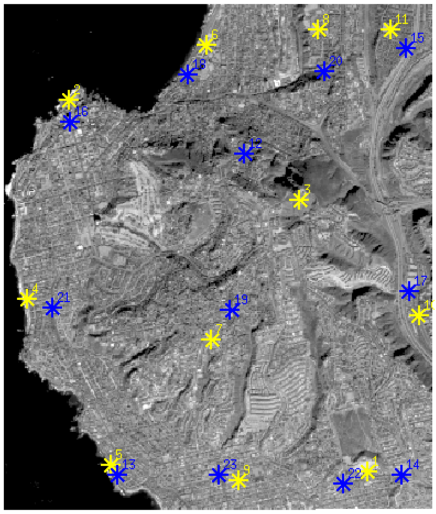
Testing Rational Polynomial Orthorectification



Panchromatic IKONOS image (1-m cell size) of La Jolla, California showing GPS survey points (yellow) used as georeference control for rational polynomial orthorectification of the image. Test points (blue) were placed in the same general locations by visual comparison with aerial orthoimages (0.15-m cell size) obtained from the County of San Diego.

MicroImages has extensively tested the Rational Polynomial (RPC) Orthorectification procedures in the TNTmips Georeference and Automatic Resampling processes using a panchromatic IKONOS image (1-meter cell size) of La Jolla, California. We regeoreferenced one copy of this image using well-distributed ground control points collected with a Global Positioning System (GPS) unit and another copy with points visually transferred from a scanned 1:24000-scale topographic map of the area (1.5-meter cell size).

GPS points used for these tests were collected with an inexpensive hand-held GARMIN GPS unit. Expect even better results from a survey-quality GPS unit.

To provide accurate elevation control for the RPC orthorectification, we used a set of 5-foot topographic contours (obtained from the County of San Diego) in the TNTmips Surface Modeling process to create a detailed digital elevation model (DEM) of the image area (1-meter cell size). To test the horizontal accuracy of the RPC orthorectification model, we temporarily added to each image 12 test georeference points (set as Inactive in the Georeference process) visually transferred from conventional aerial orthophotos (with 0.5-foot cell size) acquired from the County of San Diego. These points were well distributed and most were located near the GPS control points.

The table below shows predicted RMS error statistics for these images using the RPC model, computed automatically by the Georeference process for the active (control) and inactive (test) points. The GPS georeference control in this case provides a more accurate orthorectification. The circular error (computed manually from the RMS errors) for the both control and test point sets in the GPS image are close to that claimed by Space Imaging for their highest-accuracy IKONOS orthoimages.

Predicted Positional Errors from Rational Polynomial Model and Detailed DEM

Georeference from:	For Georeference Control Points: Root Mean Square (RMS) Errors (meters) X	Y	XY	For Georeference Control Points: Circular Error (meters), 90% Probability (CE90)	For 12 Test Points from 0.5-foot orthophotos: Root Mean Square (RMS) Errors (meters) X	Y	XY	For 12 Test Points from 0.5-foot orthophotos: Circular Error (meters), 90% Probability (CE90)
Global Positioning System Survey 11 well-distributed control points	0.63 m	2.27 m	2.36 m	3.11 m	1.30 m	1.06 m	1.68 m	2.53 m
Scanned 1:24000 topographic map 22 control points	2.09 m	2.96 m	3.62 m	5.42 m	2.66 m	4.92 m	5.59 m	8.13 m

Claimed accuracy of Space Imaging's orthorectified IKONOS image products using ground control points:	Product	Accuracy
	Precision Product	4.1 m
	Precision Plus Product	2.0 m

Topographic contours (yellow, shown with 10-foot contour interval) overlaid on portion of orthoimage (0.15-meter cell size), both obtained from County of San Diego. Street overlay (orange) traced from same orthoimage for testing. Area has 200 feet (60 meters) of relief from lower right to upper left; width of area is 440 m.

Street vector overlaid on portion of the IKONOS panchromatic image georeferenced with GPS points, prior to RPC orthorectification. Significant misregistration of the street overlay results from internal image distortion in the unrectified image due to local terrain relief.

Street vector overlaid on IKONOS pan image after RPC orthorectification. Rectification successfully removed terrain relief effects from the image, so there is now excellent registration with the planimetrically-correct street overlay.