Basics of Spectral Imaging

Tania Kleynhans

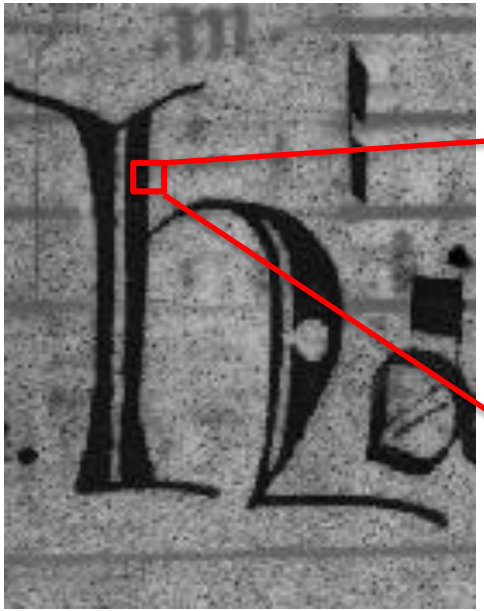
July 2019

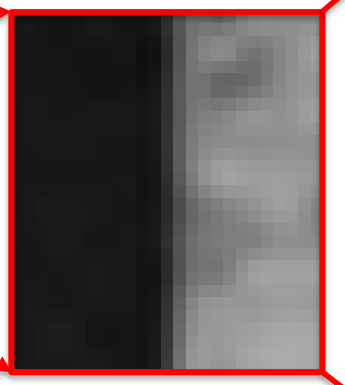
Spectral imaging – How and why it works

- 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)

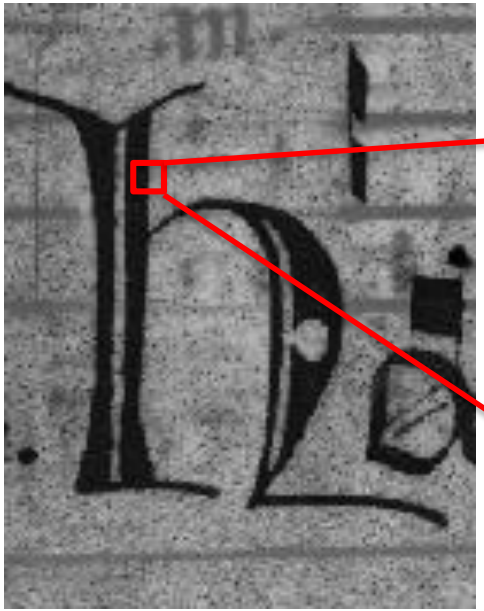


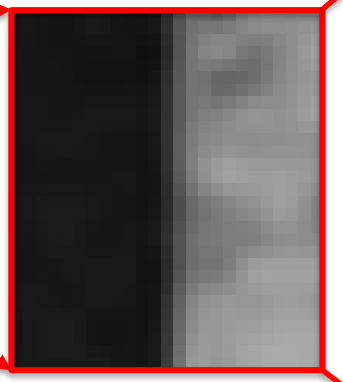


5	6	4	8	9	5	75	140	135	139	150	142	150
6	7	5	9	10	6	76	141	136	140	151	143	151
4	5	3	7	8	4	74	139	134	138	149	141	149
5	6	4	8	9	5	75	140	135	139	150	142	150
10	11	9	13	14	10	80	145	140	144	155	147	155
8	9	7	11	12	8	78	143	138	142	153	145	153
9	10	8	12	13	9	79	144	139	143	154	146	154
6	7	5	9	10	6	76	141	136	140	151	143	151
7	8	6	10	11	7	77	142	137	141	152	144	152
8	9	7	11	12	8	78	143	138	142	153	145	153
9	10	8	12	13	9	79	144	139	143	154	146	154
7	8	6	10	11	7	77	142	137	141	152	144	152
8	9	7	11	12	8	78	143	138	142	153	145	153
13	14	12	16	17	13	83	148	143	147	158	150	158
5	6	4	8	9	5	75	140	135	139	150	142	150
9	10	8	12	13	9	79	144	139	143	154	146	154
7	8	6	10	11	7	77	142	137	141	152	144	152

What is a digital image?

Numbers from 0 to 255 (range of 256 values)





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
5	6	4	8	9	5	75	140	135	139	150	142	150
10	11	9	13	14	10	80	145	140	144	155	147	155
8	9	7	11	12	8	78	143	138	142	153	145	153
9	10	8	12	13	9	79	144	139	143	154	146	154
9	10	8	12	13	9	79	144	139	143	154	146	154
7	8	6	10	11	7	77	142	137	141	152	144	152
8	9	7	11	12	8	78	143	138	142	153	145	153
13	14	12	16	17	13	83	148	143	147	158	150	158
5	6	4	8	9	5	75	140	135	139	150	142	150
9	10	8	12	13	9	79	144	139	143	154	146	154
7	8	6	10	11	7	77	142	137	141	152	144	152

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

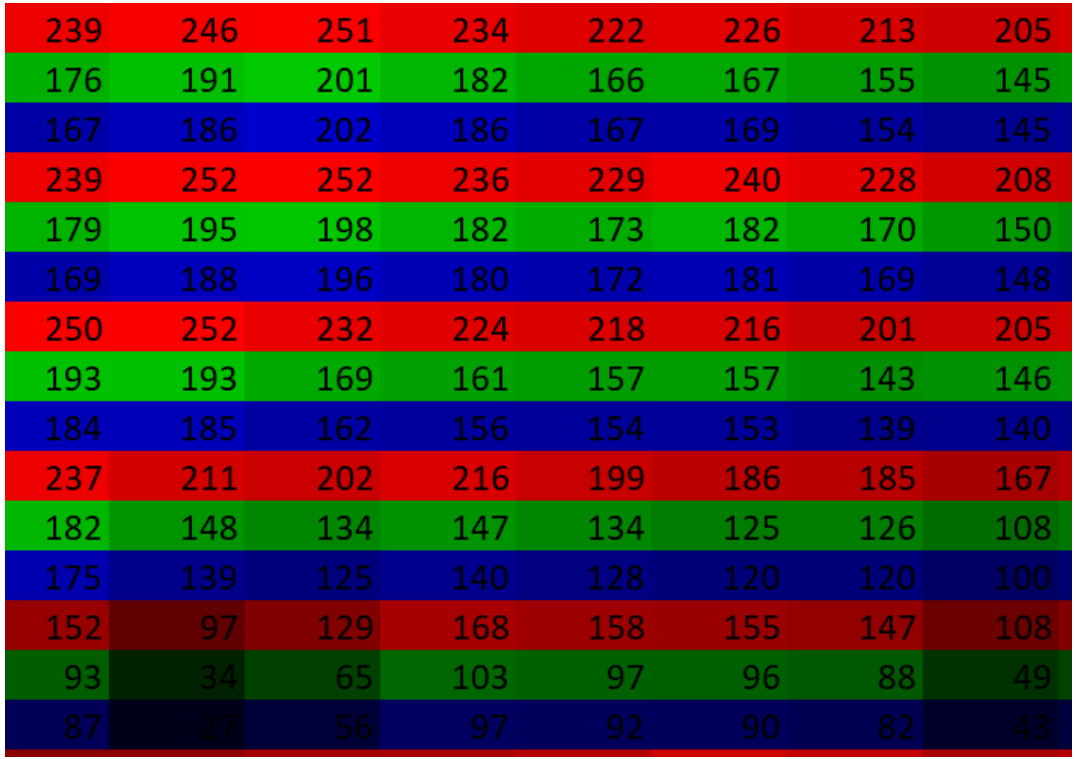
Wavelength

Color (RGB) image – 3 spectral bands - BLUE

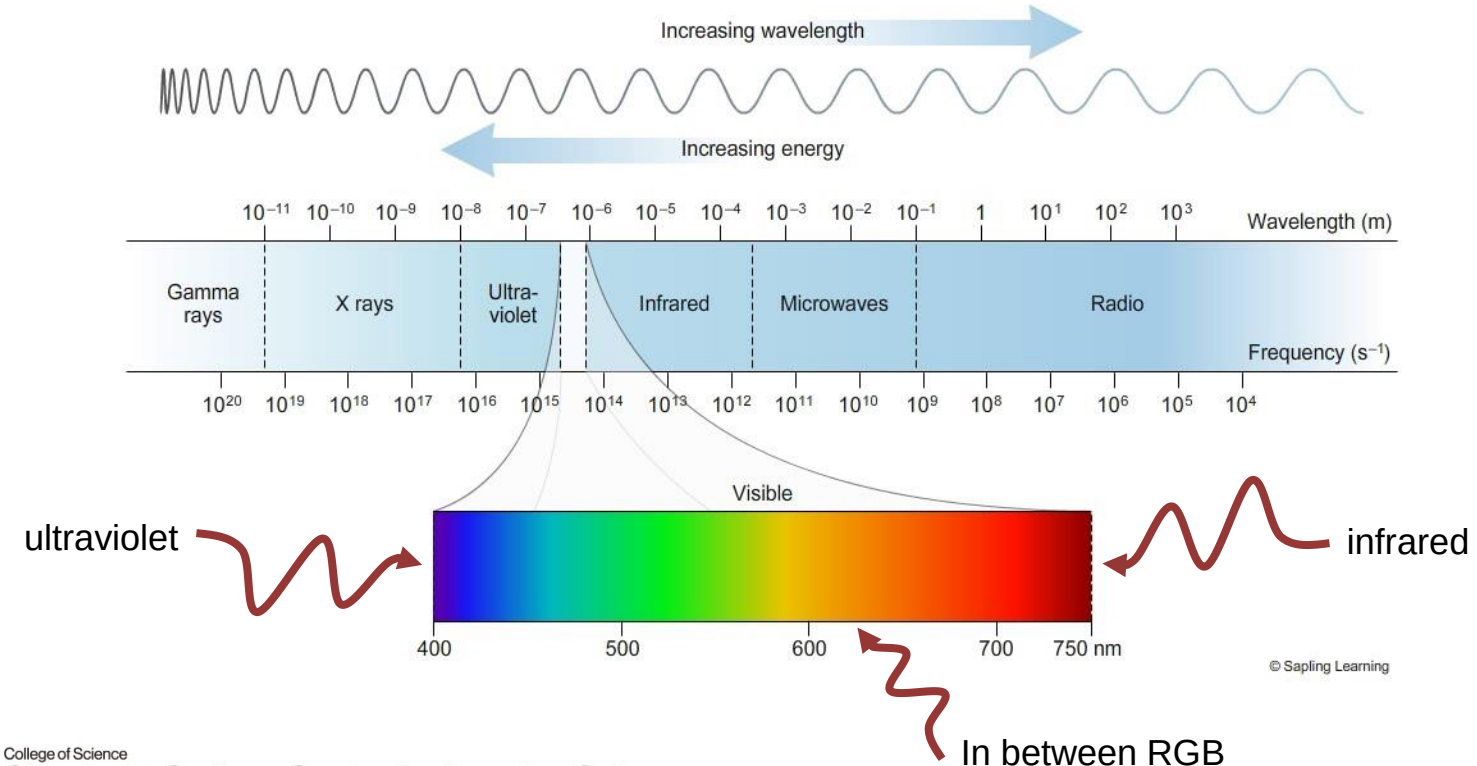
Wavelength

Color (RGB) image – 3 spectral bands - Colour

How does Red Green Blue form an image?

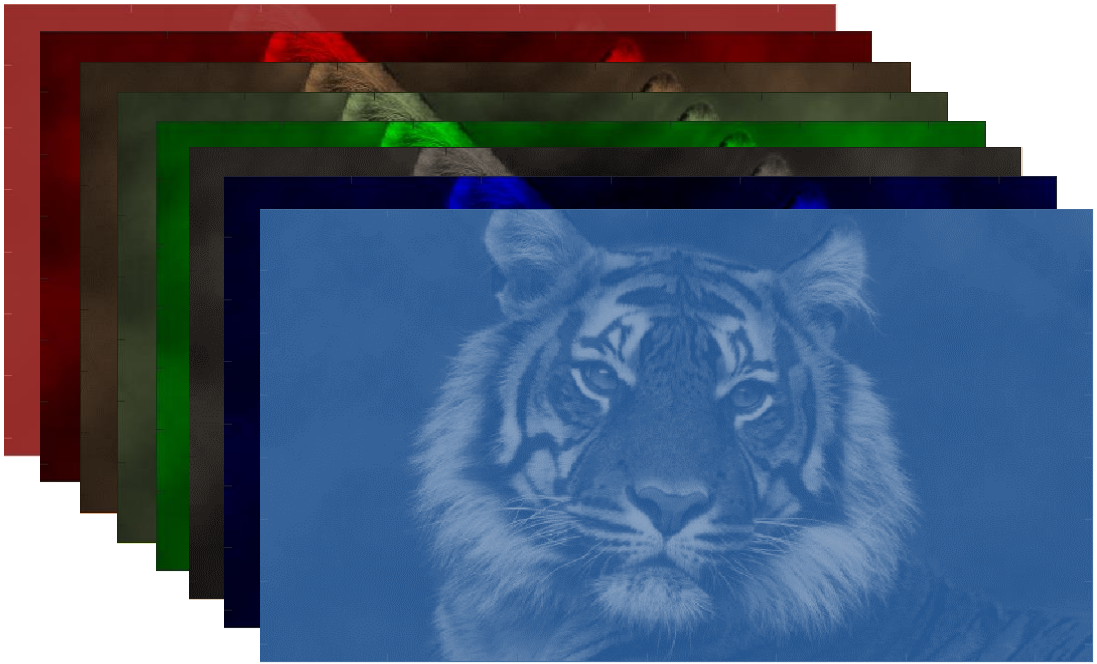


More information than visible



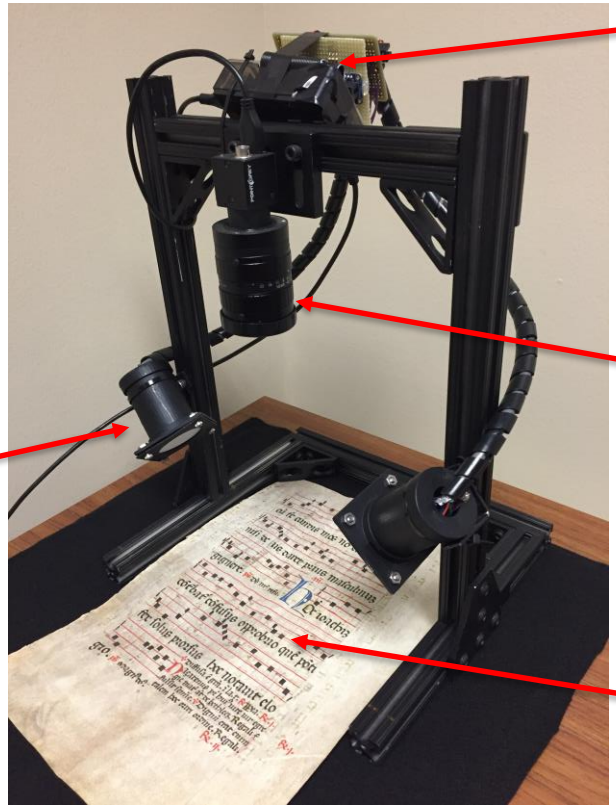
Multispectral Images

Multispectral image – 10’s of spectral bands



Prototype system

Narrowband lights (LEDs)



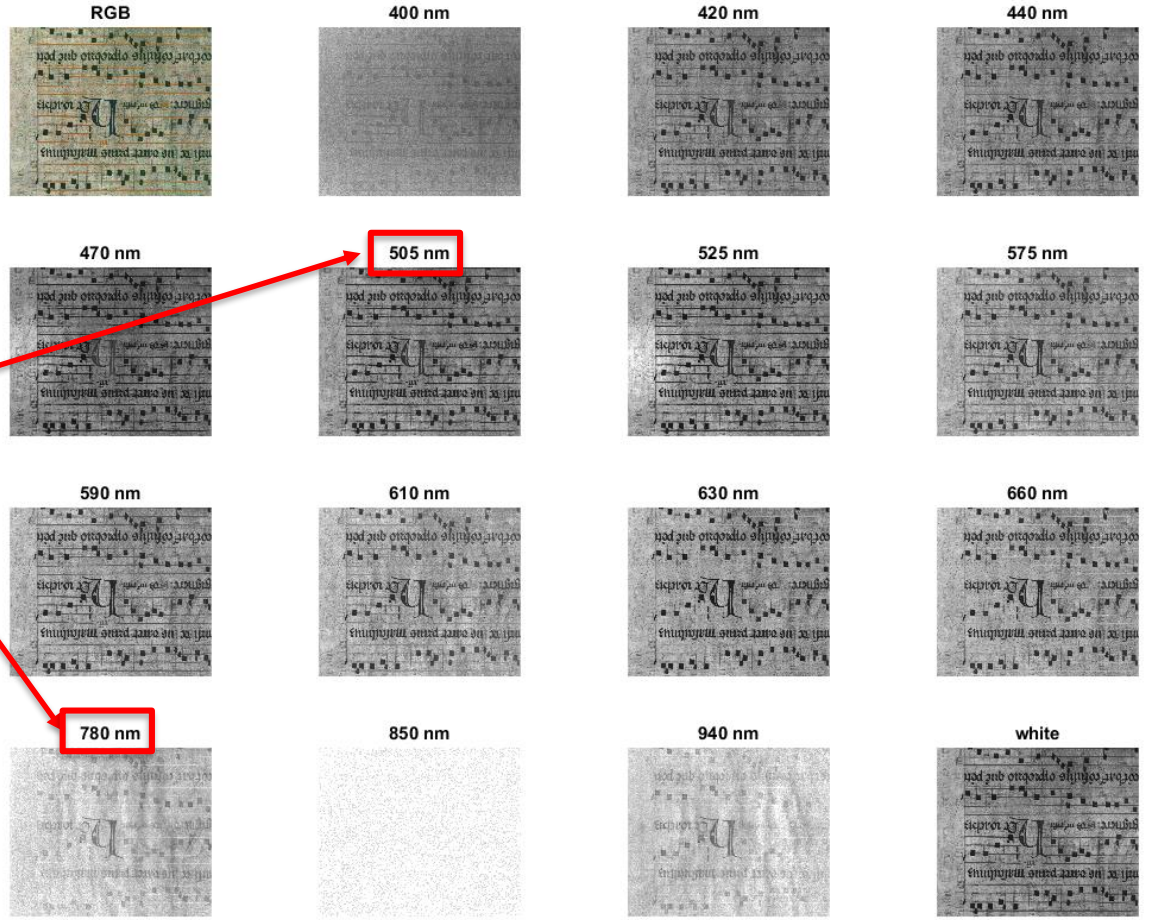
Raspberry Pi

Monochrome camera

Palimpsest (14th century music score)

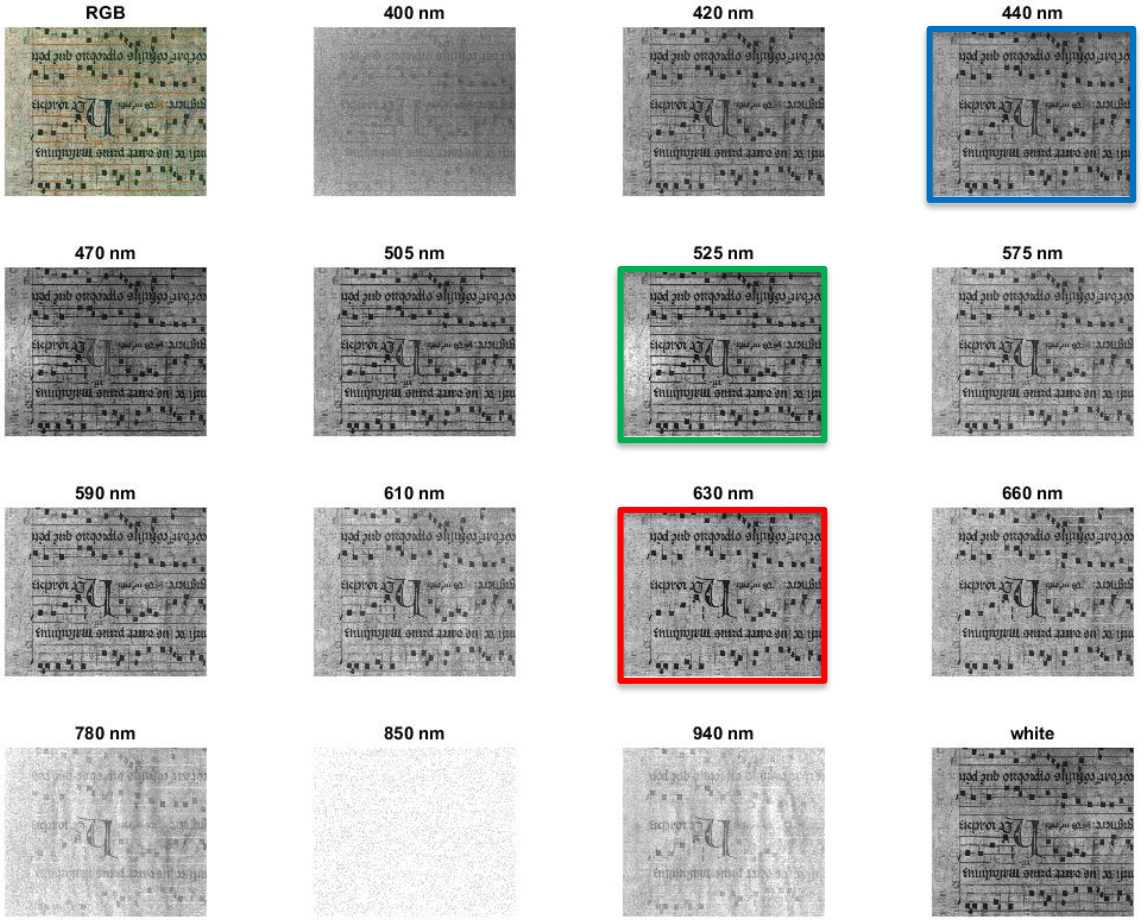
Images Captured

Different wavelengths

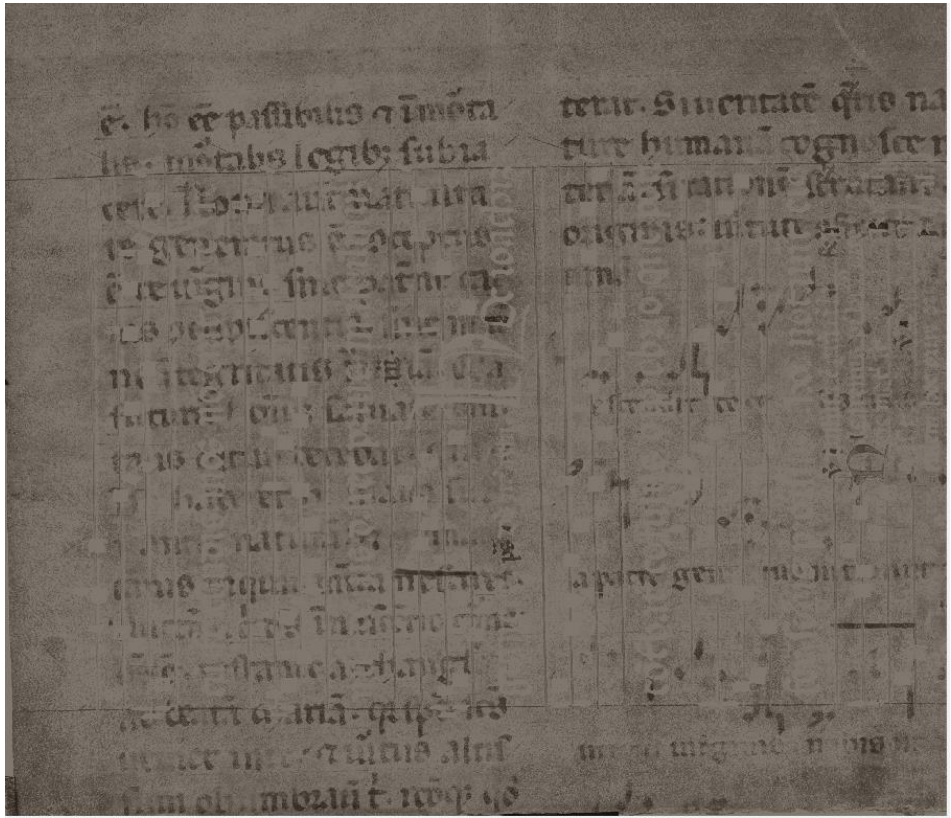


Images Captured

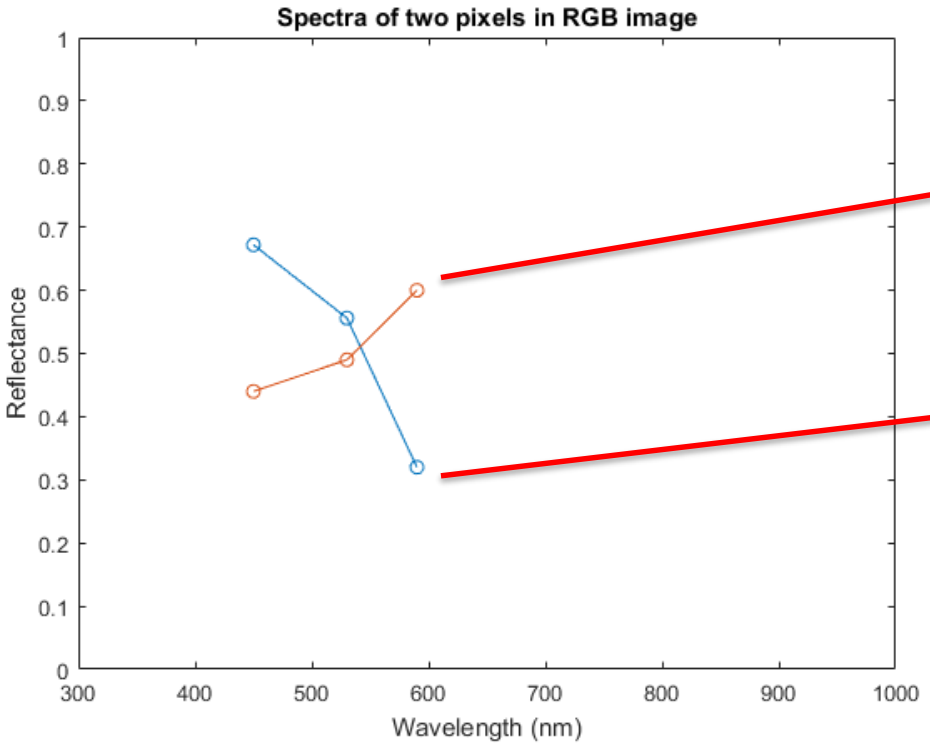
Different wavelengths

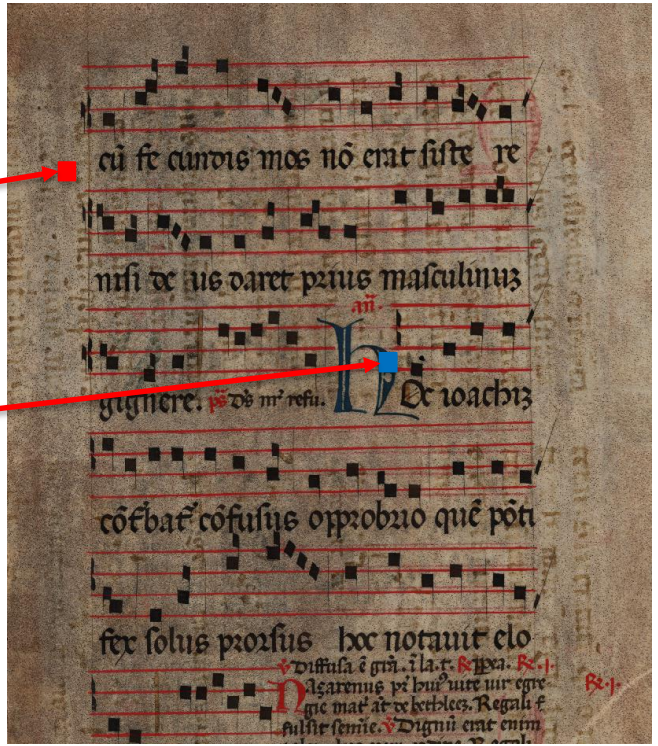


Results

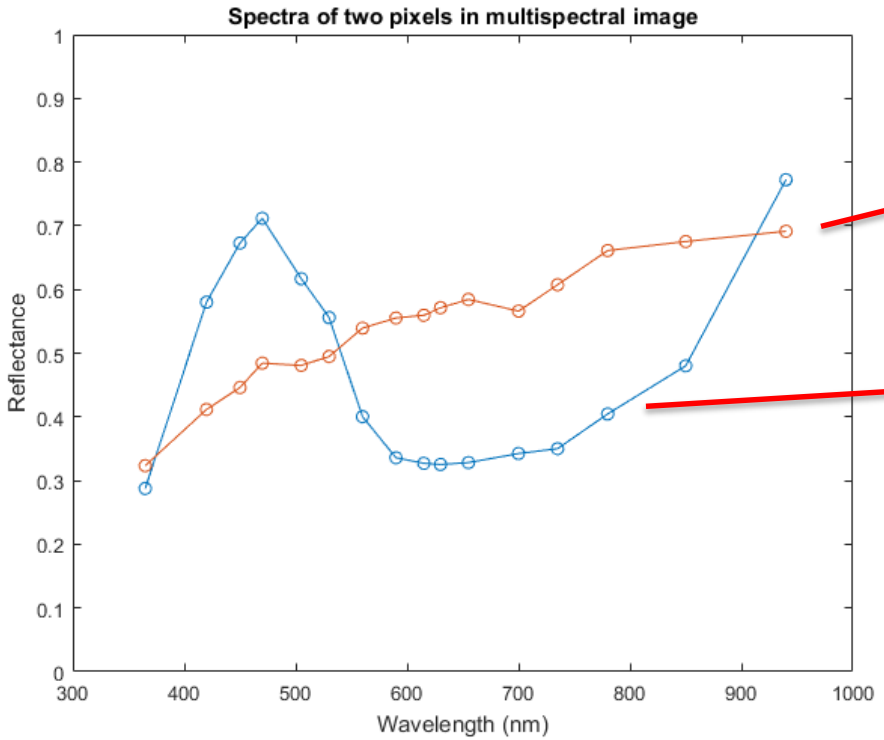


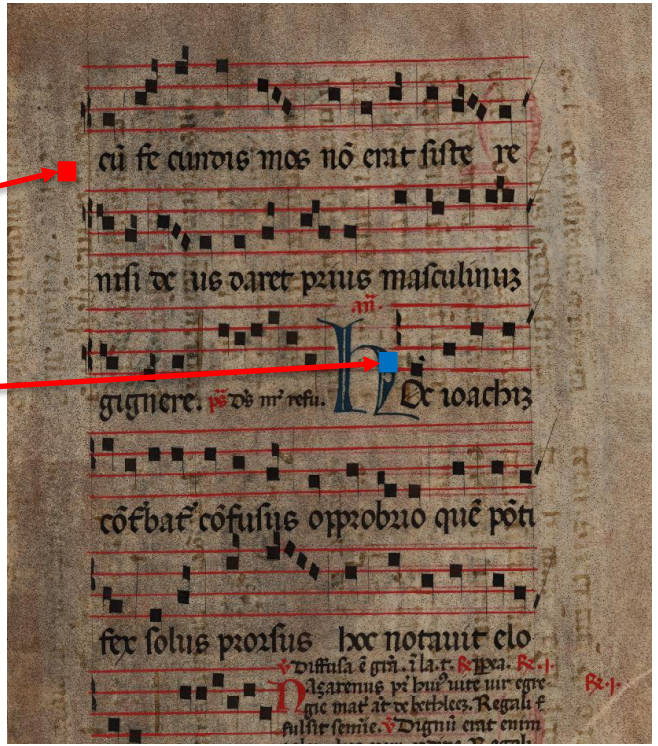
Plotting spectra - RGB



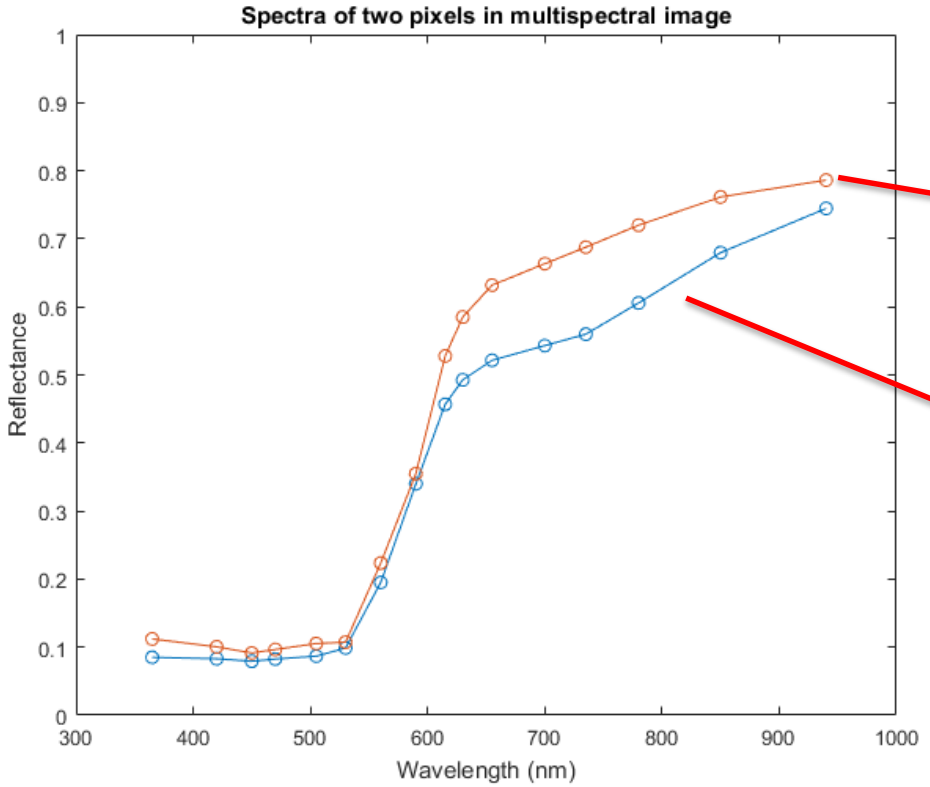


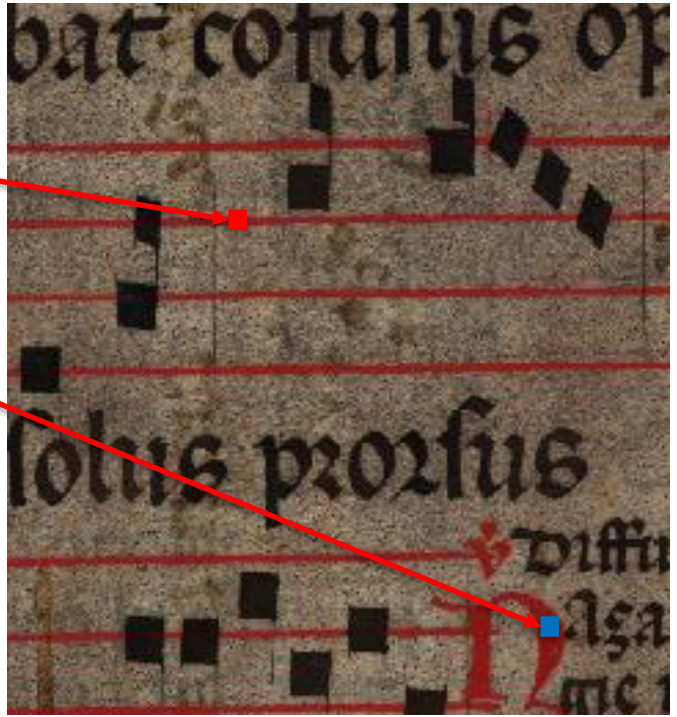
Plotting spectra - Multispectral





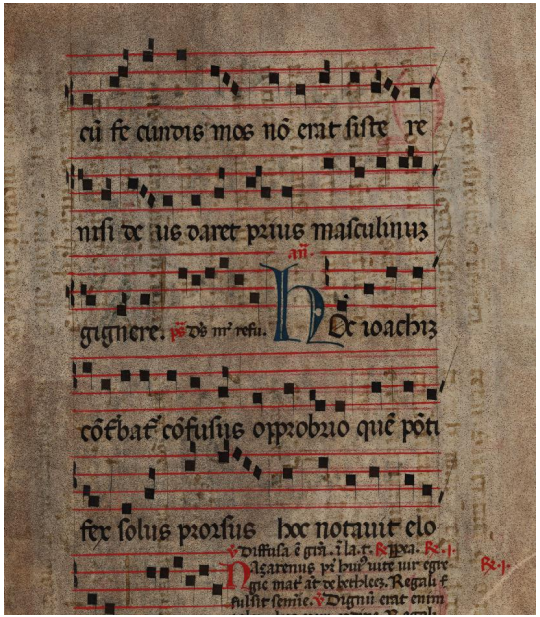
Spectral differences – RED ink



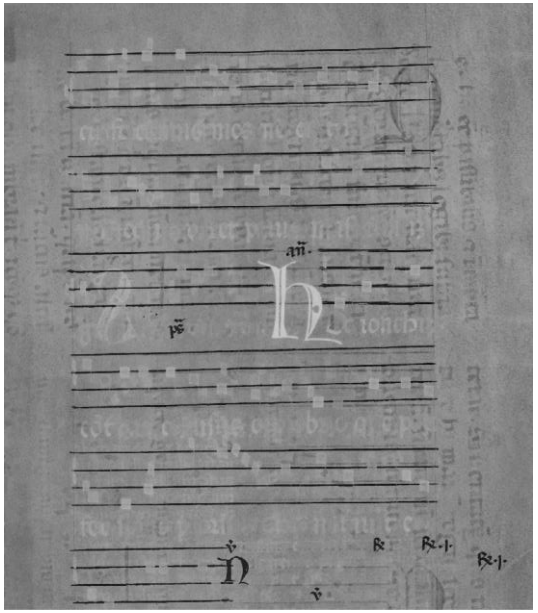


Results after image processing

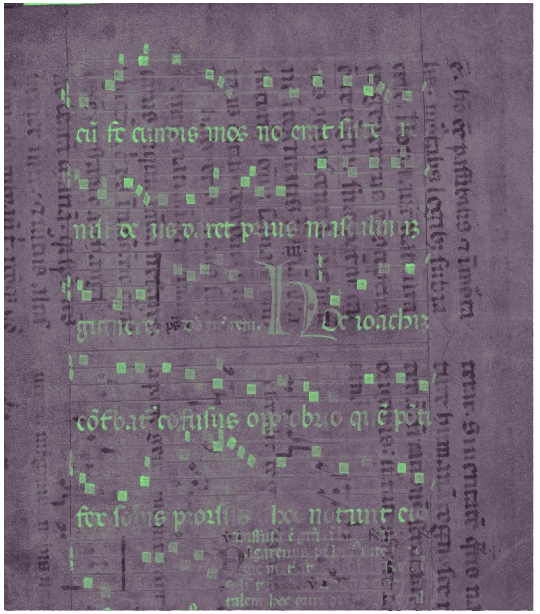
True color Image



PCA band 3



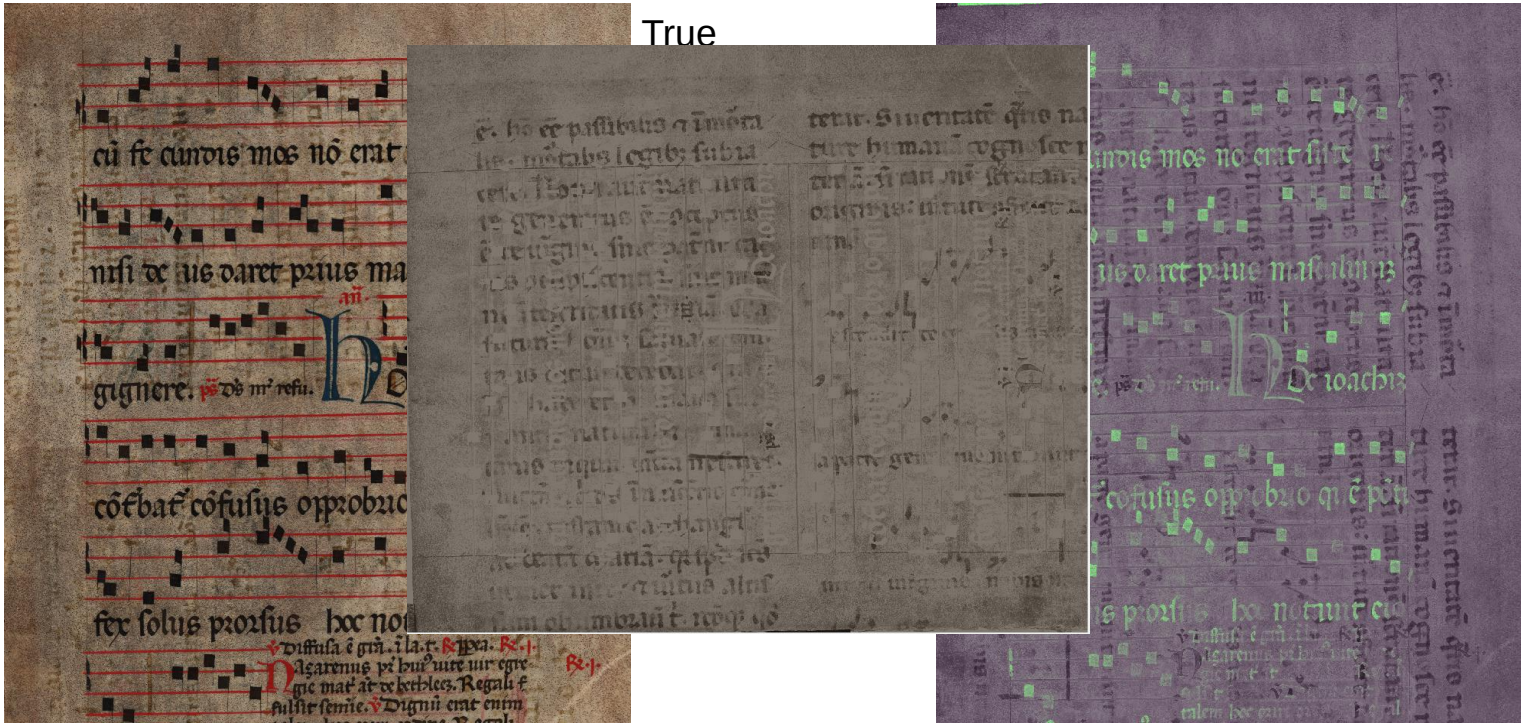
False Color



This is not magic

Just very cool science!

Results after image processing



True

False color Image

Two bands subtracted from one another