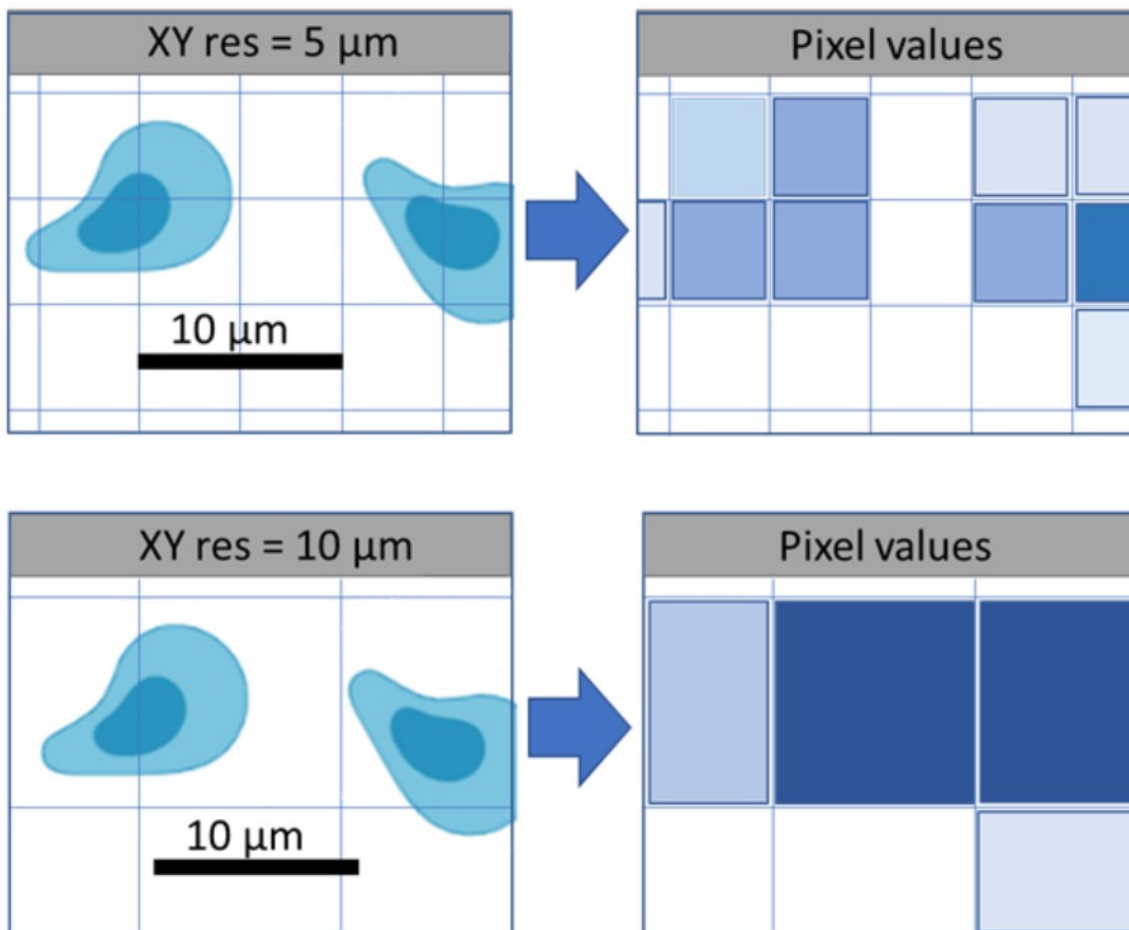


# Sampling

## How does digital sampling affect resolution

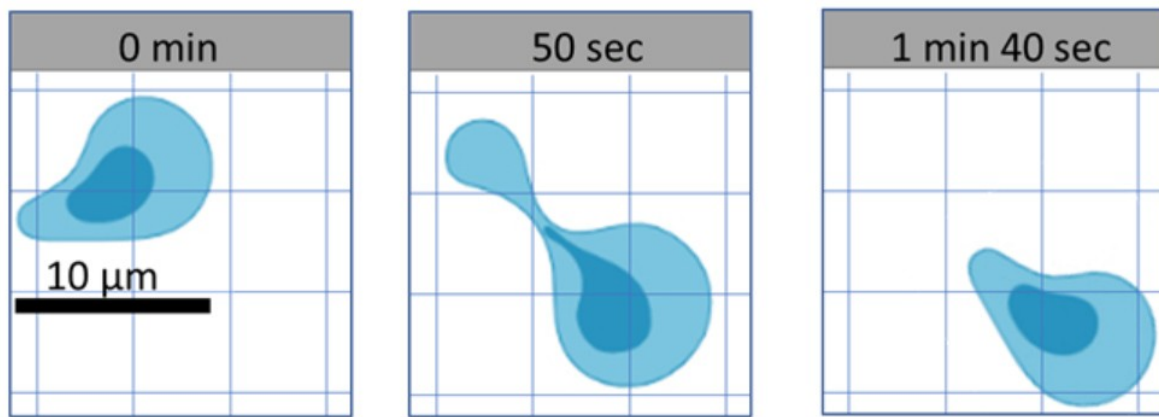
Look at imaging these object with a digital camera

How close together do pixels need to be?



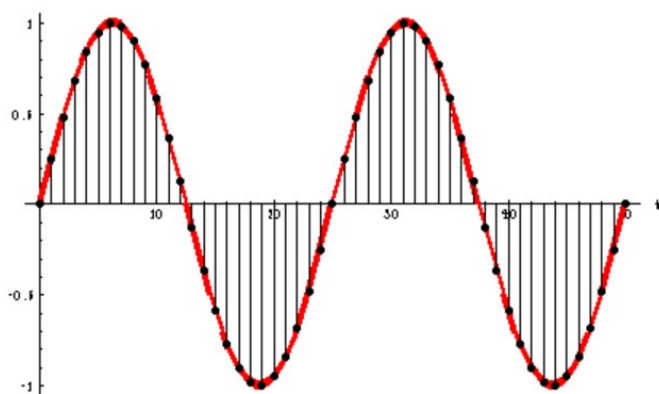
Sampling over time:

How often do you need to image a moving sample

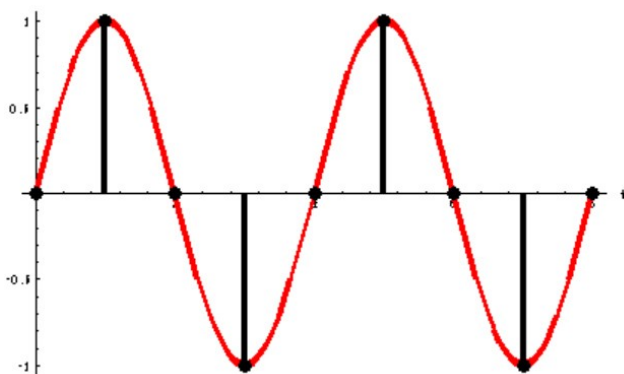


Nyquist theory states that you should sample more than 2 X the frequency that you expect.

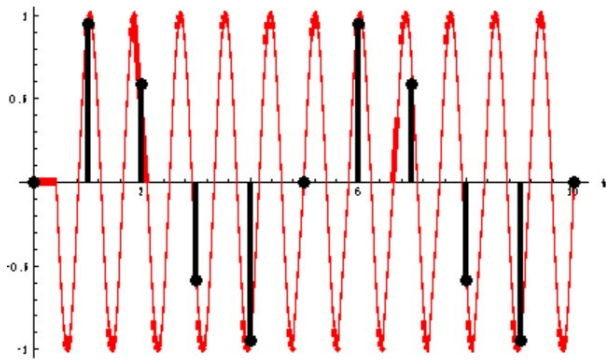
Over sampling



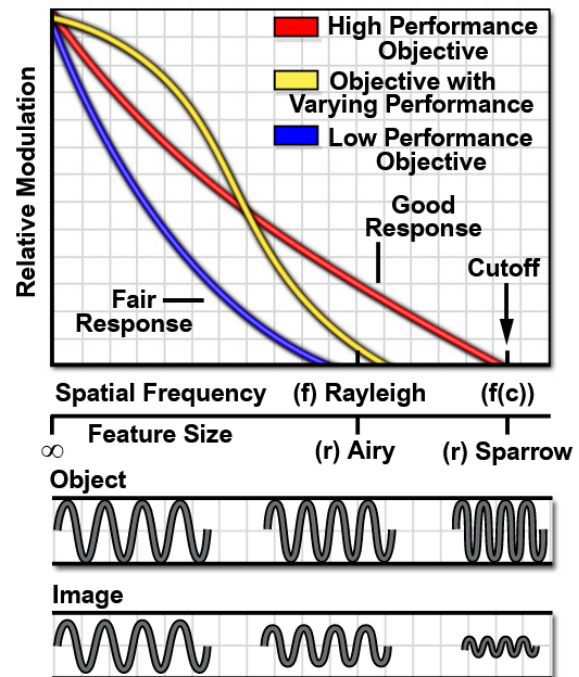
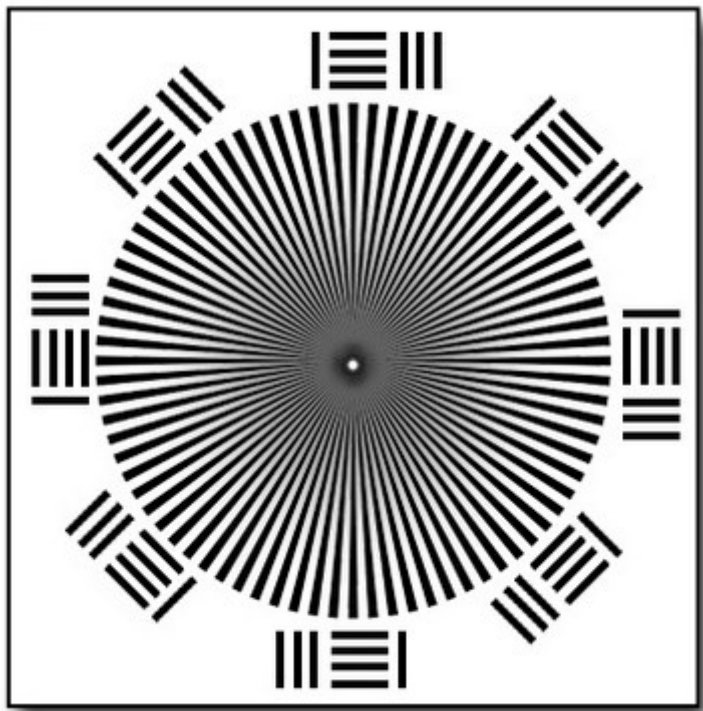
Nyquist sampling



Under sampling causes aliasing



## Optical Transfer Function MTF



When objects get close together the contrast decreases.

$$\text{MTF} = \text{Image Modulation} / \text{Object Modulation}$$

$$\text{MTF} = 2(\varphi - \cos\varphi \sin\varphi)/\pi \quad \text{and}$$

$$\varphi = \cos^{-1}(\lambda v/2NA)$$

The Optical Transfer function is the Modulation transfer function times a phase component.

$$\text{OTF} = \text{MTF} \times e^{i\varphi(f)}$$

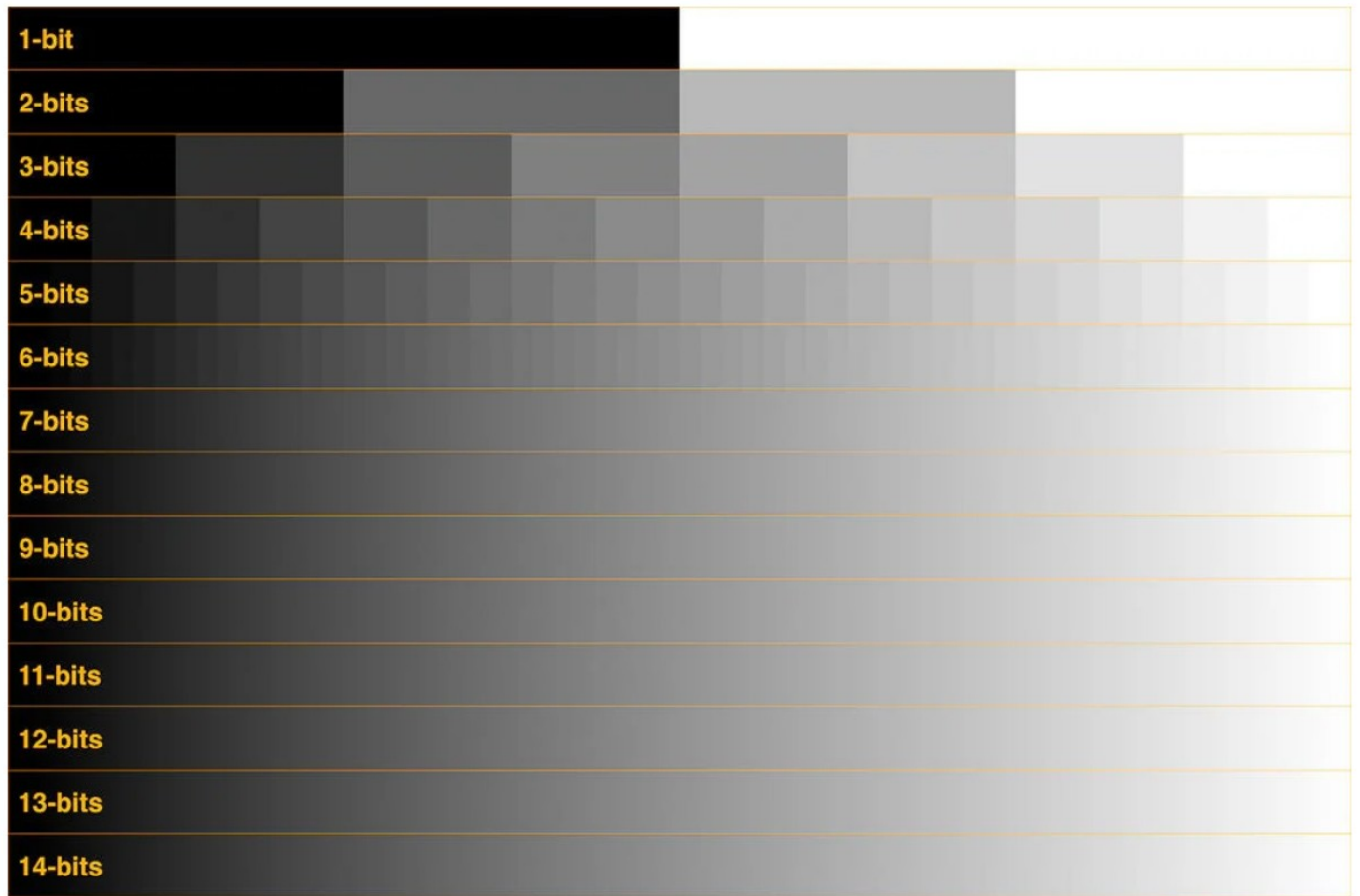
## Camera bit depth

0 or 1

00 or 01 or 10 or 11

000 or 001 or 010 or 011 or 100 or 101 or 110 or 111

and so on



Jpg is 8 bit Tiff can be 16 bit

references

<https://imb.uq.edu.au/research/facilities/microscopy/training-manuals/microscopy-online-resources/image-capture/nyquist-conditions>

<https://microscopy.berkeley.edu/courses/dib/sections/02images/sampling.html>

[https://ocw.mit.edu/courses/mechanical-engineering/2-71-optics-spring-2009/video-lectures/lecture-22-coherent-and-incoherent-imaging/MIT2\\_71S09\\_lec22.pdf](https://ocw.mit.edu/courses/mechanical-engineering/2-71-optics-spring-2009/video-lectures/lecture-22-coherent-and-incoherent-imaging/MIT2_71S09_lec22.pdf)

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Revision #10

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