

Basics of Spectral Imaging



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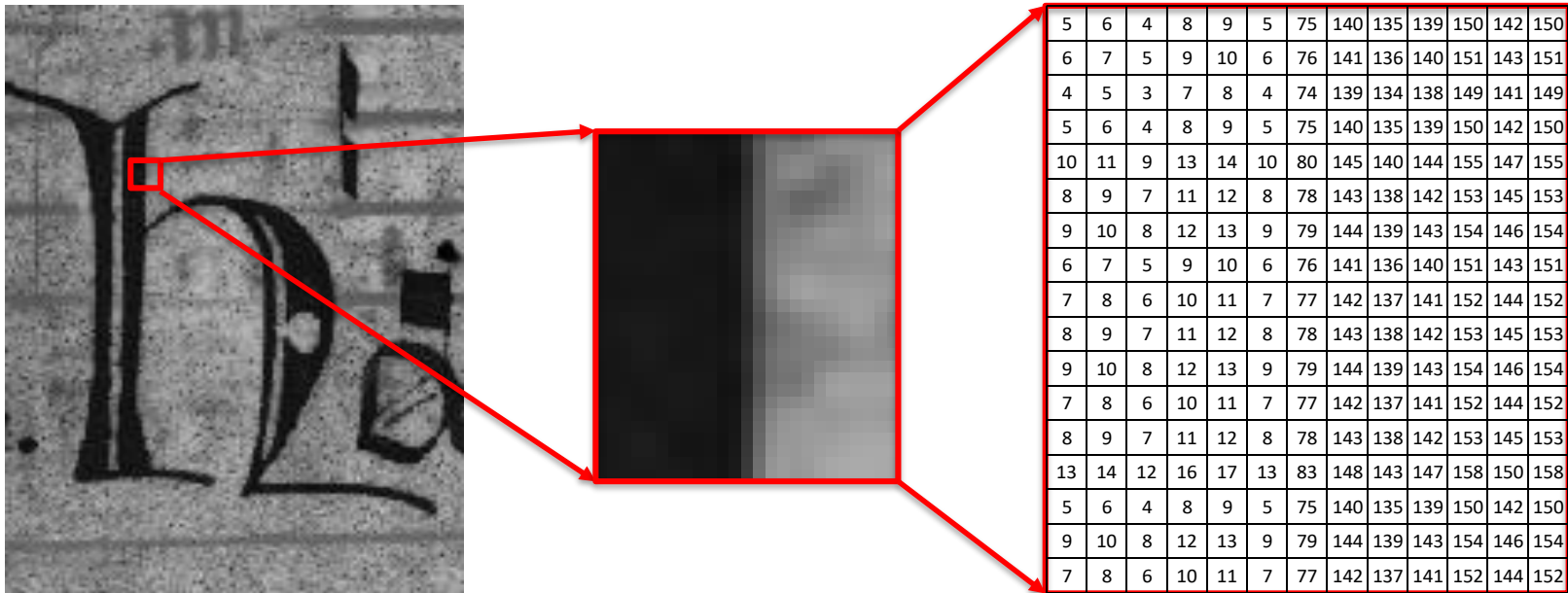
July 2019

Spectral imaging – How and why it works

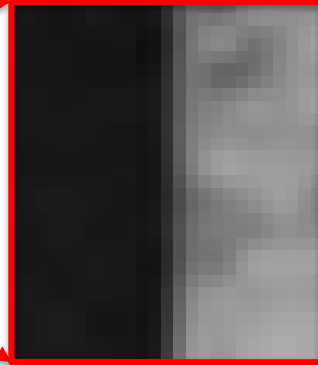
- What is a digital image – how does the computer “see” an image
- How is a colour image formed?
- Spectra and Wavelength
- Prototype System
- Results
- Spectra – what it means

What is a digital image?

Numbers from 0 to 255 (range of 256 values)



A close-up of a handwritten letter 'H' in a cursive script. A red square is drawn on the vertical stem of the 'H', and two red lines extend from its corners, one horizontally to the right and one diagonally down and to the right, illustrating a specific stroke or connection point.



5	6	4	8	9	5	75	140	135	139	150	142	150
6	7	5	9	10	6	76	141	136	140	151	143	151
4	5	3	7	8	4	74	139	134	138	149	141	149
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9	10	8	12	13	9	79	144	139	143	154	146	154
6	7	5	9	10	6	76	141	136	140	151	143	151
x 17 = 221 pixel image												
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5	6	4	8	9	5	75	140	135	139	150	142	150
10	11	9	13</									

13 x 17 = 221 pixel image

17 pixels

13 pixels

Monochrome Image - grayscale

Black and white image – 1 spectral band



Wavelength

Color (RGB) image – 3 spectral bands - RED



Wavelength

Color (RGB) image – 3 spectral bands - GREEN



Wavelength

Color (RGB) image – 3 spectral bands - BLUE



Wavelength

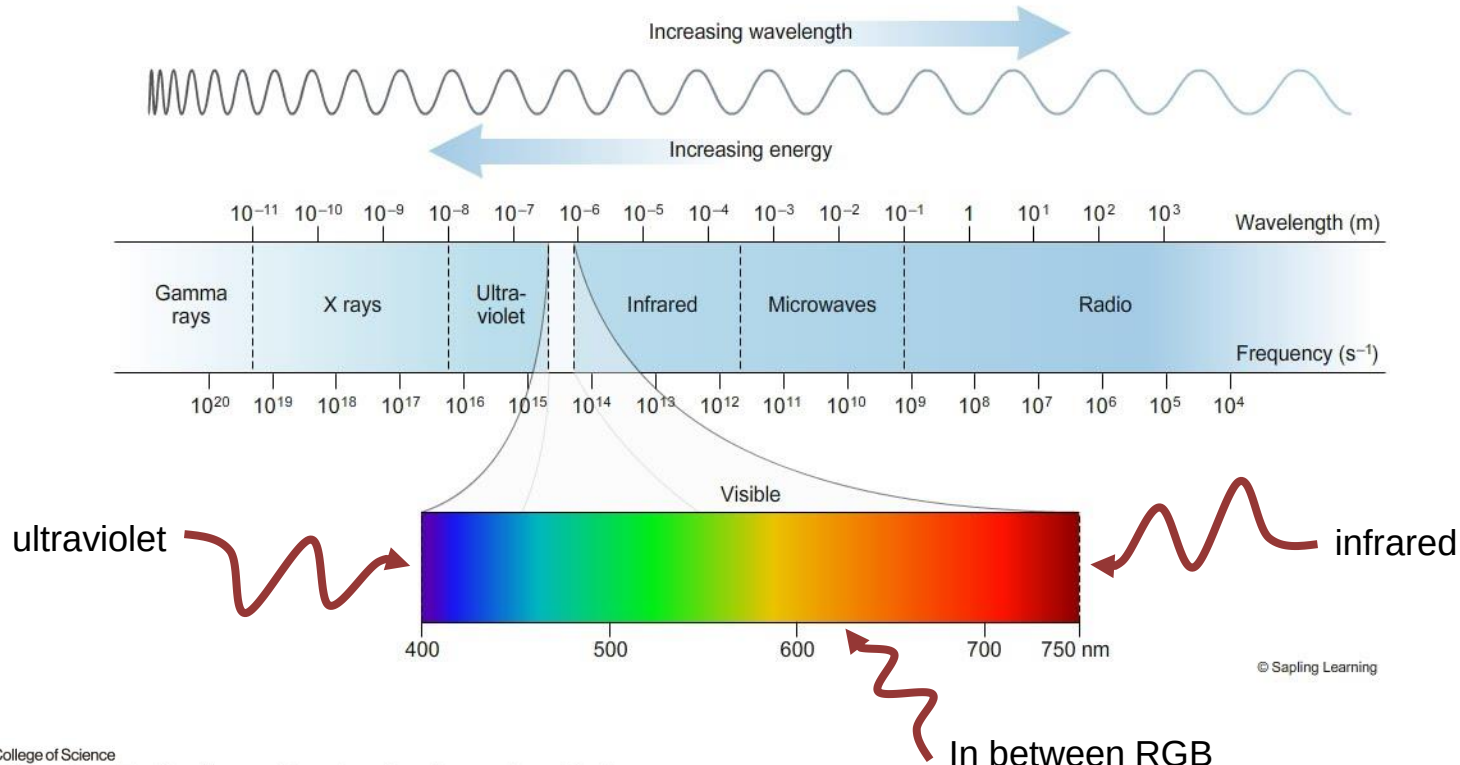
Color (RGB) image – 3 spectral bands - Colour



How does Red Green Blue form an image?

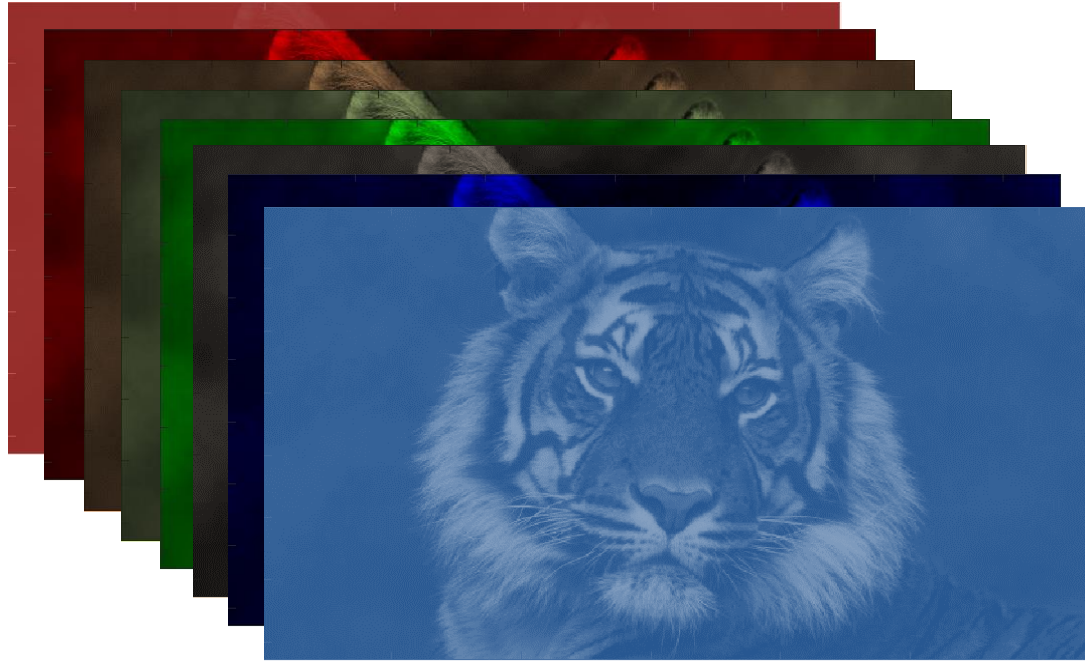
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179	195	198	182	173	182	170	150
169	188	196	180	172	181	169	148
250	252	232	224	218	216	201	205
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184	185	162	156	154	153	139	140
237	211	202	216	199	186	185	167
182	148	134	147	134	125	126	108
175	139	125	140	128	120	120	100
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87	27	56	97	92	90	82	43

More information than visible



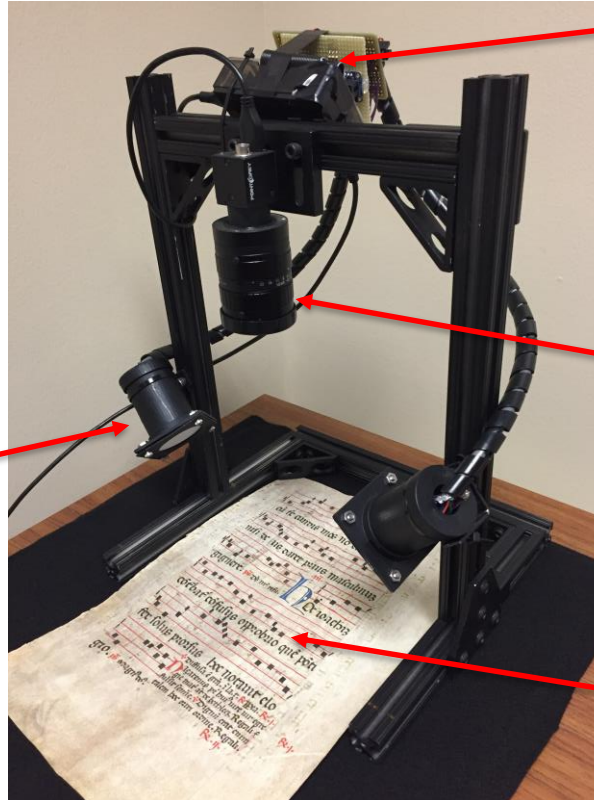
Multispectral Images

Multispectral image – 10's of spectral bands



Prototype system

Narrowband lights (LEDs)



Raspberry Pi

Monochrome camera

Palimpsest (14th century music score)

Images Captured

Different
wavelengths



Images Captured

Different
wavelengths

RGB



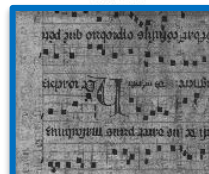
400 nm



420 nm



440 nm



470 nm



505 nm



525 nm



575 nm



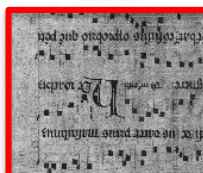
590 nm



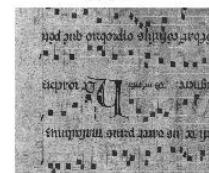
610 nm



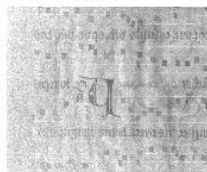
630 nm



660 nm



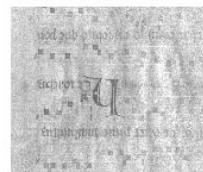
780 nm



850 nm



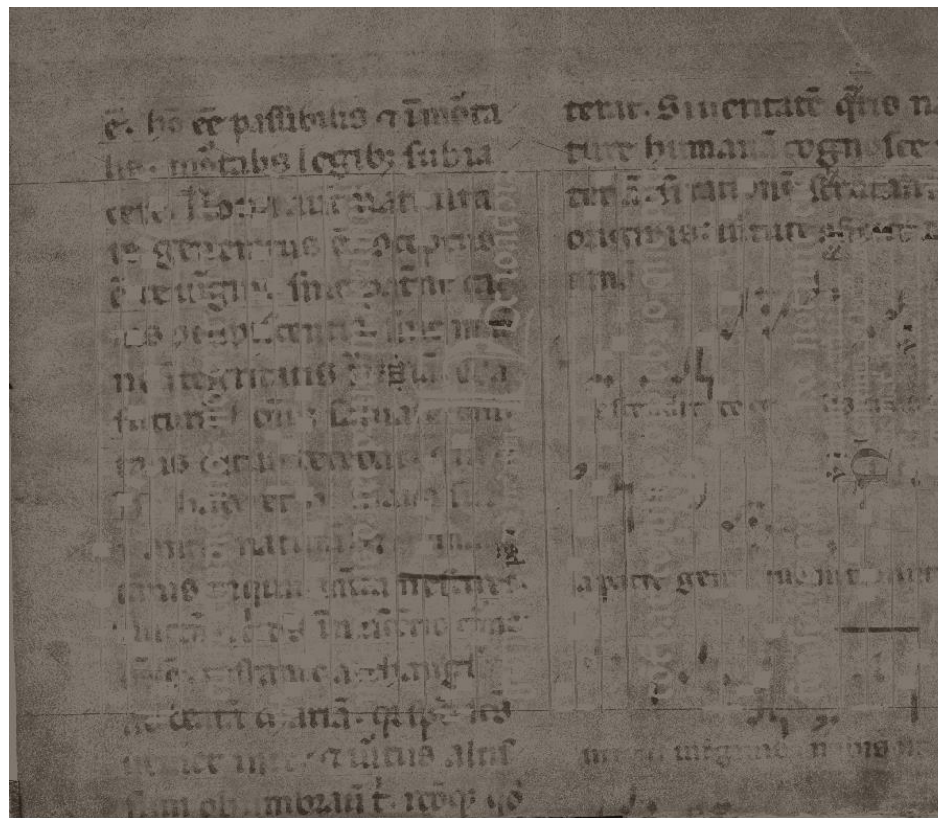
940 nm



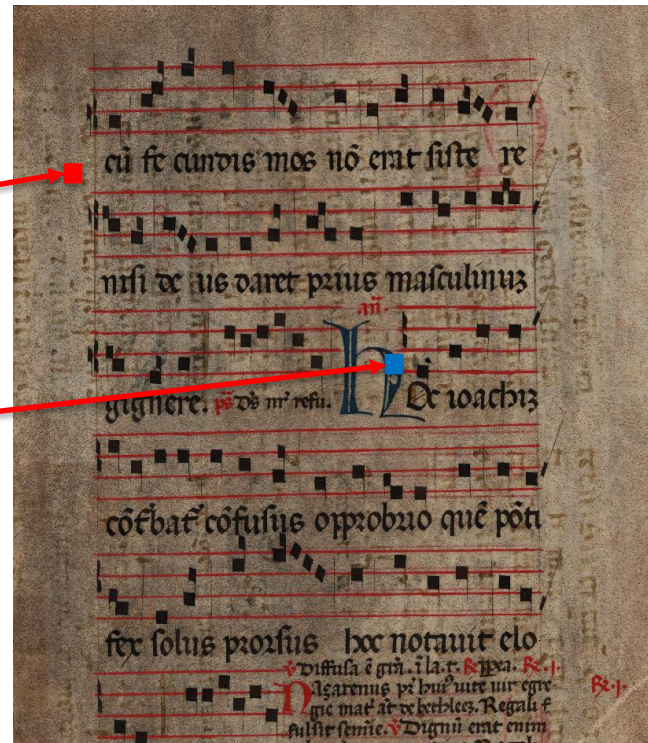
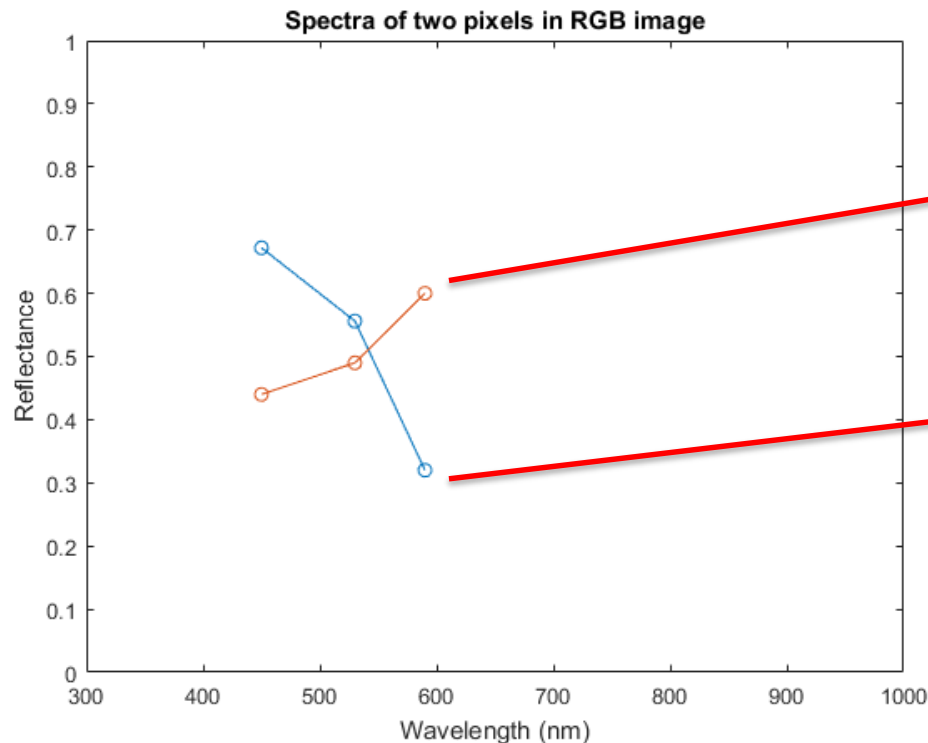
white



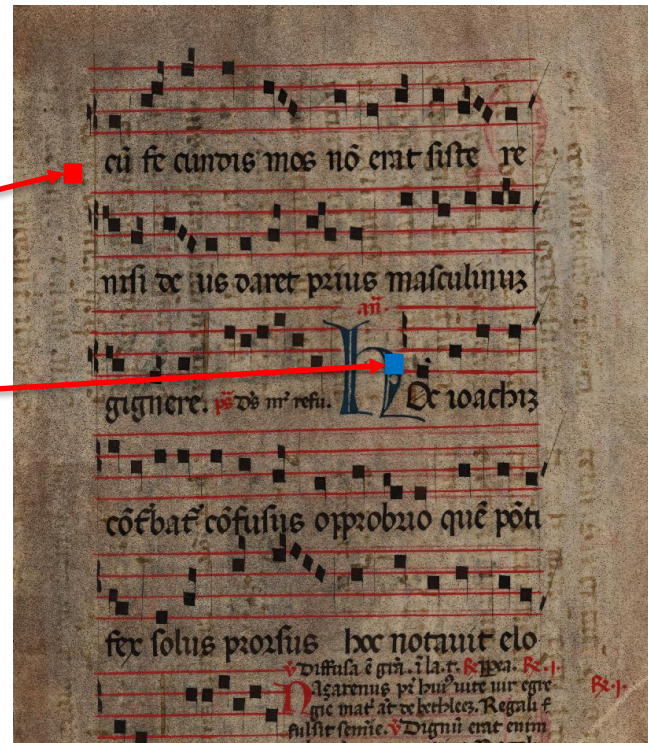
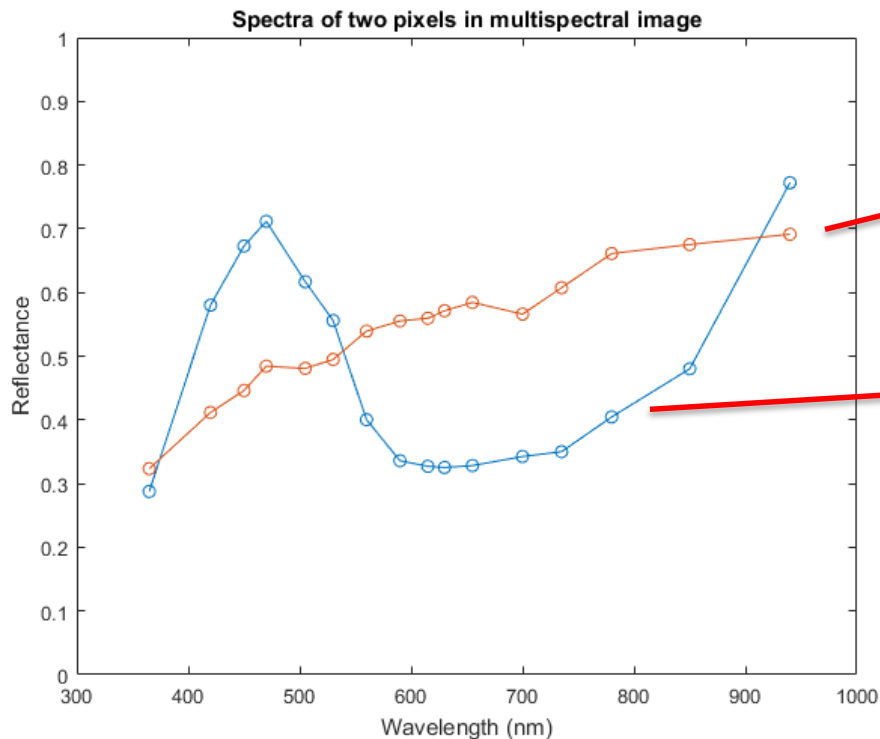
Results



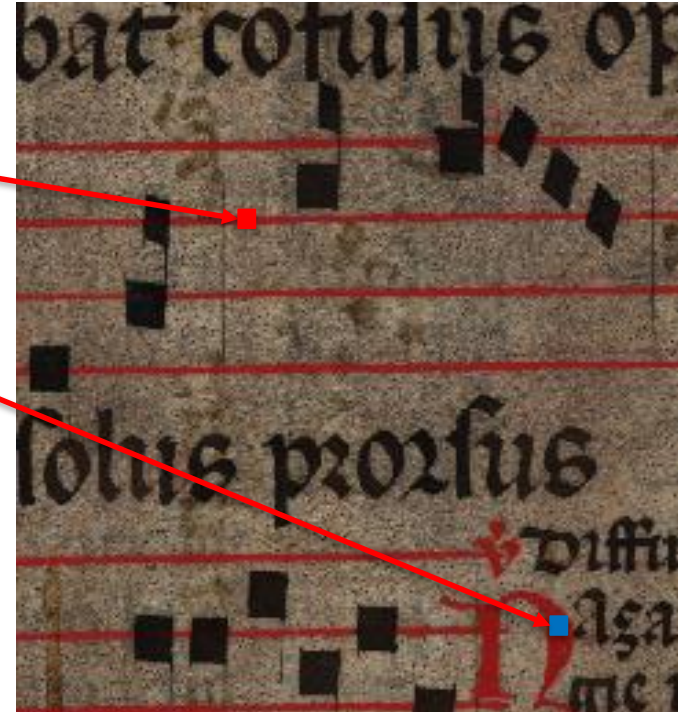
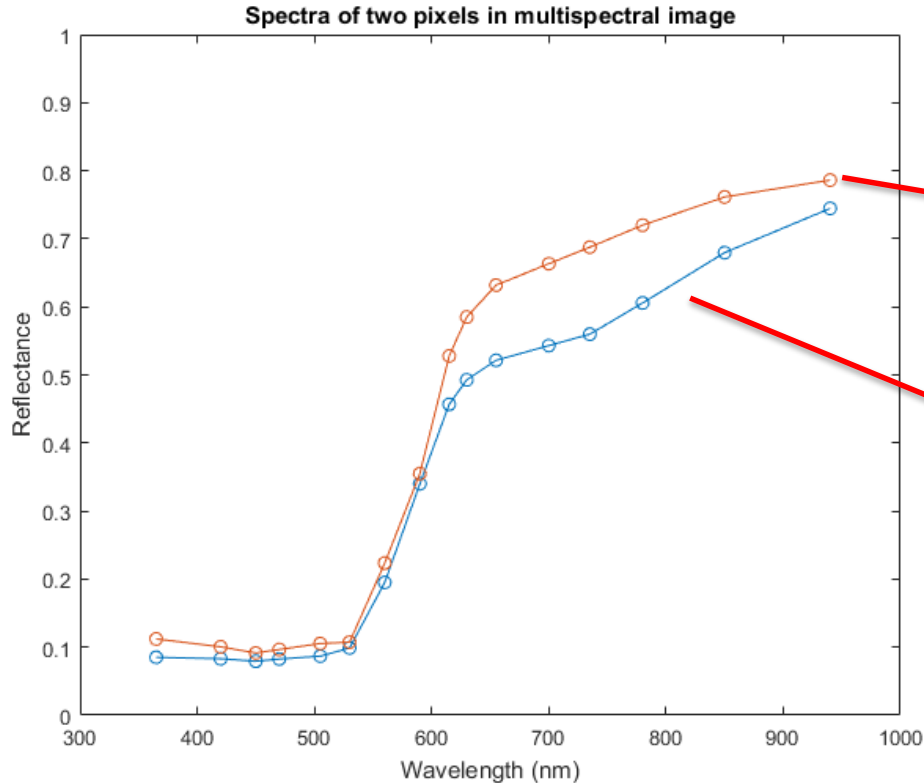
Plotting spectra - RGB



Plotting spectra - Multispectral



Spectral differences – RED ink

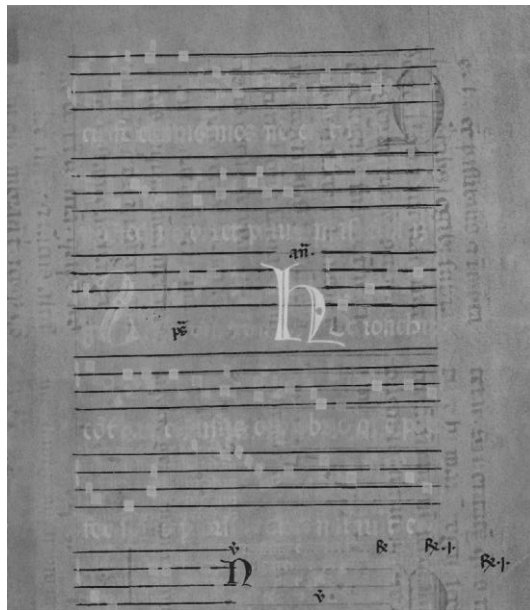


Results after image processing

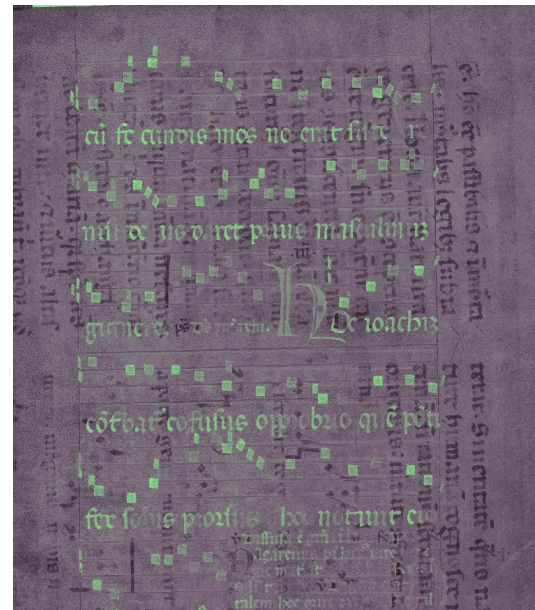
True color Image



PCA band 3



False Color



**This is not magic
Just very cool science!**

Results after image processing

