EMVA-YPA

Hyperspectral Recovery from RGB

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Hyperspectral Imaging
Most vision systems reduce observed spectrum to a **small set of measurements**, such as RGB.
Hyperspectral imaging systems attempt to record the entire observed spectrum by measuring a large amount of narrow bands.
Hyperspectral Imaging

Such systems have been widely used in laboratory or airborne settings. They require **scanning** to collect data.
Natural Hyperspectral Images?
The BGU Hyperspectral DB

- 200 images (and growing)
- Large variety of environments and scenes
- 519 spectral channels
- 1392x1300 spatial resolution
- $O(10^8)$ unique spectra
- Each HS cube is 1.8GB in size (raw format)

http://icvl.cs.bgu.ac.il/hyperspectral
Natural Hyperspectral Images

Attempting to recover HS from RGB should reveal where additional information is available is HS images.
... this didn’t work so well ...
Hyperspectral From RGB

Hyperspectral Prior

Hyperspectral Dictionary

RGB Projection

Novel RGB Image

OMP

Intermediate Representation

Weights applied to HS Dictionary

Hyperspectral Reconstruction
Experimental Results

Ground Truth

Reconstruction

460nm  530nm  550nm  610nm

Error Map

Ground Truth

Reconstruction
Experimental Results

<table>
<thead>
<tr>
<th>Data Set</th>
<th>Relative RMSE</th>
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</thead>
<tbody>
<tr>
<td><strong>Complete Data Set</strong></td>
<td>0.0756</td>
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<tr>
<td>Park Subset</td>
<td>0.0589</td>
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<tr>
<td>Indoor Subset</td>
<td>0.0507</td>
</tr>
<tr>
<td>Urban Subset</td>
<td>0.0617</td>
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<tr>
<td>Rural Subset</td>
<td>0.0354</td>
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<td>Plant-life Subset</td>
<td>0.0469</td>
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<tr>
<td><strong>Cross Domain</strong></td>
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<tr>
<td>Park Subset from Rural Prior</td>
<td>0.0801</td>
</tr>
<tr>
<td>Rural Subset from Park Prior</td>
<td>0.0592</td>
</tr>
</tbody>
</table>
Experimental Results

Physical camera experiment:
Color-Checker reconstruction.

(a) Reconstructed color-checker swatches.
Applications – industry and consumer market

• High resolution, handheld snapshot hyperspectral imaging.

• Low cost, compact sensors – consumer class HS imager.
Applications – illumination improvement
Our patented technology **recovers hyperspectral information** from **existing sensors** providing a unique and novel avenue for image enhancement and material sensing.
Questions?

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