

EGM702 – Photogrammetry and Advanced Image Analysis

Week 3, Part 1: Using Digital Imagery

1. Digital imagery
2. Image enhancement
3. Band math(s)
4. Spectral indices
5. Image transformation

What is the purpose of this “red room” in Stranger Things?

Asked 1 year, 2 months ago Active 1 year, 2 months ago Viewed 38k times



In *Stranger Things*, we frequently see Jonathan go inside this to "refine" his photos or something. I don't quite understand what happens here.

68



He puts the photo in water, and somehow this makes it more clear?



9

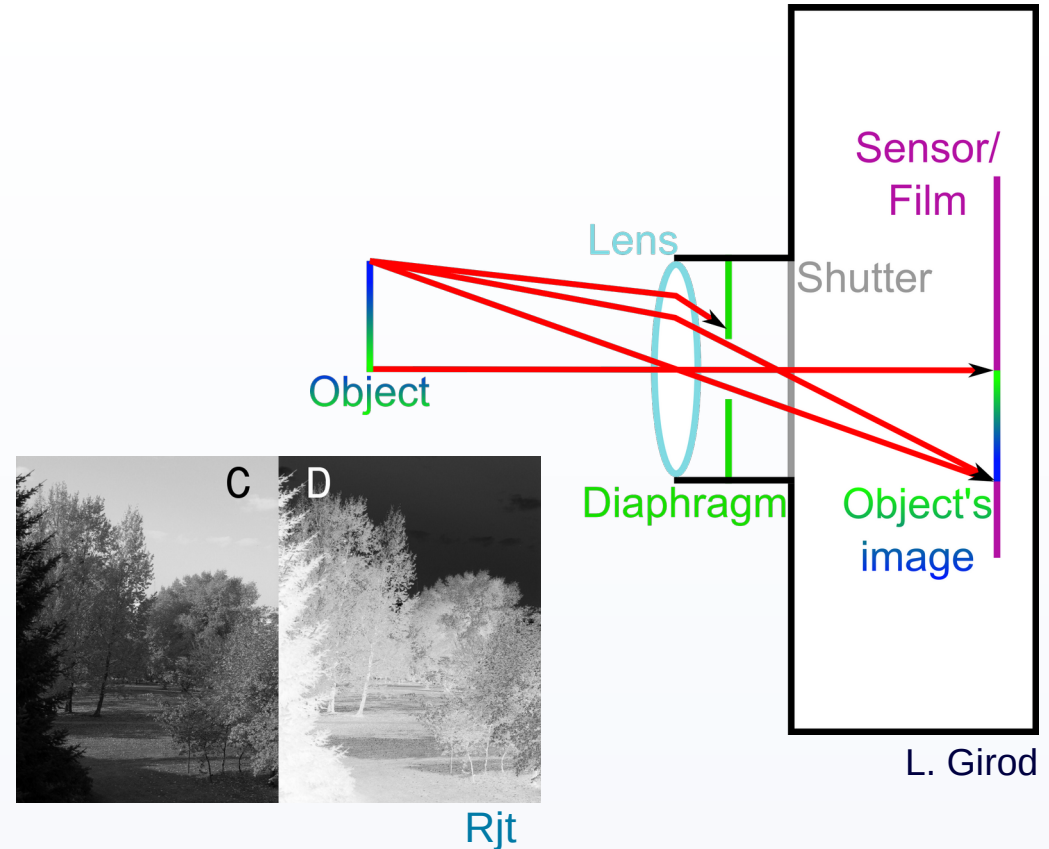
Is this an old film technique, and if so, what is it called?



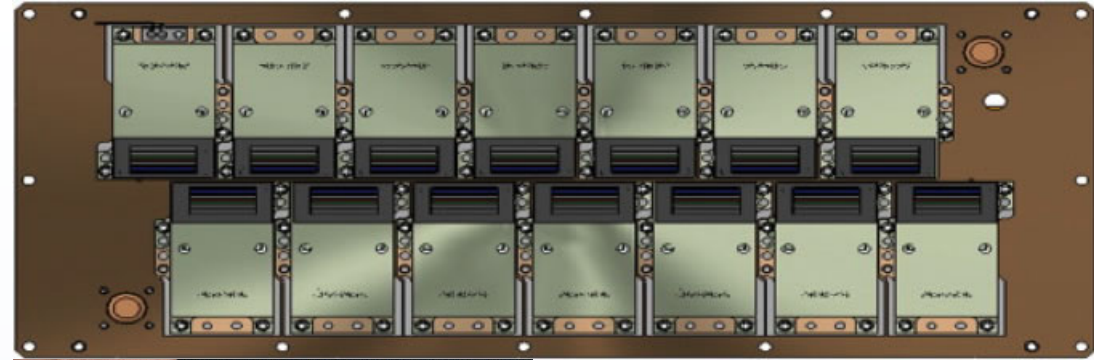
movies.stackexchange.com

In the before times...

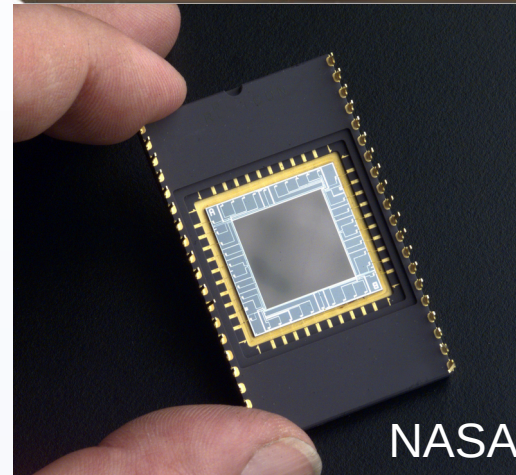
- Cameras recorded photographs on **film**:
 - Plastic or paper coated with silver halide crystals
- After “developing” the film, have a **negative** image
- Can then project the film onto light-sensitive paper:
 - Bright areas: more light/energy
 - Dark areas: less light/energy



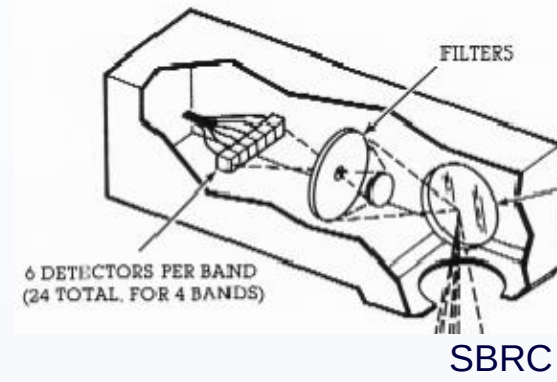
- Still measure intensity of electromagnetic radiation:
 - Charge-coupled device (CCD)
 - Complementary metal-oxide semiconductor (CMOS)
- EMR strikes detector, produces electrical charge → voltage → brightness value
 - Proportional to intensity of energy
- Monochromatic
 - Need to filter/split incoming radiation



Ball Aerospace/NASA

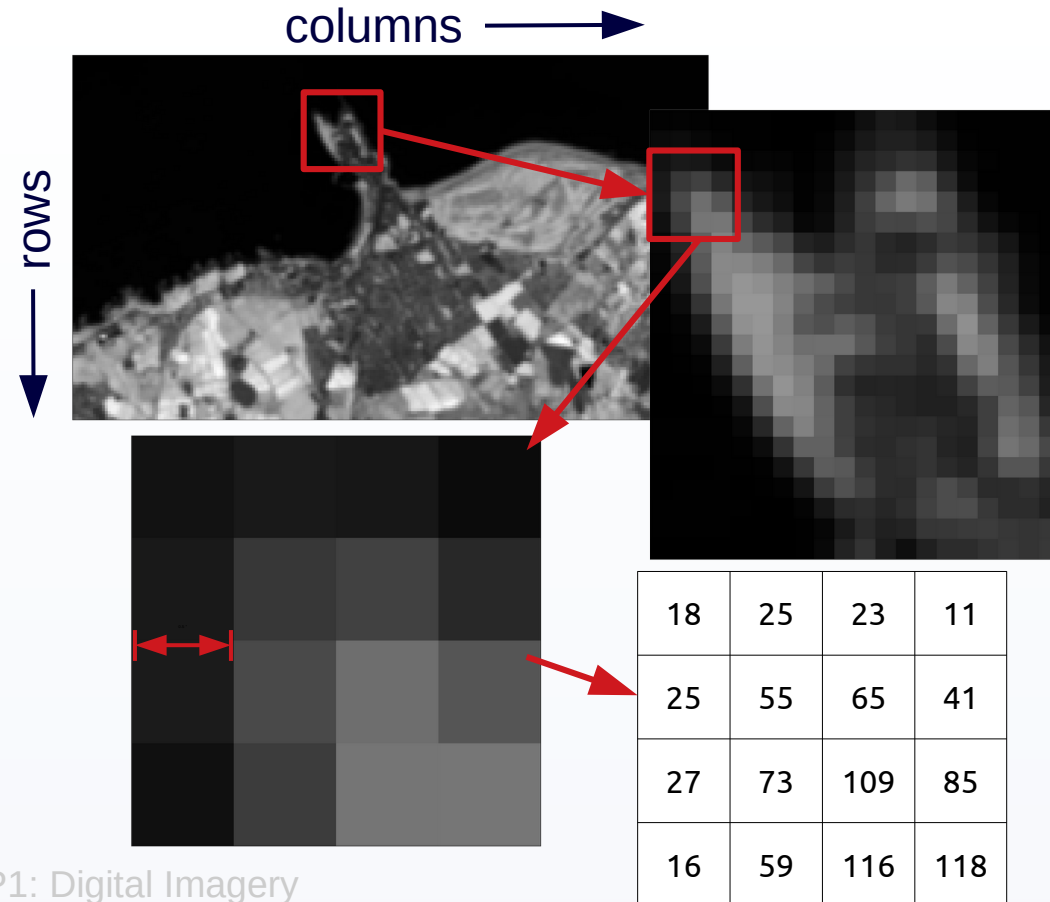


NASA

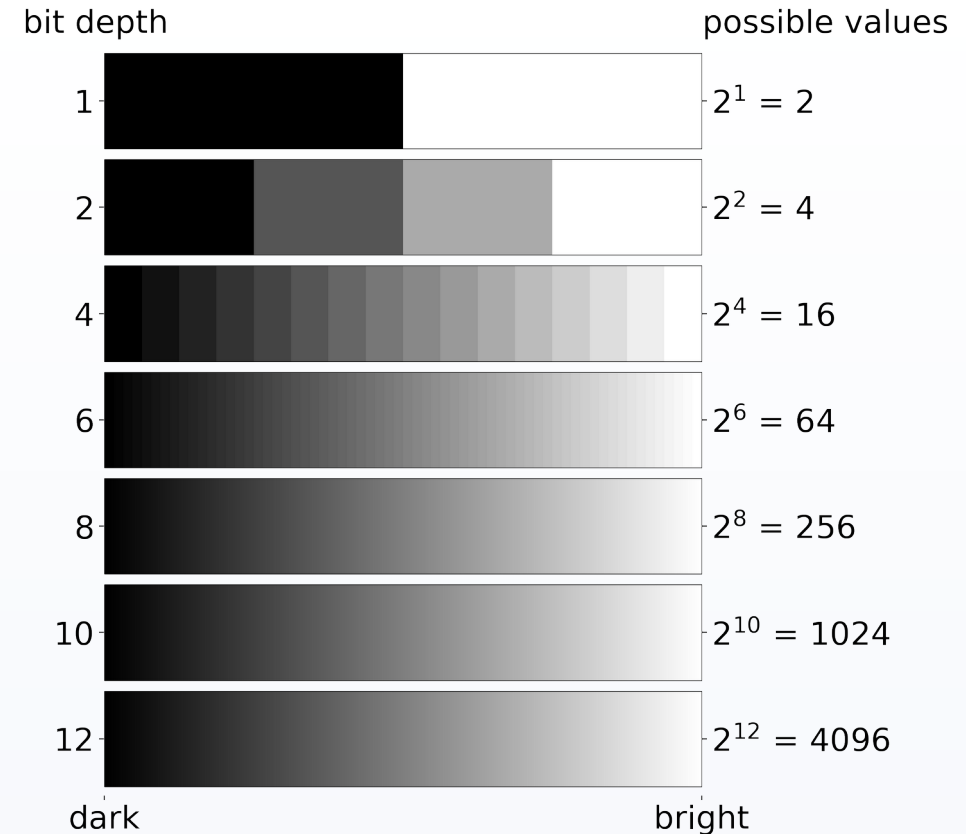


SBRC

- Typically stored as **arrays**
 - Rows (lines)
 - Columns (pixels)
- Each cell (**pixel**) has a **digital number (DN)**
 - Represents brightness value
- Ground sample distance**: the ground distance each pixel covers
 - Measured in both column (y) and row (x) direction



- For images, we typically use **unsigned integer** values:
 - i.e., non-negative integers 0, 1, 2, ...
- Colour/bit depth**: how many different values we can use
- Expressed as 2^n (n -bit)
 - 1-bit: 2^1 values
 - 2-bit: $2^2 = 4$ values
 - 8-bit: $2^8 = 256$ values
 - 16-bit: $2^{16} = 65,536$ values
 - 24-bit: $2^{24} = 16,777,216$ values (!)
- In general, the more values, the better the **radiometric resolution**
 - also, bigger images/more storage space needed

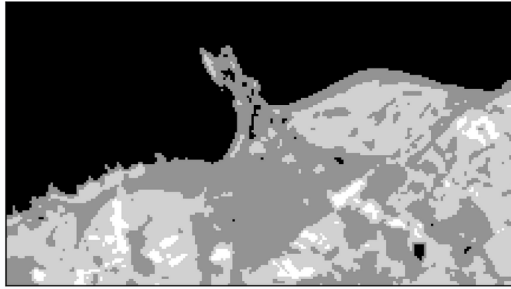


Comparing colour depths

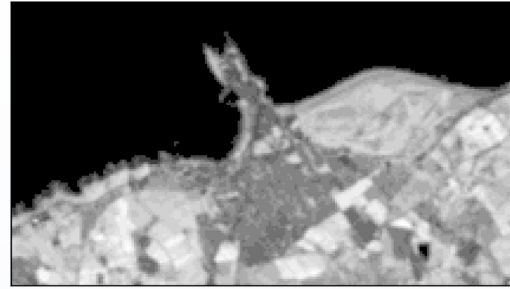
1-bit



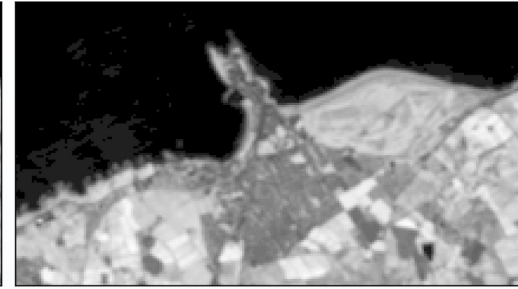
2-bit



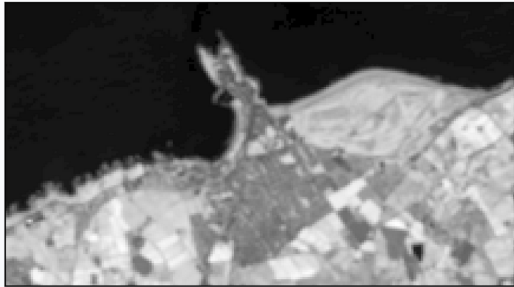
4-bit



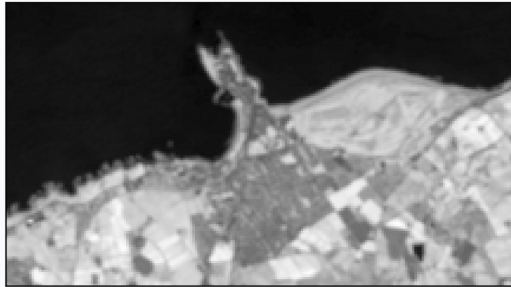
6-bit



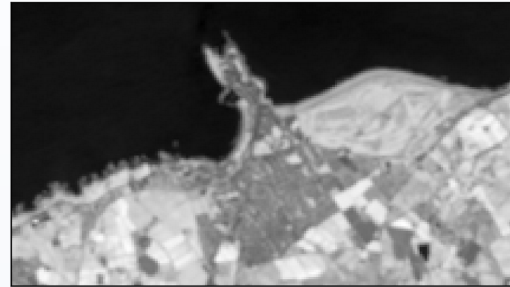
8-bit



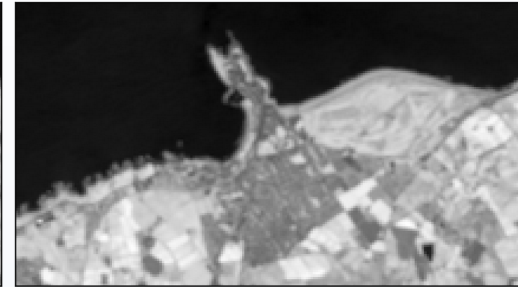
10-bit



12-bit



16-bit



- Similar to vector files, images (rasters) need information to locate the image on Earth*
- Typically includes:
 - Size of pixels (ground sample distance)
 - Location
 - How to flatten/project image (spatial reference system)
- Pixel coordinates can be referenced to pixel centers or corners
- Many (not all!) images you will work with use Universal Transverse Mercator (UTM)



Stamen Design

- Images acquired by sensors represent the amount of energy “seen” by the sensor
- Sensor, how image is stored determines properties
- Most images we will use are stored as arrays of “unsigned” integers (0, 1, 2, 3, ...)
- For use in GIS, other applications, we also need spatial information

- Lillesand, Kiefer & Chipman – Chapter 7
- Tempfli et al. – Chapter 4.3, 4.4
- How does a photon become a film photo? [[SciShow](#)]
- How do digital cameras work? [[BBC Earth Lab](#)]
- Digital Images [[computerphile](#)]