End of Absheron Peninsula, Azerbaijan
- Area: approx 10km²
- Test Area: A
- Test Area: B

Field Survey Workflow

- Test Field A: RTK-GPS
- Test Field B: T/S with laptop
Photogrammetric workflow

- Digital Camera (DiMAC WIDE)
- Memory
- GCP
- Archive system
- DPW
- Printer or plotter

- Cessna 402B
  - Cessna/ USA
  - Tale Number : TC-CAY
  - 2 Piston Engines
  - Capacity : 2 pilots, Camera Operator, Plane Technician

- DiMAC WIDE
  - DiMAC Systems/ Belgium
  - Lenz: 70mm
  - Image Output : 13,800 X 8,900 Pixels
  - Focal Length: 80.3767 mm
  - Pixel Size: 6.8 x 6.8 ㎛
  - Radiometric Resolution : 16 bits per color channel
Every Aerial Target pre-marked before the flight.

Size and Shape

- 40cm
- 10cm

Pavement

Agricultural Field

Flight Specification

- 12:30 ~13:30 / 1st. Jun. 2010
- GSD: 10.37cm
- Flight Height: 1,220m
- Num of Exposures : 281
- Num of Strips: 11
- Forward Overlap: 69%
- Side Overlap: 45%

GSD = Pixel Size(㎛) x Scale
= 6.8㎛ X (1,220/0.08)
= 10.37cm

- GSD (Ground Sampling Distance)
- Scale = Flight / Focal Length
Aerial Triangulation (AT)

<table>
<thead>
<tr>
<th>Check Point ID</th>
<th>GEODETC COORDINATES (X, Y, Z)</th>
<th>AERIAL TRIANGULATION COORDINATES (X, Y, Z)</th>
<th>DIFFERENCE (dx, dy, dz)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3003</td>
<td>439591.982 4471762.858 18.665</td>
<td>439592.019 4471762.888 18.658</td>
<td>-0.037 -0.03 0.007</td>
</tr>
<tr>
<td>3006</td>
<td>438459.211 4470983.368 2.922</td>
<td>438459.221 4470983.356 2.89</td>
<td>-0.010 0.012 0.032</td>
</tr>
<tr>
<td>3008</td>
<td>440620.241 4470764.352 8.687</td>
<td>440620.244 4470764.357 8.793</td>
<td>-0.003 -0.005 -0.106</td>
</tr>
<tr>
<td>3010</td>
<td>440945.497 4469787.239 15.317</td>
<td>440945.484 4469787.269 15.383</td>
<td>0.013 -0.030 0.066</td>
</tr>
<tr>
<td>3013</td>
<td>439482.562 4470087.680 0.056</td>
<td>439482.541 4470087.699 0.052</td>
<td>0.021 -0.019 0.004</td>
</tr>
<tr>
<td>3015</td>
<td>438692.403 4469550.241 2.666</td>
<td>438692.434 4469550.240 2.709</td>
<td>-0.031 0.001 0.043</td>
</tr>
<tr>
<td>3016</td>
<td>438124.802 4470325.431 -0.385</td>
<td>438124.81 4470325.384 -0.352</td>
<td>0.008 0.047 -0.013</td>
</tr>
<tr>
<td>3019</td>
<td>437219.548 4468920.092 -9.467</td>
<td>437219.592 4468920.026 -9.522</td>
<td>-0.044 0.066 0.055</td>
</tr>
<tr>
<td>3022</td>
<td>439868.389 4468789.839 -9.611</td>
<td>439868.356 4468789.834 -9.658</td>
<td>0.033 0.005 0.047</td>
</tr>
<tr>
<td>3023</td>
<td>440535.495 4468828.605 -16.601</td>
<td>440535.513 4468828.625 -16.501</td>
<td>-0.018 -0.020 -0.100</td>
</tr>
<tr>
<td>3027</td>
<td>440304.369 4467681.606 -20.628</td>
<td>440304.359 4467681.622 -20.723</td>
<td>0.010 -0.016 0.095</td>
</tr>
<tr>
<td>3031</td>
<td>438300.492 4468155.415 -12.877</td>
<td>438300.468 4468155.441 -13.011</td>
<td>0.024 -0.026 0.134</td>
</tr>
<tr>
<td>3033</td>
<td>437803.906 4467542.533 -14.415</td>
<td>437803.916 4467542.533 -14.392</td>
<td>-0.010 0.020 -0.023</td>
</tr>
<tr>
<td>3037</td>
<td>439575.526 4466751.580 23.272</td>
<td>439575.461 4466751.553 23.288</td>
<td>0.065 0.027 0.016</td>
</tr>
</tbody>
</table>

RMSE / Sigma nut: 1.8 micron

Results of Cadastral mapping

Scale 1:400

Field Survey

Aerial Survey
### Results of Cadastral Mapping

#### Test Field 1

<table>
<thead>
<tr>
<th>Classification</th>
<th>Test Field 1</th>
<th>Test Field 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boundary</td>
<td>876 points</td>
<td>3,548 points</td>
</tr>
<tr>
<td>Parcel</td>
<td>328 parcels</td>
<td>425 parcels</td>
</tr>
<tr>
<td>Aerial Survey</td>
<td>3,272 points</td>
<td>6,190 points</td>
</tr>
<tr>
<td>Parcel</td>
<td>323 parcels</td>
<td>386 parcels</td>
</tr>
</tbody>
</table>

#### Test Field 2

<table>
<thead>
<tr>
<th>Classification</th>
<th>Test Field 1</th>
<th>Test Field 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boundary</td>
<td>876 points</td>
<td>3,548 points</td>
</tr>
<tr>
<td>Parcel</td>
<td>328 parcels</td>
<td>425 parcels</td>
</tr>
<tr>
<td>Aerial Survey</td>
<td>3,272 points</td>
<td>6,190 points</td>
</tr>
<tr>
<td>Parcel</td>
<td>323 parcels</td>
<td>386 parcels</td>
</tr>
</tbody>
</table>

### Comparison of 2 Cadastral Maps

#### Classification

<table>
<thead>
<tr>
<th>Classification</th>
<th>Test Field 1</th>
<th>Test Field 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boundary</td>
<td>newly built residential area make up generally straight, uniform walls and distinctly demarcated</td>
<td></td>
</tr>
<tr>
<td>Parcel</td>
<td>old town, narrow and winding road relatively indistinctly demarcated</td>
<td></td>
</tr>
</tbody>
</table>

#### Coincidence Rate

- **Test Field 1**: 96% 89%
- **Test Field 2**: 82% 71%

#### Accuracy

- **Test Field 1**: $RMSE_x = 0.12m$, $RMSE_y = 0.14m$
- **Test Field 2**: $RMSE_x = 0.19m$, $RMSE_y = 0.21m$

* ASPRS Standard for planimetric feature coordinate accuracy requirement for target scale 1/1,000 as limiting RMSEx or RMSEy 0.25m.
Proposed Land Registration Process

Conclusion and Remarks

- **Affordable Survey Method**
  - Test Field 1: Aerial survey method would be one of the most reasonable ways to register the land in developing countries (fast, easy, and inexpensive)
  - Test Field 2: suggests the land registration method through the field survey with GPS or T/S.

- **Institutional Arrangement needed**
Thank you for your attention
Merci Bouqu
Sukeran
Q&A

Korea Cadastral Survey Corp.
Overseas Business Dep.
Kyutae Ahn
geohuman@gmail.com