
Astronomical Telescopes as Camera Lenses

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Questions answered

- What is going on in satellite optics?
- What can we as photographers learn?
- What can we do with this knowledge?
- Is it complicated?
 - No mathematics, one graph, lots of pictures

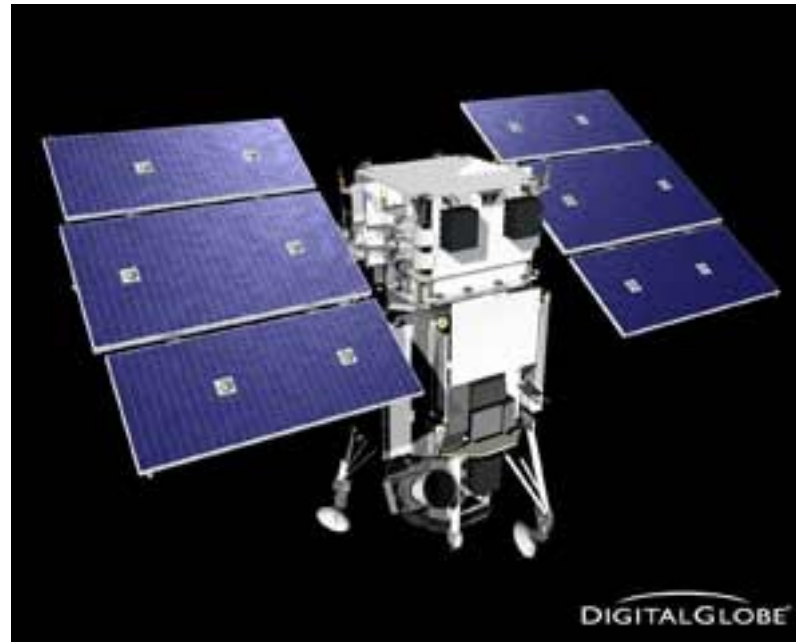
The message

- **You** can make Image Science work for you!

Contents

- Satellite imagery
- Satellite camera design considerations
- Implications for image quality
- Learning points for photographers
- A sample of the opportunities
- Having fun with Image Science!

Worldview 1 – 18th September 2007



- Focal length 8800 mm, f/14.7
- Altitude 496km, ground resolution 50cm
- Telescope mass 138 kg

Sensor by ITT Space Systems

- **“Image quality of sparse-aperture designs for remote sensing”**
- **Robert D. Fiete,**
- **Opt. Eng. 41(8) 1957–1969 (August 2002)**

Sparse (dilute) aperture telescopes

Designed to capture the same resolution but with a significant reduction in size and weight.

Learning points

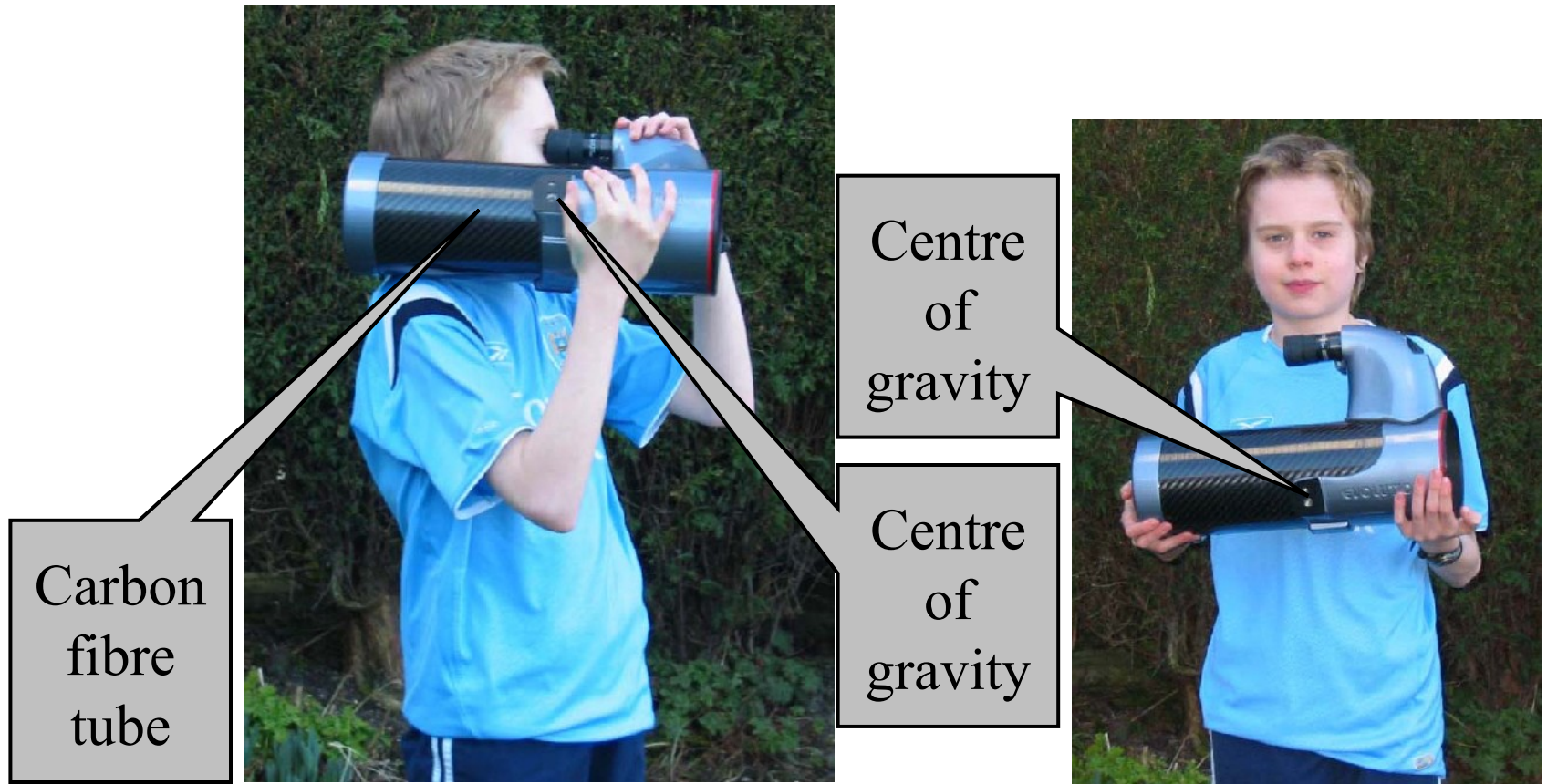
For telescopes and camera lenses

- Modern materials for weight & performance
 - Carbon fibre, modern optical glasses
- Take care of aperture obstructions
 - Increased exposure times
 - Reduced image contrast
 - Increased image noise
- Large apertures give benefits
 - Reduced exposure times
 - Better resolution

Consumer interest in astronomy

A recent Mars opposition caused a 27% uplift in consumer telescope sales

A terrestrial telescope – 800mm f/7



A 1200mm astronomical version



- Carbon fibre tube
- All glass optics
- All metal mountings
- 62cm long
- 6kg total weight
- 1200mm f/6

Clear, open apertures: $F=94\%$

Mount
for
optics

Centre
of
gravity



Telescope with a DSLR



■ Image credit: Peter G Crosby

Fuji S1 Pro – full frame width

2 km



1200mm f/6
1/2000 sec



80mm f/11
1/500 sec

3 km



1200mm f/6
1/1000 sec

System design considerations



Web cameras

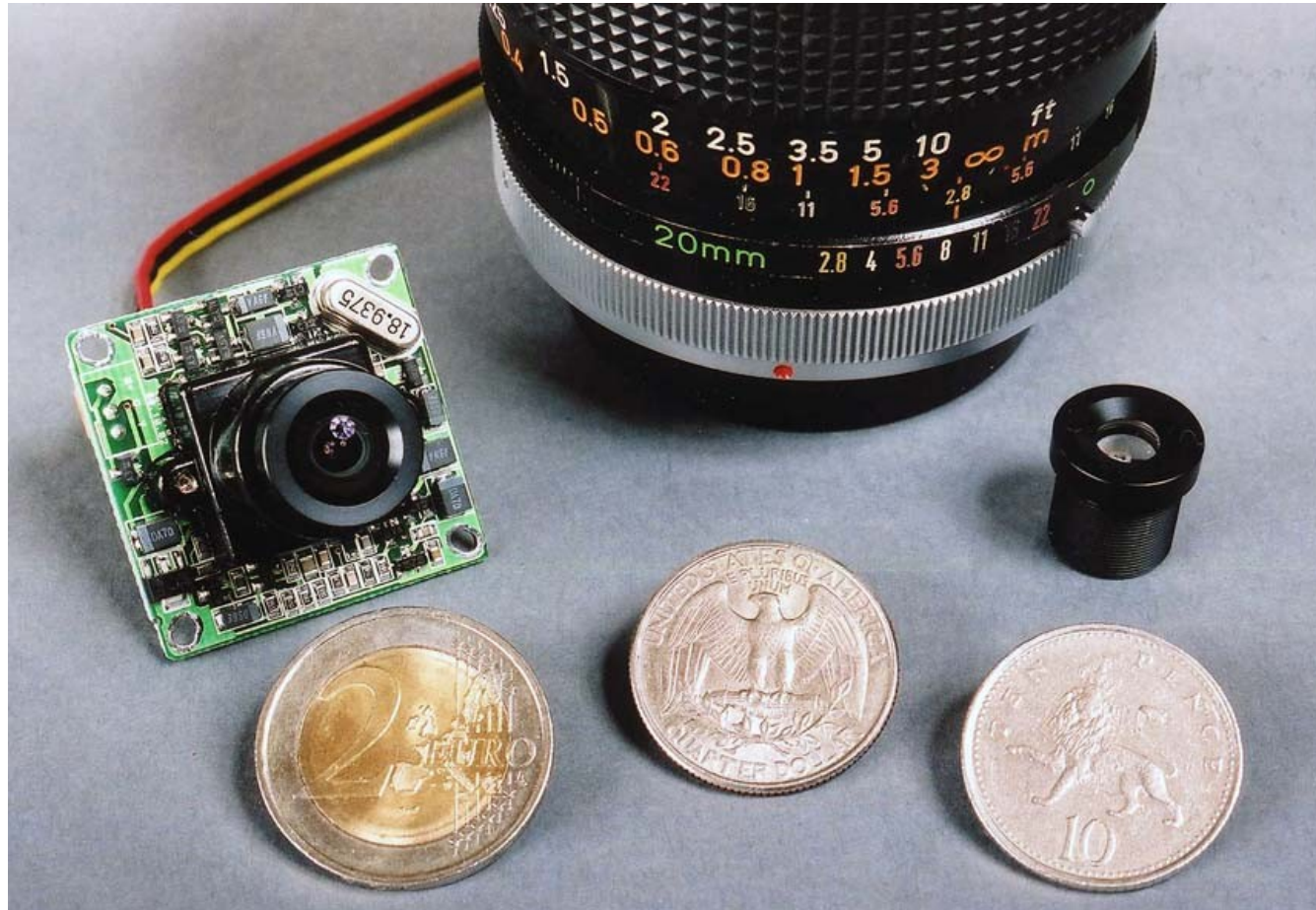


DSLR
10 μ pixels



Webcam
~5 μ pixels

Where next – monochrome cameras



■ Image credit: Peter G Crosby