# Homework 1

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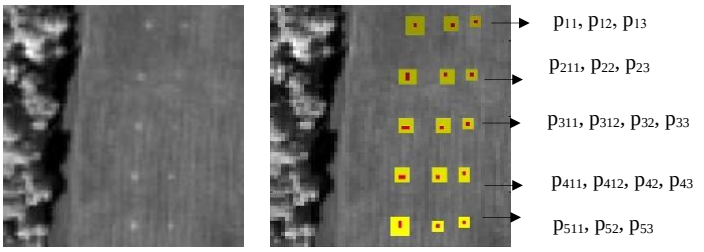
The image scene shown in Fig. 1 was used for experiments. It was acquired by the airborne Hyperspectral Digital Imagery Collection Experiment (HYDICE) sensor in August 1995 from a flight altitude of 10000 ft with ground sampling distance approximately 1.5 m. It has 210 spectral channels ranging from 0.4 μm to 2.5 μm with spectral resolution is 10 nm. The low signal/high noise bands: bands 1-3 and bands 202-210; and water vapor absorption bands: bands 101-112 and bands 137-153, were removed. So, a total of 169 bands were used for the experiments. It has size of $64 \times 64$ pixel vectors shown in Fig. 1(a) along with its ground truth provided in Fig. 1(b) is used for experiments where the center and boundary pixels of objects are highlighted by red and yellow respectively. Each element in Fig. 1(b) is a square panel and denoted by $p_{ij}$ with rows indexed by $i = 1,2,\cdots,5$ and columns indexed by $j = 1,2,3$. The 1.56m-spatial resolution of the image scene suggests that most of the 15 panels are one pixel in size except that the panels in the 1st column with the 2nd, 3rd, 4th, 5th rows which are two-pixel panels, denoted by $p_{211}$, $p_{221}$, $p_{311}$, $p_{312}$, $p_{411}$, $p_{412}$, $p_{511}$, $p_{521}$. As a result, there are a total 19 panel pixels. Fig. 1(b) shows the precise spatial locations of these 19 panel pixels where red pixels (R pixels) are the panel center pixels and the pixels in yellow (Y pixels) are panel pixels mixed with the background.

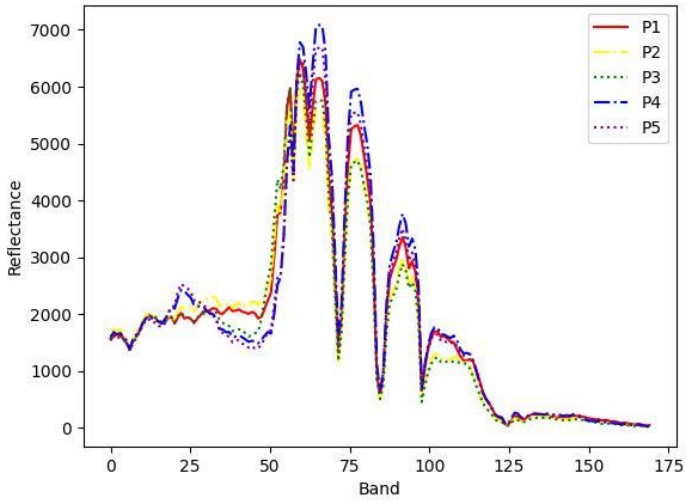



(a) (b)

**Figure 1.** (a) A HYDICE panel scene which contains 15 panels; (b) Ground truth map of spatial locations of the 15 panels

Please do the following task

(1) Plot the spectral signature




(2) Calculate SAM and SID

| SAM / SID | P1 | P2 | P3 | P4 | P5 |
|---|---|---|---|---|---|
| P1 | | 0.07926562878224819 | 0.08520852239241744 | 0.12974034545892663 | 0.11852600093208962 |
| P2 | 0.010957461546223748 | | 0.07447498112674106 | 0.18652445618775013 | 0.16909126739677485 |
| P3 | 0.01249555533700822 | 0.0072033420743063 | | 0.18590668760470447 | 0.16855461661356982 |
| P4 | 0.02111235991081719 | 0.04489244045509336 | 0.041431115415255196 | | 0.03340562308722196 |
| P5 | 0.018574299800619594 | 0.039402360016573705 | 0.03645907198664295 | 0.002110731806789024 | |

(3) Calculate SID(TAN) and SID(SIN)

| SID(TAN) / SID(SIN) | P1 | P2 | P3 | P4 | P5 |
|---|---|---|---|---|---|
| P1 | | 0.0008703737075638201 | 0.001067312128387678 | 0.0027545978821736728 | 0.002211905108048772 |
| P2 | 0.0008676408425361336 | | 0.0005374628159167677 | 0.008472017728729969 | 0.006726828368140782 |
| P3 | 0.001063439866377134 | 0.0005359729798402302 | | 0.0077922996122551155 | 0.00620421173532552 |
| P4 | 0.0027314469204183416 | 0.00832506795618971 | 0.007658031000893681 | | 0.0000705365512121458 |
| P5 | 0.002196386410449879 | 0.006630891024454715 | 0.006116287325920862 | 0.0000704971977458129 | |

(4) RSDPW values of SAM and SID using P3 as the reference signature.

| SAM / SID | P1 | P2 | P4 | P5 |
|---|---|---|---|---|
| P1 | | 1.1441227792647588 | 2.1817851358639215 | 1.9781427007654484 |
| P2 | 1.7346885942816443 | | 2.496230073403169 | 2.263238124582061 |
| P4 | 3.3156681954381186 | 5.751651801048906 | | 1.1029462813879265 |
| P5 | 2.9177632368736526 | 5.061410607819017 | 1.1363732853769233 | |

(5) RSDPW values of SAM and SID using P3 as the reference signature.

| SID(TAN) / SID(SIN) | P1 | P2 | P4 | P5 |
|---|---|---|---|---|
| P1 | | 1.9858343624519015 | 7.300862985625824 | 5.8129309789609875 |
| P2 | 1.984129622904009 | | 14.498304592408942 | 11.5435180845819 |
| P4 | 7.201188560837597 | 14.288091543675366 | | 1.2559693228855078 |
| P5 | 5.751418128377563 | 11.411559082221055 | 1.252071819523406 | |