

## A Research of Coastline Deformation with an Aerial Photo

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### Abstract

The purpose of this study is to make out a history of the coastline deformation with annual aerial photos of the target area and to suggest an efficient method for interpreting the coastline deformation. First, there were difficulties in obtaining annual aerial photos of an identical area as well as collecting periodical datum because of too much change of the real area during more than 27 years. Besides the past aerial photo is inferior to the latest one in quality. So there is nothing but to exclude an accuracy evaluation of the ortho photo. Taken into account the extent of the coastline change for 27 years is more than 10M and the all errors of the ortho image is included in this extent, both an accuracy and an error are ignored. The result of this study show that the coastline in the sea area of Namhangjin maintain advanced forward the ocean and keeps on moving with maintaining fairly wider shape of balance beach. Also The coastline deformation off 1km from the estuary is greatly irregular, which means the erosion of the sea in this area is in progress. The latest data being the aerial photo in 1996, it is difficult to find out the current conditions of a coastal erosion. However, considered the construction of a breakwater in Anmok Harbor is going on, the beach erosion becomes more accelerative recently. The aerial photos of the present Namhangjin's situation will make it possible to understand the history of the coastline change more accurately.

*Keywords* : Ortho photo, Coastline deformation, Aerial photo

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### 1. Introduction

Recently the coast is gradually utilized for the purpose of a transportations, a producing center, and a tourist resort due to increasing leisure time, and the need of preserving the coast has risen as well. So the solution of the various problems with the coast is urgently called for.

The phenomenon of erosion process and a sedimentation happened near the shoreline is closing the estuary, developing the estuary sand bar and a coast sand bar and a coast line deformation. Especially, the retire of the shoreline caused by coast erosion destroys a coastal environment and threaten both a residential district and a structure.

Until now, a lot of researches have been made to make a metamorphosis of coastlines induced by a change of natural conditions and by a establishment of structures predicted in order to preserve a coastal

environment and to promote the function of a tourist resort and of disaster prevention. However, in case of this studies, water model test (Physical modeling) is very expensive and numerical modeling is difficult to get good simulation of the model area and to forecast future because of insufficiency or lack of past field survey materials about a changed coast line. In opposition to these, study about coast line changes with aerial photo not only can solve lack of past survey data which are referred above, but also is one of ways to understand information about coast line changes of model areas.

Most of the study with aerial photo until now is not satisfied with ways in terms of analyzing aerial photos and testing accuracy according to analysis, etc. In fact, better general and effective ways to analyze aerial photos is not suggested. Therefore, this study purposes is to suggest more effective and inexpensive method to analyze coast line deformation with testing

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accuracy by producing and interpreting ortho photo of model area's aerial photo.

## 2. Method of the Ortho Photo

Because of the advantage that it can be used for a topographical map after solving distorts and another limited elements without any influence by other special methods, it has been evaluated for the method that its possibility is unlimited. This is manufactured and compensated to set on regular projection position through a process, which is called differential error modification, from one couple of cubic photos or several aerial photos. Besides, it can show exact position of model area, because, as compared with existing photographs, it is possible to observe area, distance and degree of direction exacting by expressing details of all photos seen on original aerial photos.

The ortho photo is made by removing errors and distorts of scanned image, after scanning the positive film of aerial photo with exact image scanner. The

manufacture process of the ortho photo is shown on flow chart, Fig. 1.

### 2.1 Acquisition of Aerial Photo

The aerial photo for research must fulfil the following necessary conditions. First of all, the airgraph has to be a map on a reduced scale to fit the result and stereoscopic photograph. When photograph was taken, the air graph was reiterated to have the surveyed area showed completely.

Four directing posts in the aerial photo make a relative coordinate which is able to settle a main point of it in each aerial photo. This point is known by examined-value of the camera and the each directing post has to be taken out to the appropriate area in the course the scanning for converting into the ortho photo. In this process a coordinate value of the direct post is memorized with the coordinate system of an image.

### Scanning aerial photo

Because an accuracy of ortho photo is important, the film developed with a positive is utilized directly.

While the amount of a colored is three times as many as one of a black and white and a colored is more easy to distinguish a terrain and a natural feature, a colored film is generally more difficult in fixing a joining point of length and width than a black and white film and the error of a colored film is more larger than one of a black and white. So that selection of a colored and a black and white depends on an object of a research.

For production of a ortho photo, private aerial photo scanner is utilized lest an error should occur in the course of scanning. Dots per inch of aerial photo have correlation between accuracy of a data and amount of a data.

### Producing Digital Elevation Model(DEM)

The data of digital elevation can be extracted from the aerial photo finished orientation with the way of relation matching and the aerial photo is the data of producing a topographic map and the ortho photo.

The quality of the scanned image, the precision of a photograph and the computation of the survey of the datum greatly affect the result of the producing DEM.

The place where the height changes rapidly, such as a building, a dam, a telegraph pole, a bank etc. has to be handled with a peculiarity separately. Without a handling separately, it is impossible to produce DEM and the image is collapsed.

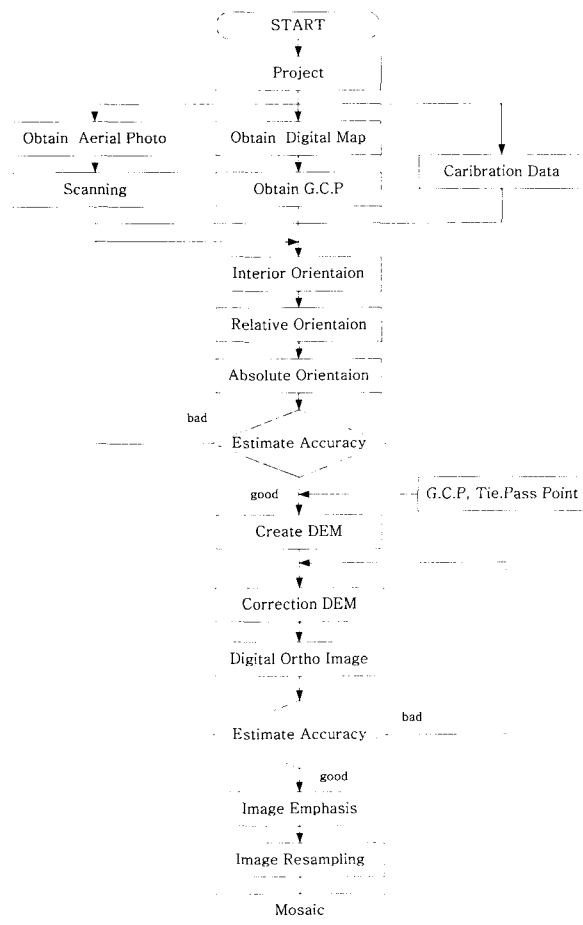


Fig. 1. Analysis flow chart of the ortho photo.

**Retouching Bias**

The retouching bias is the course that a displacement and a distortion of subject is eliminated and all points of the ground are adjusted with ortho projection to project all points of the ground on a datum level, which gets more and more important due to combination and reiteration of a digital map and imageable map in GIS.

Ortho calibration is to eliminate a spinning-distortion and a relief-displacement of a image. The inputted data are a geometrical arrangement to be found by survey of the datum, DEM to be formed of raster and DEM to be formed of a irregular trigonometric network.

The outcome of the ortho photo is decided by an accuracy of calculating a survey of the datum, a dots per inch and a visibility of a real data of aerial photo and an accuracy of DEM data.

**3. Acquisition and Analysis by the Ortho Photo**

**3.1 Producing the Ortho Photo**

In this research the ortho photo is produced for acquisition of a coastline's information. The data of an aerial photo in this research is followings(Table 1). The software for producing the ortho photo is VirtuZo NT 3.2.

Aerial photos utilized in this research are above Fig. 2. Ground control points(GCP) which are able to be surveyed a field, to be discerned in a topographic map, to distinguish terrains and natural features in a topographic map, and for topographic surveying to be easy are distributed evenly in the target area and indicated in both aerial photos and related maps simultaneously.

Selected GCPs are to have a distribution as like the Fig. 3 by using 1:25,000 topographic map. Besides, the acquisition of standardized GCPs have been made in 1/5,000 on the digital map. Finally produced ortho photos are above Fig. 4.

Table 1. Data of aerial photo

Date	November 1972	November 1979	November 1989	October 1996
Scale	1/37,500	1/20,000	1/20,000	1/20,000
Scanning(DPI)	1200dpi			
GCP	1/5,000 (by a digital map)			
Output Scale	1/5,000			

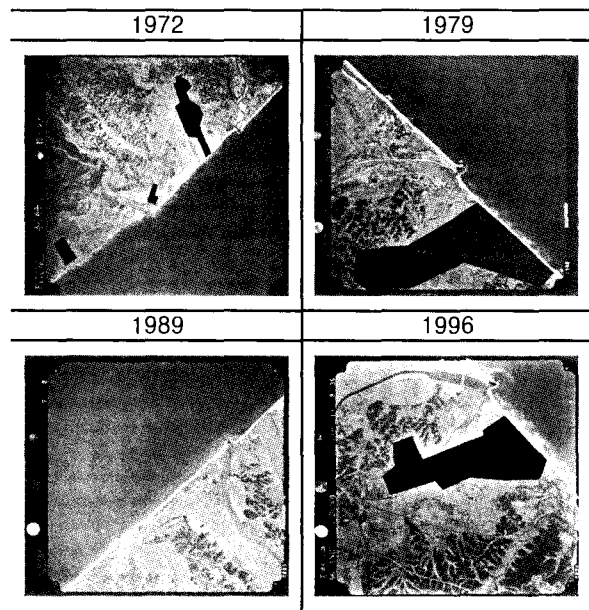


Fig. 2. the aerial photo utilized in this research.

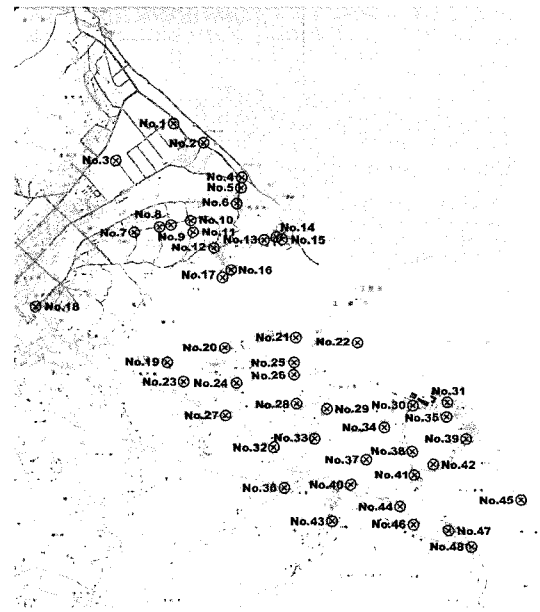


Fig. 3. distribution chart about selecting the GCP to analyze.

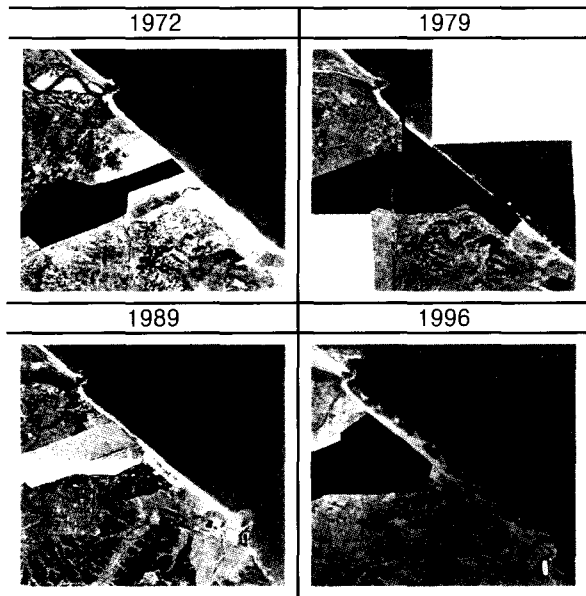


Fig. 4. Data of ortho photo by year.

#### 4. Analysis of Coastline Deformation

##### 4.1 Selecting Target Area and Natural Conditions

The target area of this study is the whole area of NamHangJin located in south coast of Anmok Harbor, Gangneung-shi, Gangwon-do, where the difference between rise and fall of the tide is very little - less than 0.3m and a inclination of the beach runs approximately parallel - between 1/40 and 1/60. A tide and current differs with seasons, but the difference, about 0.2~0.3m/s, is insignificant.

Because a inclination of the beach caused by a wave surf zone is important for analyzing a coastline deformation with a aerial photo, the reality beach is surveyed actually. The available inclination of the beach is 1/10 on an average.

According to Fig. 5, Namdae river rises from Taeback mountains and flows through the north of Namhangjin and into east sea. The basin of this is a lozenge shape and the width of this is 265.20km<sup>2</sup>, the lane of river is extended to 31.84km.

##### 4.2 Analyzing a Coastline Deformation with a Ortho Photo

Above all it is important to understand the modificatory route with past data of a subject area in order to examine a coastline deformation. So the aerial photos of the whole area of Namhangjin, Gangneung-shi in 1972, 1979, 1989 and 1996 are collected, the shoreline

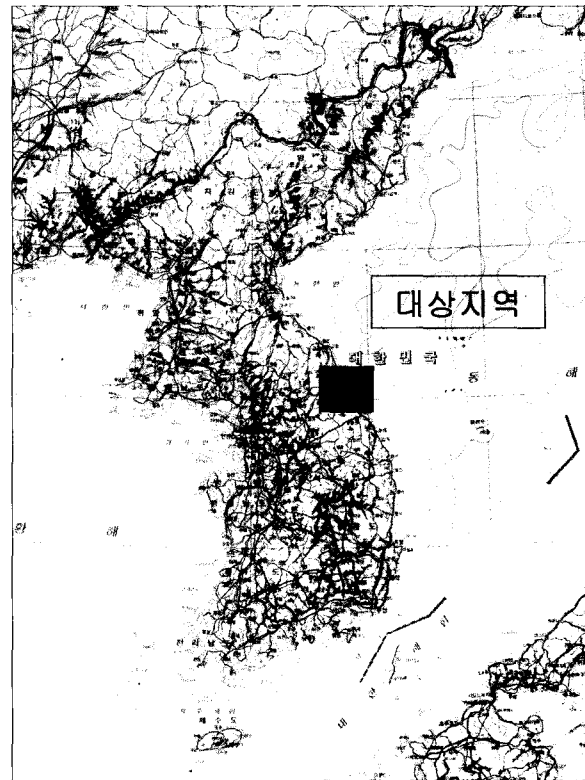


Fig. 5. potential map of the subject area.

change for 27 years past is dissected.

The method of analyzing aerial photo is that of ortho photo. After dissecting aerial photos, photos are produced by 1/5000 scale using coordinates referred from photos and the coastline is made digital.

The tide level in subject area which is analogized from each material of aerial photo in 1972, 1979, 1989 and 1996 is 4cm in 1972, 7cm in 1979, 5cm in 1989 and 15cm in 1996. The inclination of the beach in target area which is surveyed with wave run-up zone actually is about 1/10. Based upon above data, the height of tide in actual subject area is set on the base of the average sea level, 19cm. The level of tide is revised and then the range of coastline movement in each year is indicated at Fig. 6.

The comparison between the aerial photo in 1979 and that in 1972 tells some advance of the coastline in the north of Namhangjin and more remarkable movement of the coastline in the south. In the aerial photo in 1989, the coastline in the sea area of Namhangjin advanced forward the ocean and keeps the more wider beach than that in 1972 and 1979. However the aerial photo in 1996 informs that the width of the beach is narrower than that in 1972, 1979 and 1989. The movement of the coastline off 1km from estuary is overall shifted parallel.

Inferred from these data, the coastline change of the

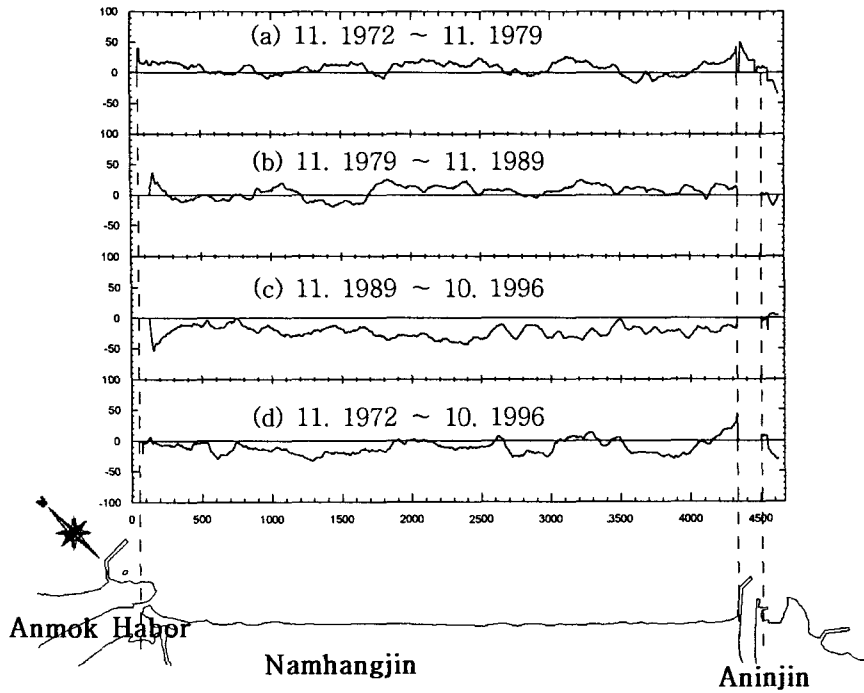


Fig. 6. Analysis the range of the coastlines change by ortho photo.

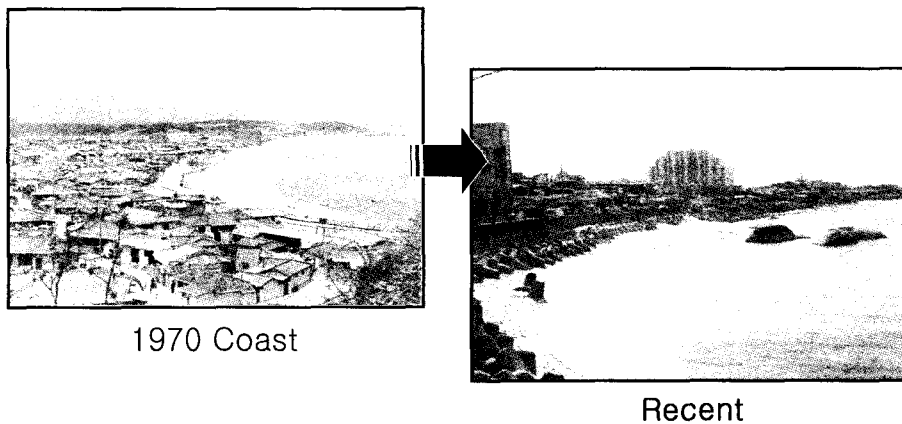


Fig. 7. Coast change by photo data.

south of Namhangjin is maintained the shape of a balance beach and keeps in moving. The coastline deformation off 1km from the estuary is greatly irregular and this means the erosion of the sea in this area is in progress.

In this study the latest data being the aerial photo in 1996, it is difficult to find out the current conditions of a coastal erosion. Yet taken into account that the construction of a breakwater in Anmok Harbor is going on, the beach erosion becomes more accelerative recently. Furthermore, current aerial photo is needed to get a thorough grip on the course of the coastline change.

## 5. Conclusion

In this study the coastline deformation is analyzed with the method of the ortho photo. The results are followings.

1. This research would like to suggest that the method of the ortho photo which is effective method to analyze coastlines deformation makes it possible to analyze the coastline deformation which has changed from the past to the present.
2. While a usual method is to analyze the data obtained by a hydrographic chart, topographic map or a affine transfer, a method of the ortho photo makes

it possible to compare and analyze data of the past and the present

3. Although in order to come to a more correct conclusion by Digital Photogrammetry, it is needed to get accurate GCPs of the past aerial photos, it is difficult to obtain GCPs of digital map because a present terrain is different from a past. And it causes accuracy to fall in the course of changing a past image into an ortho photo.

4. The course to supplement the position-information of a coastline by measuring an inclination of the beach and revising a tide level is needed for the produced ortho photo.

5. The coastline of the sea area of Namhangjin has retired remarkably than the past. Besides, though it is impossible to mention the current coast because there is no latest aerial photo data of the subject area, inferred from data it seems that the beach erosion goes on continuously.

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