Chapter 49
Improving the Efficiency of Image Interpretation Using Ground Truth Terrestrial Photographs

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ABSTRACT

Researchers worldwide use remotely sensed imagery in their projects, in both the social and natural sciences. However, users often encounter difficulties working with satellite images and aerial photographs, as image interpretation requires specific experience and skills. The best way to acquire these skills is to go into the field, identify your location in an overhead image, observe the landscape, and find corresponding features in the overhead image. In many cases, personal observations could be substituted by using terrestrial photographs taken from the ground with conventional cameras. This chapter discusses the value of terrestrial photographs as a substitute for field observations, elaborates on issues of data collection, and presents results of experimental estimation of the effectiveness of the use of terrestrial ground truth photographs for interpretation of remotely sensed imagery. The chapter introduces the concept of GeoTruth – a web-based collaborative framework for collection, storing and distribution of ground truth terrestrial photographs and corresponding metadata.

INTRODUCTION

Emerging innovations in optics, electronics and computers have led to the launch of a number of earth-observation systems which transmit terabytes of visual data every day. Some of the data are free, and pricing for the rest is declining due to competition among image providers. This provides great opportunities for institutions, research groups and organizations worldwide to use remotely sensed imagery in their projects in both the social and natural sciences.

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Yet users often encounter difficulties working with aerial or satellite images, because these images differ from conventional photos in at least three important ways: objects are portrayed from an overhead (and unfamiliar) position, images are taken at scales most people are unaccustomed to seeing, and images are recorded over a range of wave lengths on multiple channels which are often beyond the visible spectral zone.

Along with computer-assisted automated classification of low-resolution multispectral imagery, visual image interpretation of large-scale aerial photographs and high-resolution satellite images is still widely used not only by non-technically driven geographers, biologists and other scientists, but by experienced professionals, as well.

While geographers at many universities study the basics of visual image interpretation, other professionals (*e.g.* biologists and environmental specialists) are generally not aware of image interpretation techniques until they become involved in a project and are forced to acquire such skills. The most practical way to acquire such experience is for observers to go into the field, locate themselves in an overhead image, observe the landscape and find corresponding features in the overhead image. Visual links between the natural view of a particular object and its representation in an overhead image create a particular association in the user's brain. The wider the variety of such mental images, the more experienced an image interpreter becomes. These mental pictures, along with analytical abilities for establishing such associations between objects and sites are the essence of visual image interpretation.

In many cases, natural observations could be substituted for terrestrial photographs taken from the ground with conventional cameras. If the coordinates of a terrestrial photograph are known, the position of the photographer can be located in an overhead image, making it possible for users to use conventional terrestrial photographs as a ground truth to establish a visual link between an object and its representation in an overhead image without traveling to the field.

There have been a few attempts to create repositories of sample objects, but they either represent images acquired by a particular sensor without ground truth (Remote Sensing Guides, 2008) or they provide a ground truth photograph and represent very specific objects (i.e. types of vegetation) in a limited area (Ochi & Takagi, 1996; Zion National Park, 2015). Any such repository will always have certain limits, because the compilation of feature identification keys with ground truth for diverse geographic objects worldwide is too immense a task for any single project or organization. Users could, however, compile such repositories by themselves. Many such users have had, and will have, field trips in which they take terrestrial photographs of different landscapes, geographic objects and phenomena; many use GPS and are willing to share their data over the Internet. A good example of such activity is The Degree Confluence Project (www.confluence.org). This example suggests that enthusiasts can form a virtual community driven by a common interest. The same can happen among professionals who use aerial photographs and satellite imagery. Such a utilitarian Virtual Professional Community would obviously be driven by common professional interests and could eventually be seeded around a Web-based data portal which allows any user to share geographically-referenced terrestrial photographs. Such a mechanism could provide the ability to store and explore geo-referenced data and metadata to allow any user to search and download terrestrial photographs pertaining to the user's area of interest and use them as a ground truth for interpretation of remotely sensed images.

This chapter introduces the concept of an open-source GeoTruth system – a web-based, open-community, participatory mechanism for the collection, storing and distribution of geo-referenced ground truth terrestrial photographs and corresponding metadata. The chapter discusses the value of terrestrial photographs as a substitute for field observations, elaborates on issues of data and metadata collection,

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