

plausible landscape restoration with archived maps and aerial photographs in GSI

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This study aims to restore past 3D landscape with high fidelity using archived maps and air photos in the Geographical Survey Institute (GSI). A restored birds-eye image evoke a concrete image of what we can't see any more. A restored scene excites nostalgia in people knowing past scenery and it interests intellectual curiosity to those who live in the town but don't know how their town was. The studies on landscape restoration only restored a planar image viewing from a fixed point and restoring a virtual landscape model of whole area was difficult. GSI owns many topographical materials such as maps and air photos. Monochrome aerial photographs by U.S. Army (U.S. Army photos), which were taken during and after WWII, are the oldest photos and the Swift survey maps, which surveyed in 1880s, are the oldest maps. They will make it possible to restore the past landscape of a area with high fidelity even if no colour photo is available.

This study introduces a method for making a plausible past 3D landscape model with a terrain model and colour ortho imagery created from archived monochrome air photos and maps.

Creation of the past terrain model

The current terrain model is available instead of the past terrain model if negligible terrain modification has made. In case of terrain modification was massive, however, the current terrain model is unsuitable for landscape restoration. This study uses U.S. Army photos as a source. The problem is that interior orientation parameters of U.S. Army photos is unknown. Theoretically speaking, at least 5GCPs (the number varies with the model) are needed to register a non-metric camera, but it is sometimes difficult to acquire large number of control points when terrain modification was massive or there is no map corresponding to the photos. The authors proposed a internal orientation parameter estimation method of U.S. Army photos. This method makes it possible to create terrain model from U.S. Army photos with small number of ground control point. In this study, ground control points were acquired from city planning maps surveyed in 1963. The obtained terrain model is 5m resolution and the model express detailed relief with high fidelity.

Creation of the past colour ortho images

Few colour photos exist which record a scene of national land before a period of high economic growth. Even if a photo exists, it is hard to make a colour image covering whole area as its location is limited. In this study, a colour ortho image was produced from both U.S. Army photos and the Swift survey maps. Monochrome U.S. Army photos are colourized with the method proposed by the authors. The method adds colour information to a photo based on land cover information. Colour information is collected from the present colour aerial photos. For using the images as GIS data, coordinates information, measured in terrain model creation stage, is attached to them.

A colour ortho image from the Swift survey maps was created by putting a texture corresponding to land cover presented on the maps. Texture pattern was obtained from the present colour aerial photos. As the map has no coordinates information, we added coordinates information by applying affine transformation.

Build virtual landscape model

A virtual landscape model was constructed from the past terrain model and the colour ortho images on a GIS, that enables to make a birds-eye view from any angle at any position. This landscape model makes it easy to visually understand past scenery of an area as the model shows past scenery as if a scene was actually taken. A terrain modification, the change of land use on a hill, and expansion of housing area can be intuitively recognized by comparing the model with a model of another period or actual birds-eye view. Additionally, if we used a created birds-eye view on a ground survey, it might become easy to gather information about the past town.