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Daniel Unger Arthur Temple College of Forestry and Agriculture, Stephen F. Austin State University, unger@sfasu.edu

Hillary Tribby

Hans Michael Williams Arthur Temple College of Forestry and Agriculture Division of Stephen F. Austin State University, hwilliams@sfasu.edu

I-Kuai Hung Arthur Temple College of Forestry and Agriculture, Stephen F. Austin State University, hungi@sfasu.edu

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Accuracy Assessment of Land Cover Maps Derived from Multiple Data Sources

Dr. Daniel R. Unger, Associate Professor Hilary Tribby, Research Assistant Dr. Hans M. Williams, Kenneth Nelson Distinguished Professor Dr. I-Kuai Hung, Assistant Professor Arthur Temple College of Forestry and Agriculture Stephen F. Austin State University Nacogdoches, Texas



IKONOS Data Generation



(PCA)







Fine Classification Scheme





INTRODUCTION

Since remote sensing technologies are constantly changing, incorporating data into any given remote sensing project has become more complex. This project evaluated and recommended which data sources should be integrated into image classifications in order to produce the most accurate land cover map. Maximum Likelihood (ML) and Artificial Neural Network (ANN) supervised classification methods using Principal Components Analysis (PCA) were used to demarcate land cover types within IKONOS and Landsat ETM+ imagery. Three additional data sources were integrated into the classification process: a Canopy Height Model (CHM), Digital Terrain Model (DTM), and Thermal data. Both the CHM and DTM were derived from multiple return small footprint LIDAR. In addition to evaluating classification methodology, classifications were analyzed for two different classification schemes and for two classification levels; the Texas Geographic Information Council (T.G.I.C.) level 4 and 2 and the United States Geological Survey (U.S.G.S.) LULC level 2 and 1 classification schemes respectively. In addition, a focal majority filter was applied to each derived map to assess the removal of island polygons on land cover map accuracy. Study objectives were to evaluate the accuracy of single and multi-source image land cover classifications including all possible combinations of data types and to develop architecture for an artificial neural network that will process image classifications by defining the optimum variables, such as momentum, learning rate, hidden layers, and output nodes.



Landsat ETM+ Data Generation



(PCA)



Coarse Classification Scheme

Data source: IKONOS imagery, Space Imaging; Landsat ETM+ imagery, Forest Resources Institute; LIDAR data, Terrapoint; Vector data, Arthur Temple College of Forestry and Agriculture GIS database.

Land Cover Map of Forest Lake, Texas Classification Method: Maximum Likelihood Classification System: T.G.I.C. Level 2 Satellite Imagery: IKONOS June 7, 2000 Data Source: PCA and CHM nd Cover Class Woody Wetland Woodland Natural Herbaceous Emergent Wetland 1:52,000 Mete 500 1,000 Ha: $k \neq 0$ If $Z \ge 1.960$, then Ho is rejected and conclude that the data are deemed significantly different than random chance; otherwise, do not reject the null hypothesis and conclude that the results are not significantly different than random chance

(T.G.I.C. Level 2 – Maximum Likelihood and Artificial Neural Network) Land Cover Map of Forest Lake, Texas





| | | Reference Data | | | | | | | | |
|-------------------------------------|--------------------|----------------|-----------|--------|---------|---------|----------|--|--|--|
| | | Forest | Rangeland | Water | Wetland | Total | User's % | | | |
| 0-0000E0 | Forest | 463 | 93 | 2 | 36 | 594 | 77.95% | | | |
| | Rangeland | 29 | 127 | 2 | 6 | 164 | 77.44% | | | |
| | Water | 2 | 5 | 21 | 2 | 30 | 70.00% | | | |
| | Wetland | 50 | 21 | 1 | 40 | 112 | 35.71% | | | |
| | Total | 544 | 246 | 26 | 84 | 900 | Overall | | | |
| g | Producer's % | 85.11% | 51.63% | 80.77% | 47.62% | Overall | 72.33% | | | |
| | | | | | | | | | | |
| Ho: <i>k̂</i> = 0 Ha: <i>k̂</i> ≠ 0 | | | | | | | | | | |
| If $Z \ge 1$ | .960, then Ho is r | \hat{K} | 0.4864 | | | | | | | |
| than ra | ndom chance; oth | ASE | 0.0235 | | | | | | | |
| results | are not significan | Ζ | 20.6836 | Reject | | | | | | |



| | | Reference D | | | | | | | | |
|---|--------------|-------------|-----------|--------|---------|--|--|--|--|--|
| | | Forest | Rangeland | Water | Wetland | | | | | |
| ြို | Forest | 387 | 38 | 4 | 19 | | | | | |
| a s s | Rangeland | 43 | 120 | 4 | 6 | | | | | |
| † | Water | 0 | 1 | 18 | 0 | | | | | |
| d | Wetland | 114 | 87 | 0 | 59 | | | | | |
| Ь | Total | 544 | 246 | 26 | 84 | | | | | |
| ğ | Producer's % | 71.14% | 48.78% | 69.23% | 70.24% | | | | | |
| Ho: κ̂ = 0 Ha: κ̂ ≠ 0 | | | | | | | | | | |
| If $Z \ge 1.960$, then Ho is rejected and conclude that the data are deemed significantly different than random chance; otherwise, do not reject | | | | | | | | | | |
| the null hypothesis and conclude that the results are not significantly different than random chance. | | | | | | | | | | |



The ML classification method performed statistically better than the ANN process (a=0.05). The Landsat ETM+ based classifications performed statistically better than the IKONOS based classifications (a=0.05). The most accurate land cover maps were created within the ML classification method using the Landsat ETM+ PCA and integrated multiple sources of data with K[^] accuracies ranging from 0.4134 to 0.4868 at both U.S.G.S. levels of analysis. The least accurate land cover maps were created within an ANN of the Landsat ETM+ imagery, DTM and Thermal at the U.S.G.S. Level 1, with K[^] accuracies of 0.0813 and 0.0828 respectively. Other extremely low accuracy land cover maps were created by the ANN T.G.I.C. Level 4 and 2 of IKONOS imagery and the integrated multiple sources of data with K[^] accuracies ranging from 0.0876 to 0.2670.

CONCLUSIONS

Multiple Sources of data did not statistically increase land cover classification accuracy consistently. Focal Majority Filter did not statistically increase land cover classification accuracy consistently. Maximum Likelihood performed statistically better than the Artificial Neural Networks consistently. Landsat ETM+ classifications performed statistically better than IKONOS. Lower classification scheme levels performed similarly for Landsat, but statistically better for IKONOS.



(CHM)





 Total
 10
 373
 80
 135
 18
 182
 102
 900
 Ov

If $Z \ge 1.960$, then Ho is rejected and conclude that the data
are deemed significantly different than random chance;
otherwise, do not reject the null hypothesis and conclude
that the results are not significantly different than randomASE0.0169Z30.8448Reject

roducer's % 30.00% 67.29% 87.50% 63.70% 77.78% 51.65% 51.96% Overall 63.4

Z 30.8448 Reject

(Filtered – Maximum Likelihood and Artificial Neural Network)









March 3, 20



