Abstract

Impervious surfaces, including rooftops, pathways, and parking lots, are surfaces through which water cannot permeate, and are recognized as key indicators of urban environments. This project intends to develop methods that could be suitable for mapping urban surface materials based on spectral and thermal information in a way that can be easily adopted at other locations in the future. In addition, radiance values for classes were calculated in order to relate surface material type to the Urban Heat Island (UHI) effect.

Research goals

- Classify urban surface materials using hyperspectral imagery and thermal imagery.
- Calculate radiance values for classes in order to relate to the Urban Heat Island (UHI) effect.

Study area & Data

- Study area: UNI campus, Cedar Falls, IA, USA.
- Data sets:
  3. NAIP air photo: 1 m, taken in summer of 2011.
  4. 2011 UNI building survey.

Methods

Hyperspectral imagery

- Initial image quality assessment
- Image classification
- Atmospheric correction
- Accuracy assessment
- Geometric correction
- Dataset dimensionality reduction
- Endmember selection
- Compare accuracies
- Calculate radiance values

Results

Using only hyperspectral imagery

Overall accuracy: 59%

- Roof concrete
epdm
- Road concrete
- Shingle
- Metal
- Clay
- Vegetation

Using both hyperspectral imagery and thermal imagery

Overall accuracy: 73%

Discussion

- Adding the thermal layer eliminated most inaccuracy caused by shadows.
- Some factors limited the classification from obtaining a higher accuracy:
  1. presence of cars
  2. isolated misclassified pixels (noise)
  3. discrepancies between classification based on UNI building survey and materials exposed to air in real life caused by lack of site
- Theoretically, the classification accuracy can dramatically increase by:
  1. remove all regions with cars in both images
  2. use algorithms that turn isolated misclassified pixels into the correct classes
  3. conduct a field visit to the UNI campus
- The results unexpectedly showed road concrete and vegetation to have the highest radiance values, even though EPDM is the darkest in color, while metal and clay have the lowest radiance. This result may be because of the air conditioning inside the buildings that cools building rooftops down.

Conclusions

This project studied urban impervious surface classification using both high resolution hyperspectral imagery and thermal imagery. Seven classes were made including six impervious surface classes and one vegetation class. After the addition of a thermal layer, classification accuracy increased from 59% to 73%. Although the accuracy can be theoretically even higher, 73% accuracy is sufficient enough to demonstrate that the methods and algorithms used in this study will be useful in other study areas. The radiance values for classes are not reliable enough to drive a conclusion relate to Urban Heat Island (UNI) effect. The reason may be due to the air conditioning inside the buildings that cools building rooftops down.

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