UNIVERSITY of DAYTON

VISION LAB

Center of Excellence for Computer Vision and Wide Area Surveillance Research


Paheding Sidike


Yakov Diskin


Saibabu Arigela

Visibility Improvement Through Hyperspectral Band Integration

Paheding Sidike, Yakov Diskin, Saibabu Arigela, and Vijayan K. Asari

Objective

- To exploit band information of the hyperspectral imagery
- To develop adaptive contrast enhancement technique
- To assist in object detection/classification

Hyperspectral Sensor

Spectral Range	400 - 900 nm
Spectral Resolution	2.1 nm
Spectral Channels	240
Spatial Channels	640
Max Frame Rate	145 fps


Sensor

Indoor System

Outdoor System

Methodology

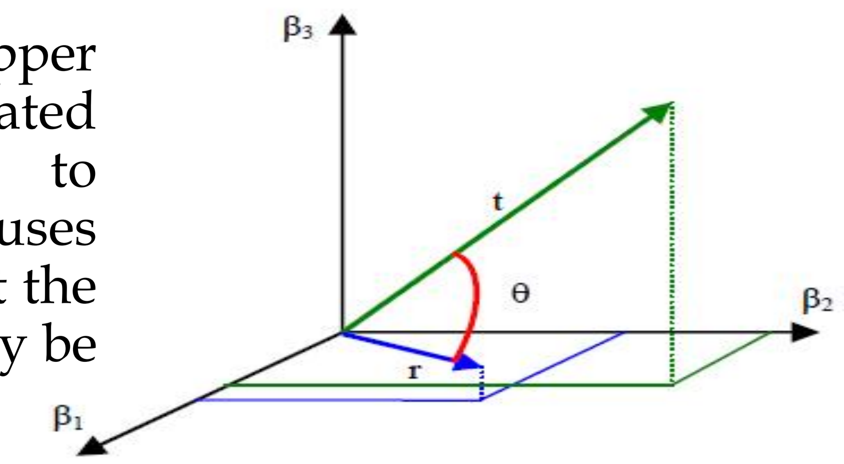
The hyperspectral image enhancement procedure is broken into nine steps resulting in an improvement of visibility.

1. Raw Hyperspectral Image → 2. Image Normalization → 3. Mean Spectral Signature → 4. Spectral Matching (i.e. SAM) → 5. SAM Scaling → 6. SAM Boosting → 7. Super Resolution → 8. Image Restoration → 9. Enhanced Image

SAM: Spectral Angle Mapper

Spectral Angle Mapper

The Spectral Angle Mapper classification (SAM) is an automated method which is insensitive to illumination change since it uses only the vector direction and not the vector length. This technique may be mathematically modeled as

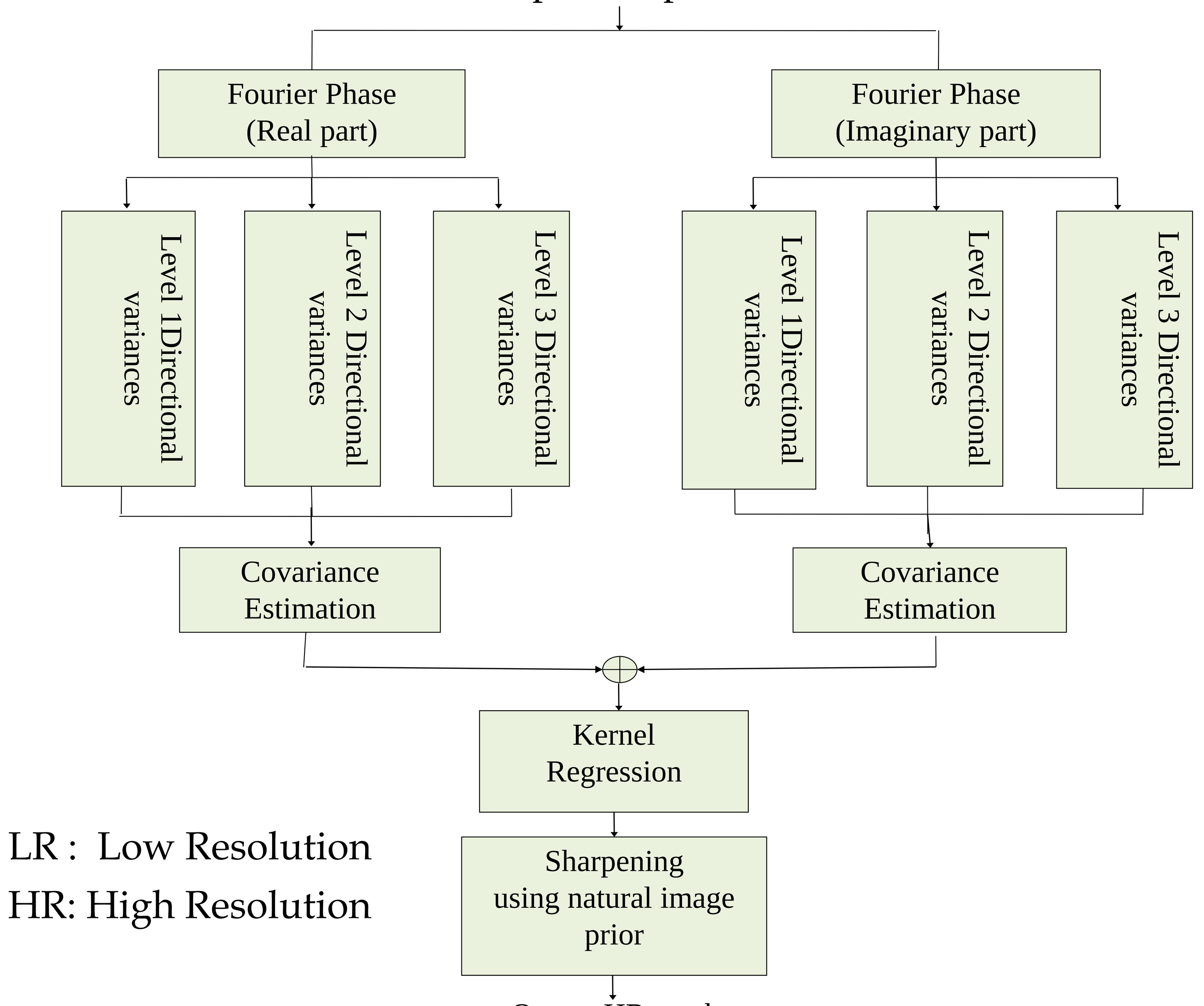


$$SAM(\boldsymbol{s}_i, \boldsymbol{s}_j) = \cos^{-1}\left(\frac{\sum_{l=1}^{L} s_{il} s_{jl}}{[\sum_{l=1}^{L} {s_{il}}^2]^2 [\sum_{l=1}^{L} {s_{jl}}^2]^2}\right)$$

where s_i, s_j are the spectral signatures of two pixel vectors, and L is total band number in a classification.

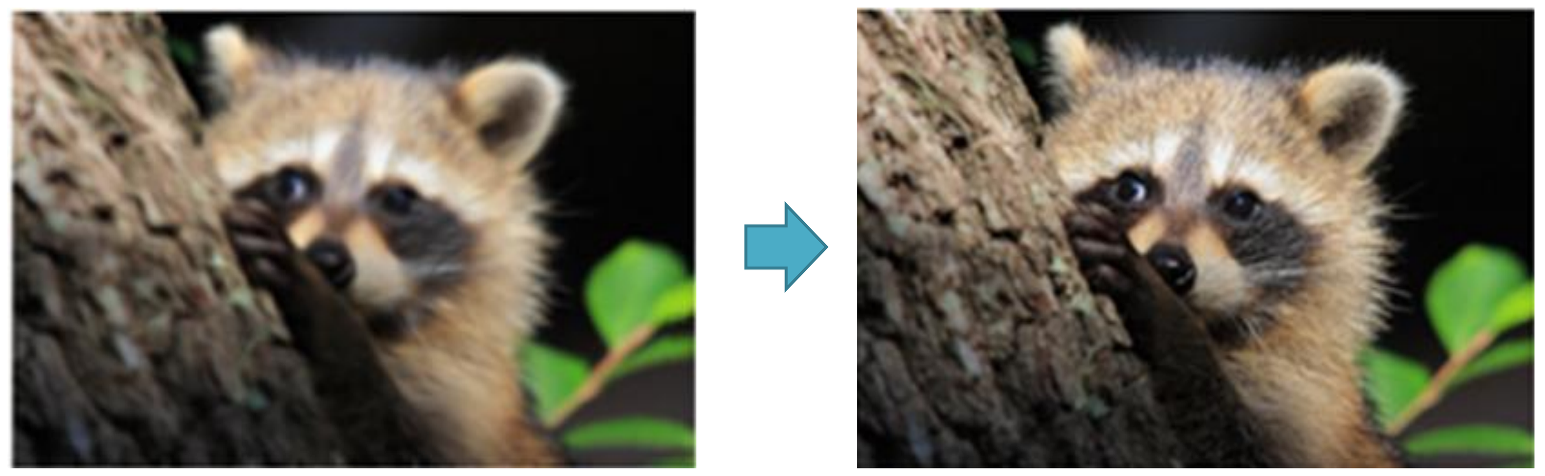
Super Resolution

The single image resolution enhancement is applied to the SAM image. This technique uses adaptive kernel regression technique based on multi-level local covariance to estimate the high resolution image from a low resolution input.

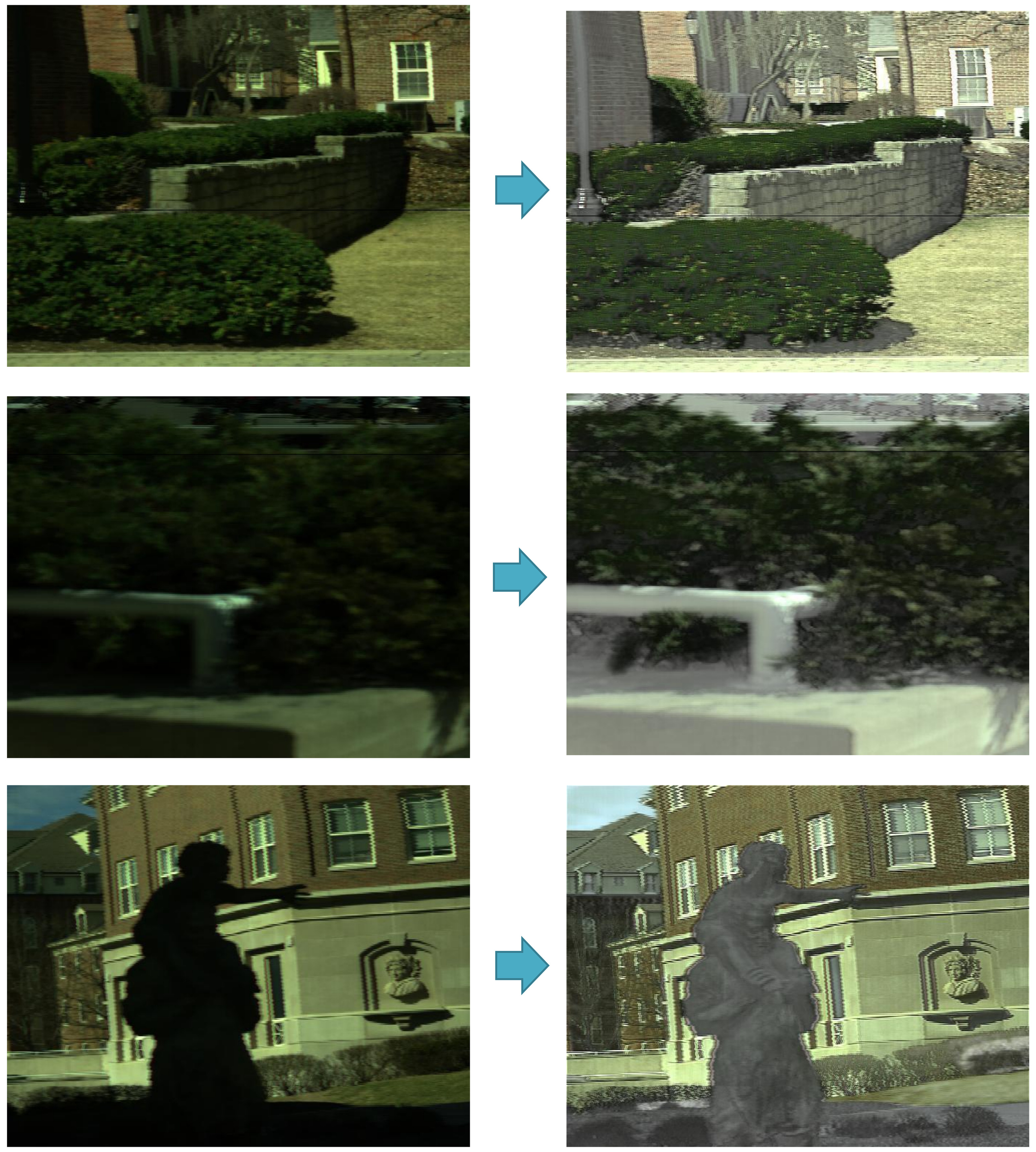


LR : Low Resolution
HR: High Resolution

Super Resolution Results



Sample Results


Original Image　Enhanced Image

UNIVERSITY of DAYTON
Vision Lab
Kettering Laboratories
300 College Park
Dayton, OH 45469-0232

UD VISION LAB
www.visionlab.udayton.edu

Dr. Vijayan Asari
Director
(937) 229-4504
VAsari1@udayton.edu