

Using Photo Interpretation to Produce Accurate Maps

Covertypes Mapping Services

Since the 1930s, James W. Sewall Company has used aerial photography to classify and map natural resources. Even with the advent of satellite imagery, interpreted aerial photos have remained the medium of choice for detailed natural resource mapping. During the last 20 years, the process of creating maps from photography has become highly automated, with the end product a digital file that resides in a geographic information system (GIS). Sewall takes advantage of both advanced technologies and analytic techniques to produce maps that meet exacting specifications in interpretation and geometric accuracy.

PHOTO INTERPRETATION

Quality photo interpretation begins with experienced photo interpreters who are familiar with the specific resource under classification. Following a preliminary review of the aerial photography, Sewall photo interpreters generally perform “ground-truthing” in the field to address specific questions that arise. Although most field locations are pre-selected with some consideration to accessibility, a number of sites are randomly chosen. Depending on project scale, accuracy requirements, and budget, Sewall also performs aerial reconnaissance.

In the fieldwork phase, our photo interpreters work closely with client field personnel who are familiar with the subject area and the classification system. The amount of checking and choice of method depend upon the complexity of the classification system and accuracy requirements.

On some projects, Sewall performs interpretation in conjunction with an inventory, in which field sampling observations are made independently of the photo interpretation process. Using field sampling data and observations increases the accuracy of the interpretation.

Sewall performs photo interpretation directly from roll film on a Bausch and Lomb SIS 95 stereoscope. Our photo interpreters identify and trace natural resource and land use classes on acetate overlays. Coding frame-by-frame, we pay careful attention to completeness of line work, labeling, and edge-matching between photos and flight lines.



Photo interpretation for wetlands and land use classification in the Dennys River watershed in eastern Maine.

FEATURE CONVERSION

Following photo interpretation, Sewall converts the photo-interpreted features, both lines and points, to an accurate, horizontally controlled digital base map. During this phase, Sewall clients can select one or a combination of several conversion options, including orthophoto creation, orthorectification using existing orthophotography, and monoscopic transfer.

1. *Orthophoto creation.* In the process of orthophotography production, aerial photographs are scanned, orthorectified to correct distortion, and mosaicked to form a seamless data layer. The same parameters used in this process can be reused to orthorectify the acetate overlays of the interpreted photography. The overlays, with fiducials carefully marked, are scanned, rectified, and converted to ArcInfo format. The features are then edited to create a clean GIS data layer that can be superimposed upon the orthomosaic.

2. *Orthorectification using existing orthophotography.* Pre-existing orthophotography, if relatively current, provides a good source of photo-identifiable control points with which to establish the relationship between new photography and ground coordinates. At least four well-defined point features are selected per photo. These control points must be identifiable on both the new, interpreted photos and the orthophotography. Combined with camera calibration parameters and a digital elevation model (DEM), these points provide the necessary measurements for orthorectification software. The process for rectifying scanned acetates, as described in Option 1, can then be used. A variation of this process using the same data allows digitizing into the new data layer directly from the photography. Under control of software, photo distortion from the horizontal coordinates of features is removed as the photography is digitized.

3. *Monoscopic transfer.* Features can be transferred from photography to a controlled base, such as a USGS map or orthophoto, using a *camera lucida* (Bausch and Lomb zoom transfer scope or vertical sketchmaster) or projection device (KARGYL projector). These devices offer a simultaneous view of both the control base and the features on the photography. The operator makes adjustments to achieve a good match between the two and then traces the features from the photograph onto the base. The resulting manuscript is scanned and converted to ArcInfo format. Features are then edited to create a clean GIS coverage.

Options 1 and 2 are preferred because they eliminate problems with horizontal accuracy caused by relief displacement and camera geometry. Option 3 lacks the precision of the other methods and is recommended only for mapping flat or rolling terrain, when some degree of horizontal inaccuracy is tolerable in the cost-benefit equation.

DIGITAL MAP CREATION

Each of the above options has its own set of production steps that can include scanning to convert map data to digital form. If scanning is used to convert map data, Sewall technicians check the document to be scanned for completeness prior to scanning. A carefully prepared manuscript streamlines the conversion to a clean final product. To process scanned features into final GIS coverages, GIS analysts use ArcInfo editing software and standardized procedures to ensure completeness and correctness of polygon topology. Labeling is performed on ArcInfo workstations under the control of a software program custom written specifically for the project's classification system in ESRI's Arc Macro Language. Sewall analysts use this program to check that all coded values are valid and that all polygons have labels.

To ensure that each label matches the corresponding photo-interpreted class, Sewall photo interpreters create a checkplot, which highlights any stands with incomplete or missing labels. Once corrections are made, photo interpreters check all remaining labels against the original photo interpretation. At this time, they also check the relationship between water and road features on the checkplot and in the newly created polygon layer for correctness. Additional lines are sometimes required to correct a labeling or vector location error. The mapping process is complete when the final map is faithful to the photo interpretation.

PROFESSIONAL EXPERIENCE

Daniel E. Boss, LPF
GIS Project Manager

For over 20 years, Daniel Boss has developed and maintained enterprise systems using key technologies, including GIS, relational database systems, statistical analysis, and planning models. With expertise in ArcInfo, Visual Basic, and Intergraph software, Mr. Boss plays a strategic role in improving efficiencies and the profitability of Sewall client enterprises.

Mary T. McDonald, LPF
GIS Project Manager

With expertise in ArcInfo and AML, Mary McDonald digitizes, analyzes, and plots a broad range of mapping for GIS integration, including USGS topographic, forest inventory, hydrography, flood hazard, wetlands, soils, land use, tax, and facility infrastructure maps. She manages Sewall's long-term archiving and maintenance of digital map files and trains and supervises GIS technicians.

Lyman Feero
Wildlife Biologist/Photo Interpreter

With over 27 years' experience, Lyman Feero performs detailed aerial photo interpretation to identify and classify habitat and tree species and to analyze land use/land cover for forestland and wetlands. He also develops wildlife management plans for both industrial and nonindustrial lands.



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