CELEBRATING INNOVATION

&

IMPROVING OPERATIONAL PRACTICE

SEPT 06 – 10 2021

Forensic 3D imaging and printing: adding another dimension to future practices

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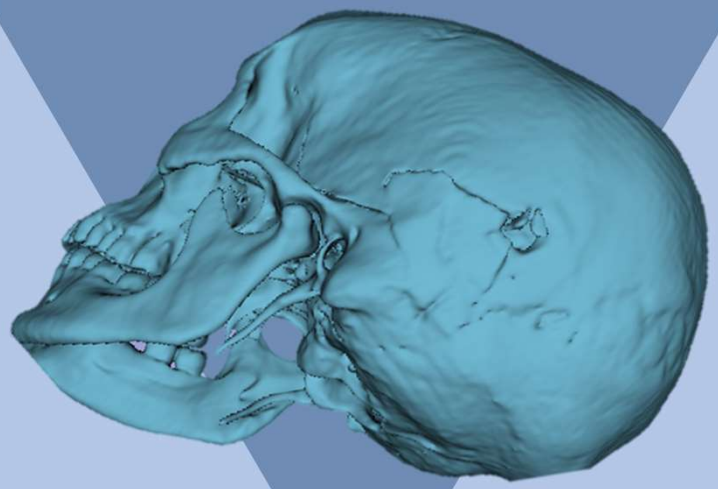
Overview



- 3D imaging and printing technology is rapidly developing across industries, including in forensic science
- 3D digital models and prints beneficial for ‘preserving’ and presenting evidence
- Limited demonstration of application in forensic cases in the literature

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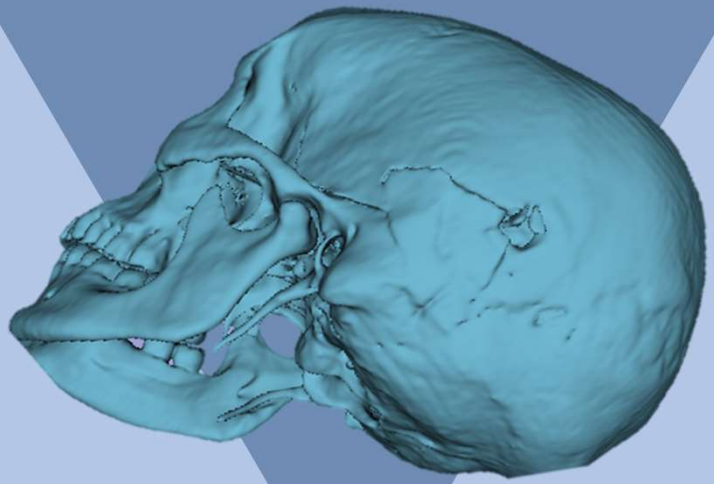
Overview



- In the next 40 mins talk through the process of crime scene to court
- But including imaging (Me) and 3D printing (Rachael)

- Object → imaging → printing → courtroom

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Evidence

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https://media.buzzle.com/media/images-en/photos/conceptual/1200-21614073-crime-scene.jpg

Imaging

what do I mean by 3D imaging technology?

- Collecting visual data and presenting it back in 3D (sometimes)

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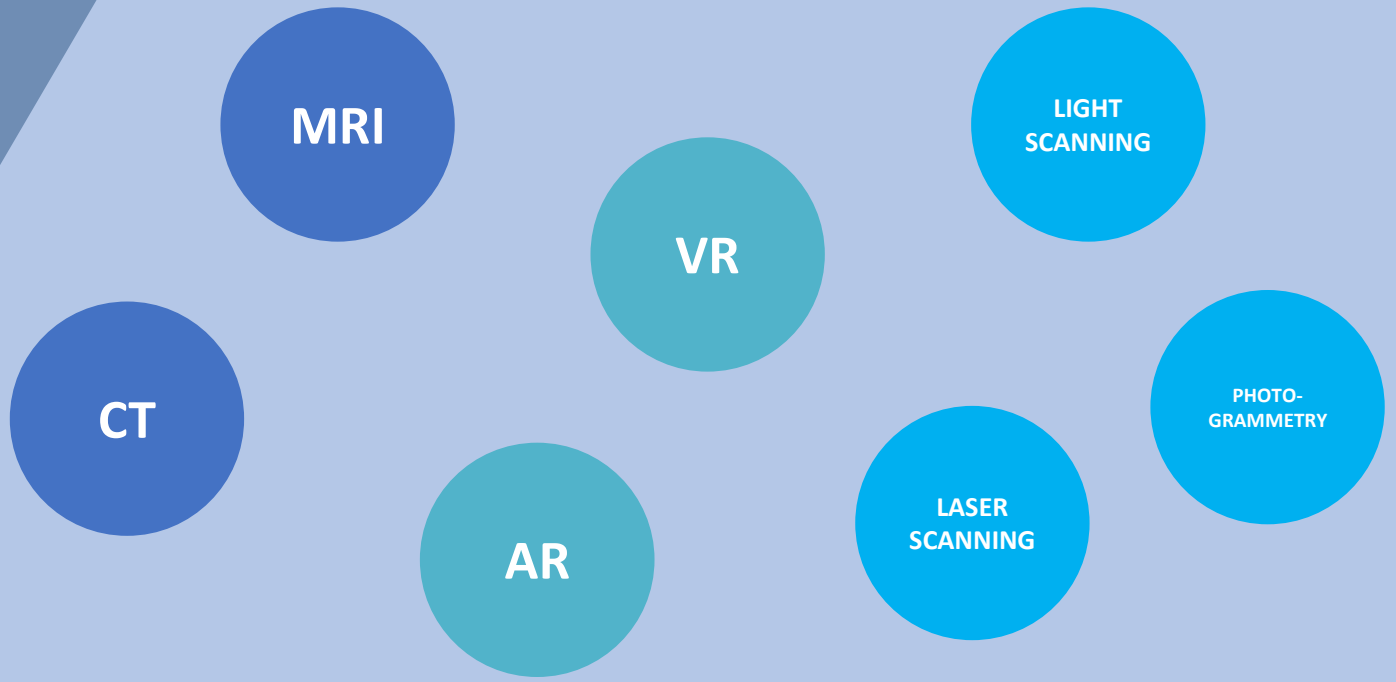
3D TECHNOLOGY

- Different types of 3D image acquisition
- Plus, virtual 3D models, VR, and AR



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3D imaging

Surface techniques

- Different types of 3D image acquisition

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3D imaging

Surface techniques

- Photogrammetry

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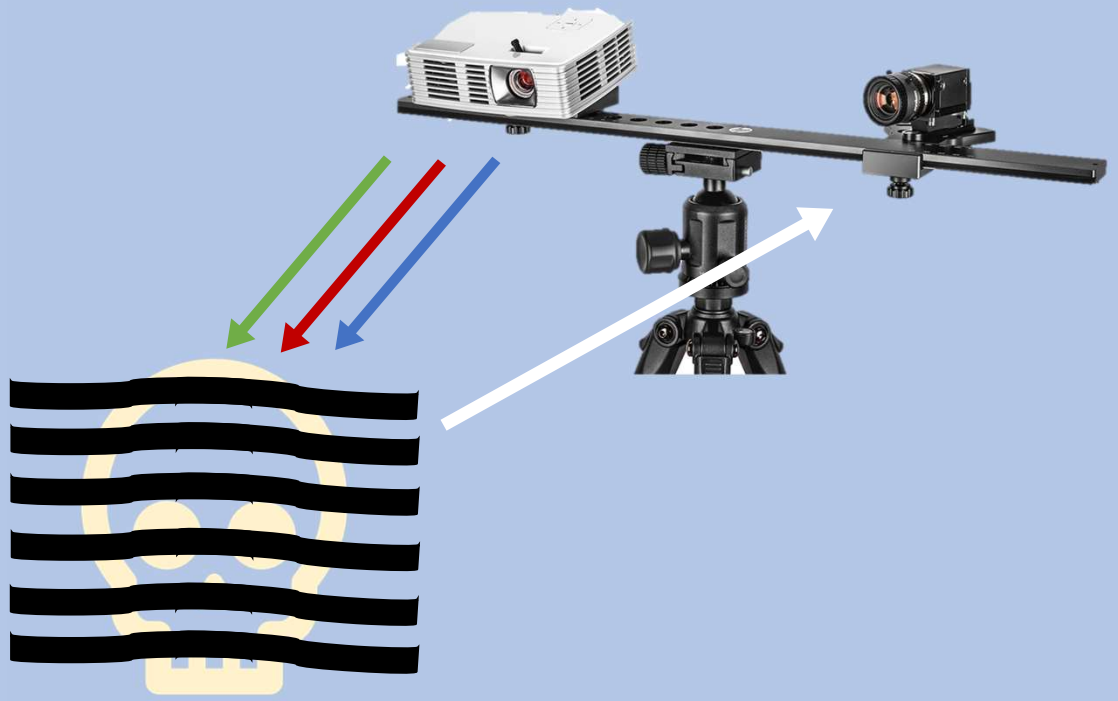
3D imaging

Surface techniques

- Structured Light



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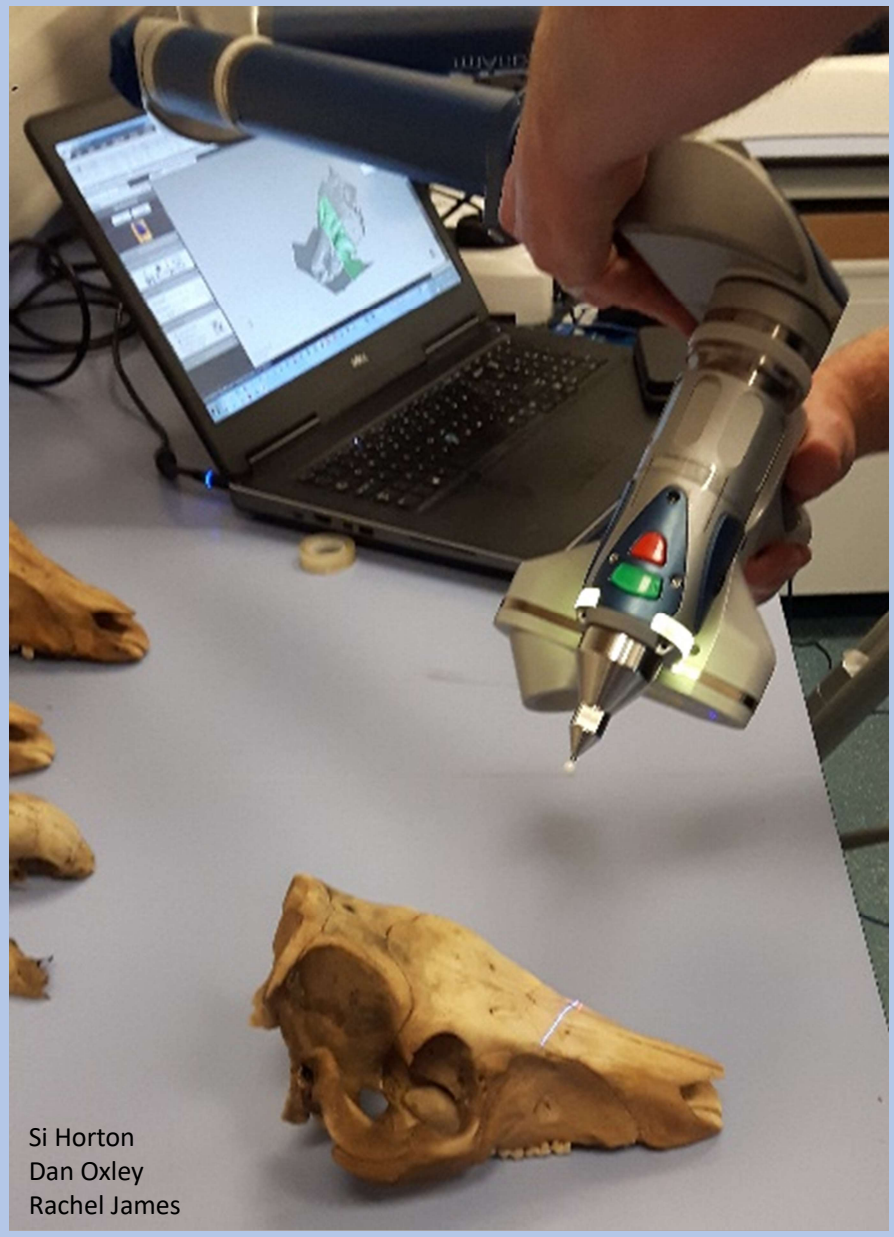
3D imaging

Surface techniques

- Laser



Si Horton
Dan Oxley
Rachel James

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3D imaging

Transmissive techniques

- CT and MRI

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3D imaging

Transmissive techniques

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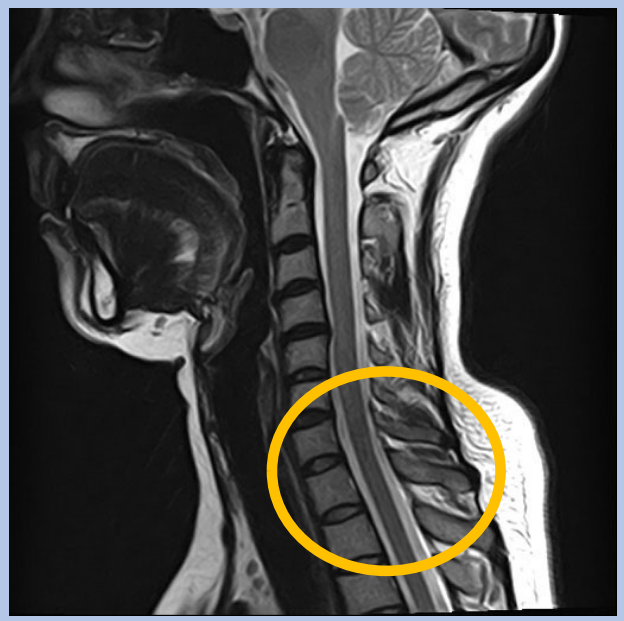
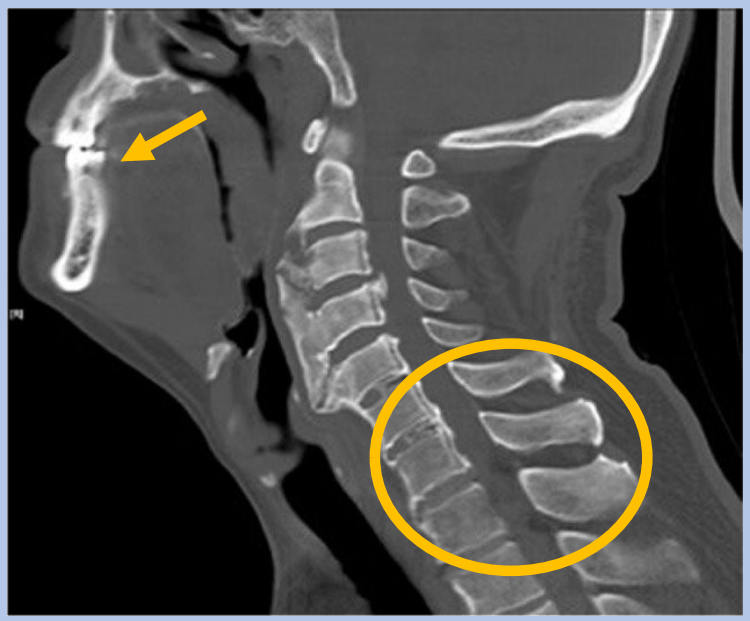
MRI

CT





https://www.minclinic.ru/pics/vertebral/Cervical%20spondylotic%20myelopathy%20(CMS)%20MRI%20classification/Disc%20pathology,%20canal%20narrowing,%20no%20cord%20impingment.webp

Zhang et al (2014)

3D imaging

What to use, for what, and when?

- Bit overwhelming

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3D imaging

What to use for, what, and when?

- Will depend entirely on what it is you are imaging

and

- What it is you want to achieve

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Literature

3D imaging

EXAMPLES

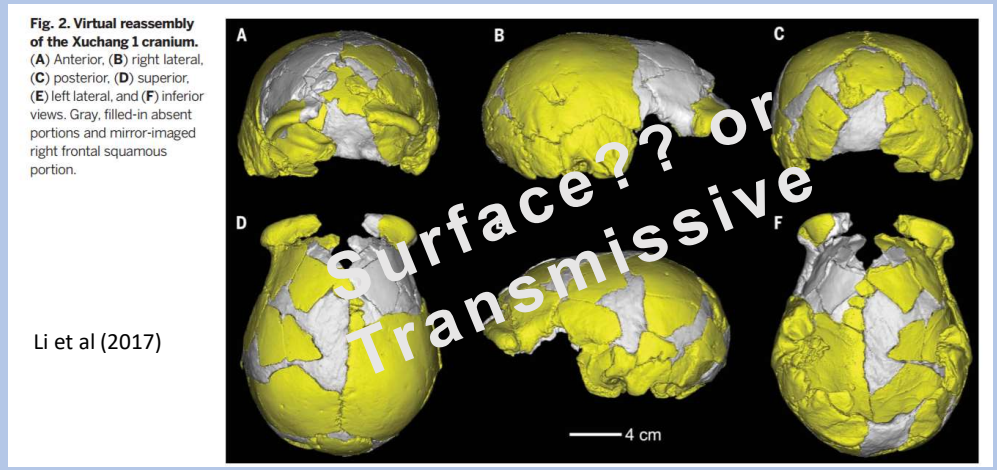
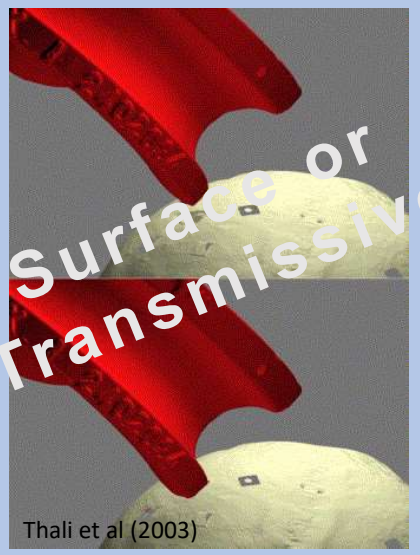


Fig. 2. Virtual reassembly of the Xuchang 1 cranium. (**A**) Anterior, (**B**) right lateral, (**C**) posterior, (**D**) superior, (**E**) left lateral, and (**F**) inferior views. Gray, filled-in absent portions and mirror-imaged right frontal squamous portion.

Li et al (2017)

South Tyrol Museum of Archaeology/Regional Hospital of Bolzano



Thali et al (2003)

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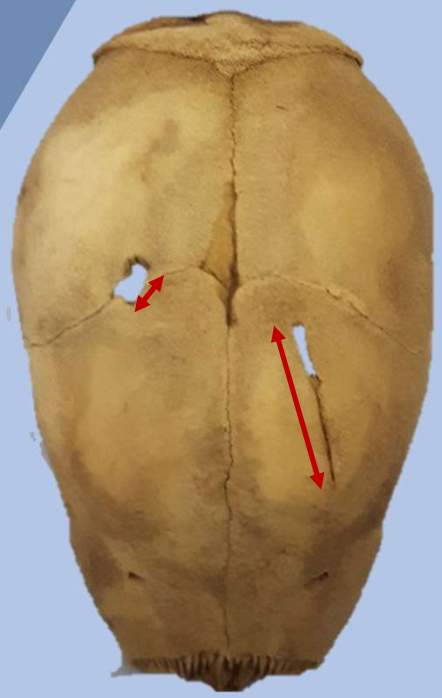
Si Horton
Dan Oxley
Rachel James
Dr Katherine Brown

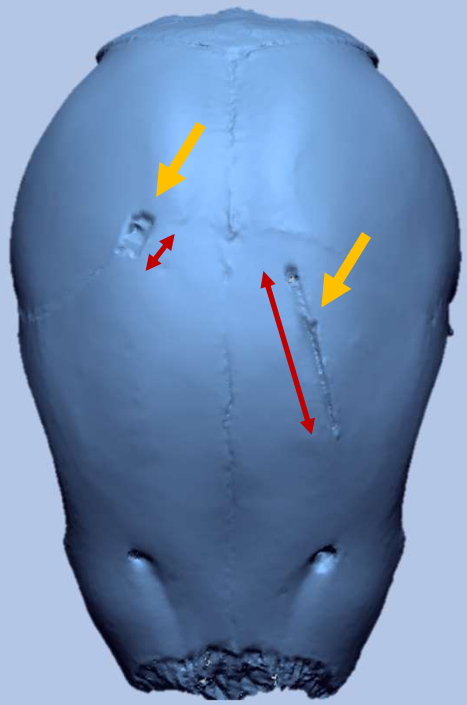
3D imaging

EXAMPLES

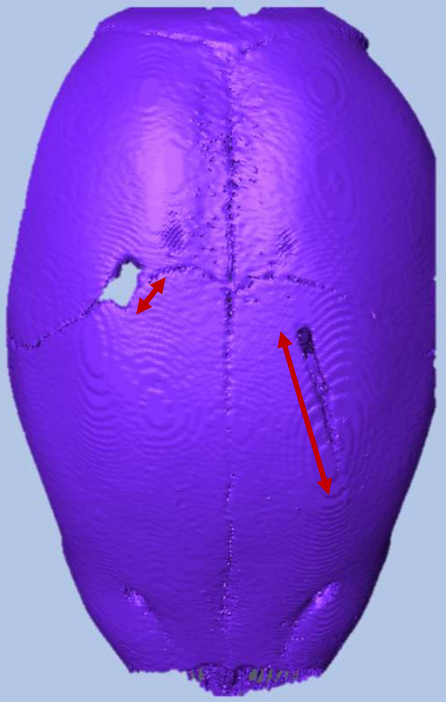
- Our work



Photography



Laser



Micro-CT

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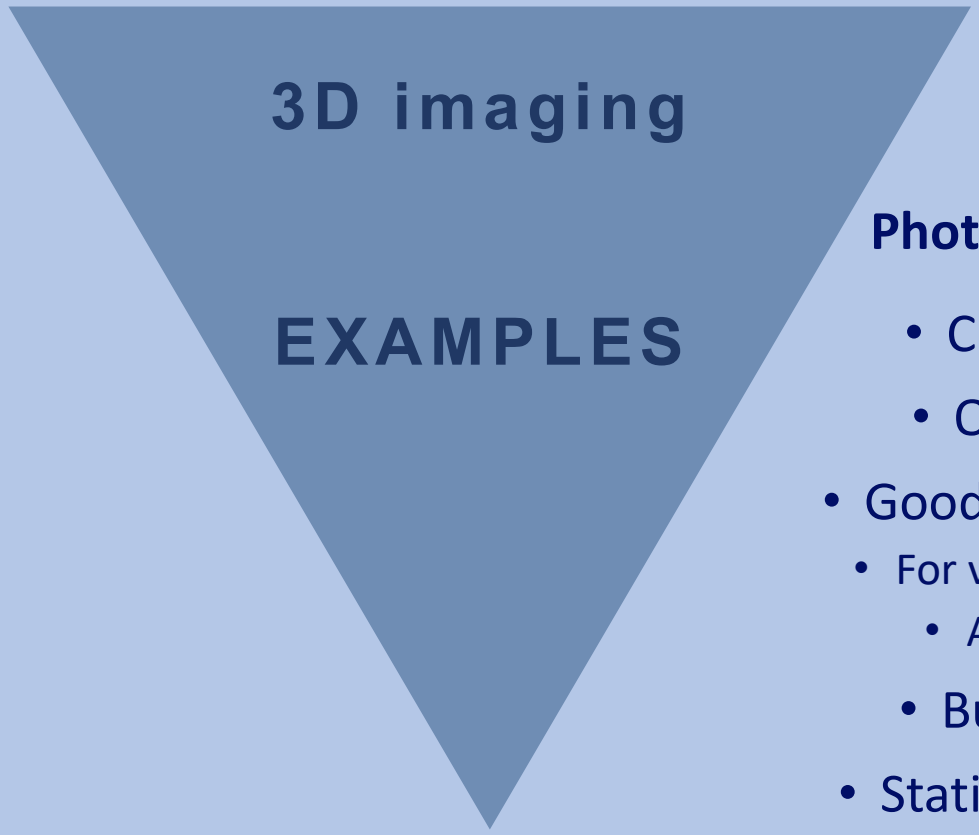
Our work



Photography

- Cheap
- Quick
- Good enough
  - For visualisation?
  - Analyses?
- But 2D
- Static image

Laser

- Cheap
- Quick
- Good enough
  - For visualisation?
  - Analyses?
- Note gap filling
- Surface only

Micro-CT or CT

- Higher quality
- Higher cost
- No prep
- Increased imaging time
- Volume
- Excessive detail/size?

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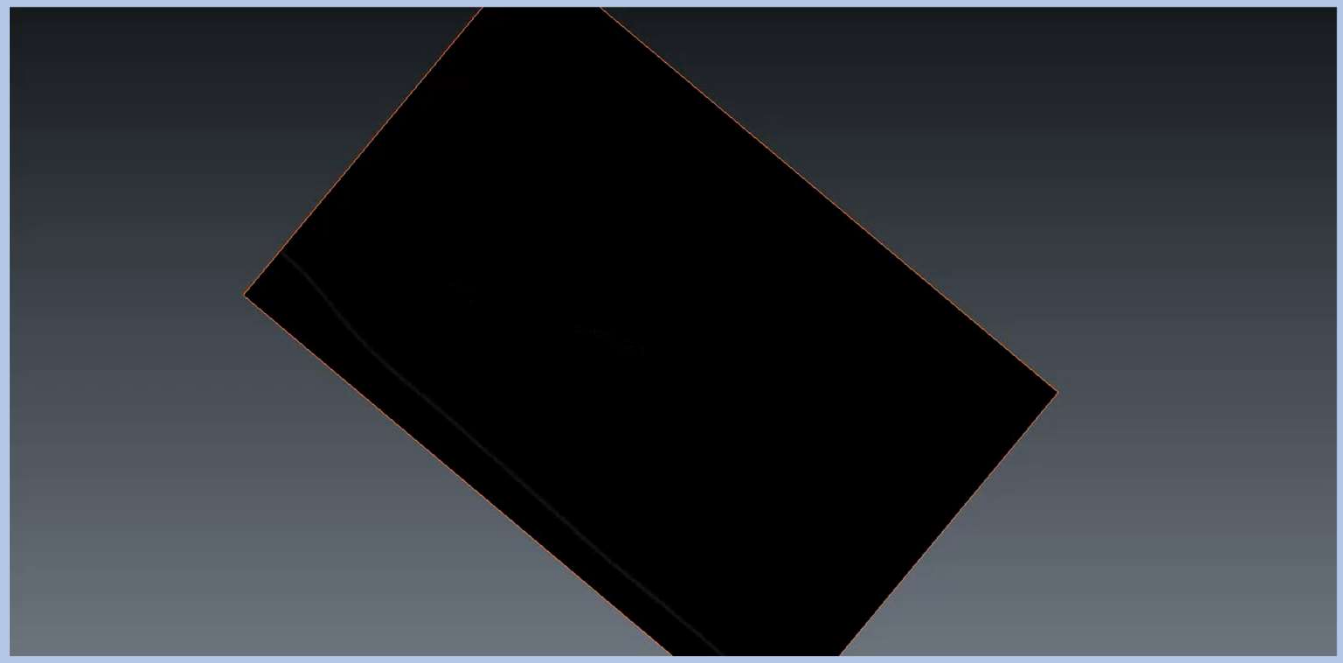
3D imaging

EXAMPLES

- Our work



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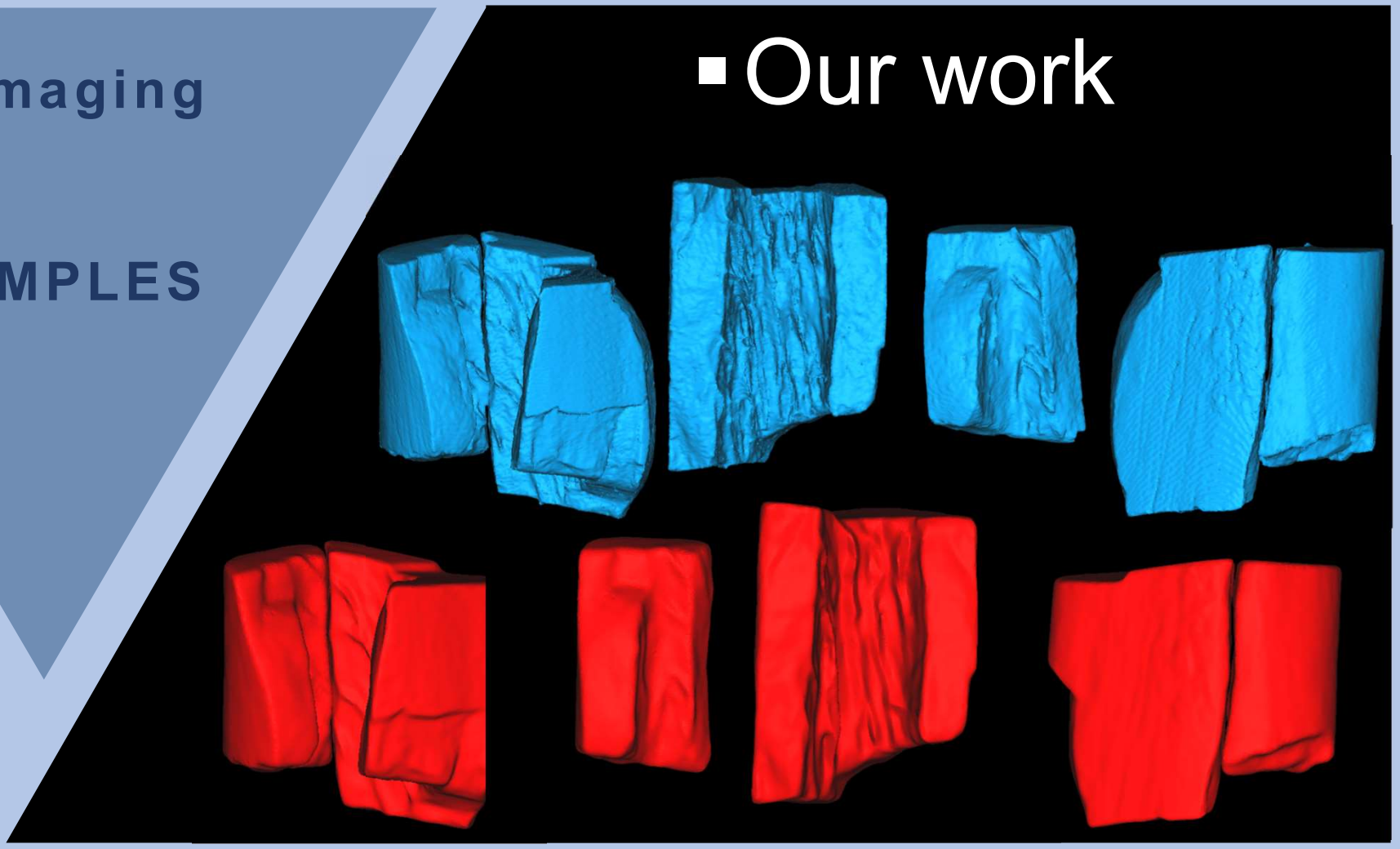
Collings, A. J. & Brown, K. 2020. Reconstruction and physical fit analysis of fragmented skeletal remains using 3D imaging and printing. Forensic Science International: Reports.

3D imaging

EXAMPLES



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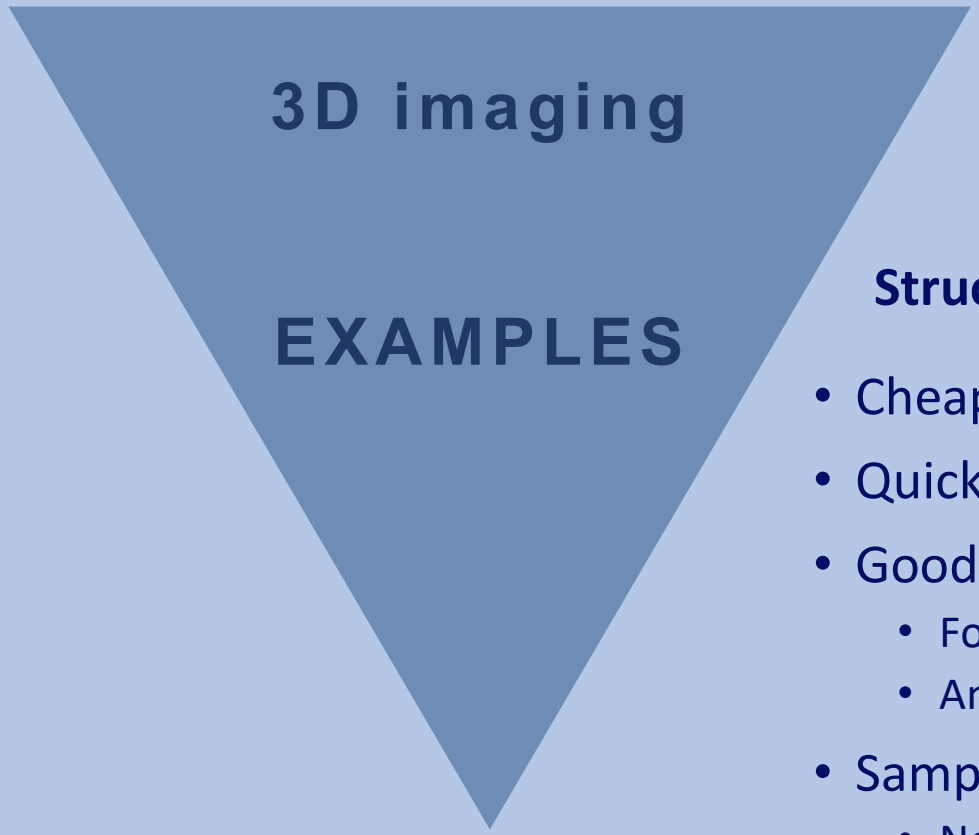
Our work



Structured Light

- Cheaper
- Quicker
- Good enough
  - For visualisation?
  - Analyses?
- Sample prep
  - Note damage from cleaning

Micro-CT

- Higher quality
- Higher cost
- No prep
- Increased imaging time
- Necessary detail?

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Sharelle Carty
Antonia Glass
Helent Tidy
Andrew Hunter
FCN 3D working group

Our research

3D imaging

Starting September…

Does mattifying spray impact other evidence recovery?

https://www.sigmandtlab.net/wp-content/uploads/2019/03/NDTServices_LPT_Content_950_460.jpg

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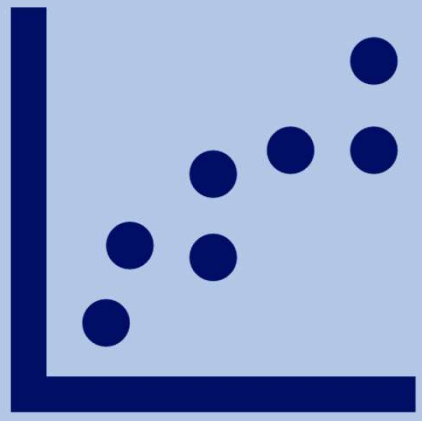
- What's the difference…?

3D imaging

IMPORTANT:
Visualise versus Analyse



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3D imaging

IMPORTANT:
Visualise versus Analyse

- More sophisticated analyses
  - GMM
  - Quantitative comparisons (heat mapping/deviance)
- Mechanical modelling

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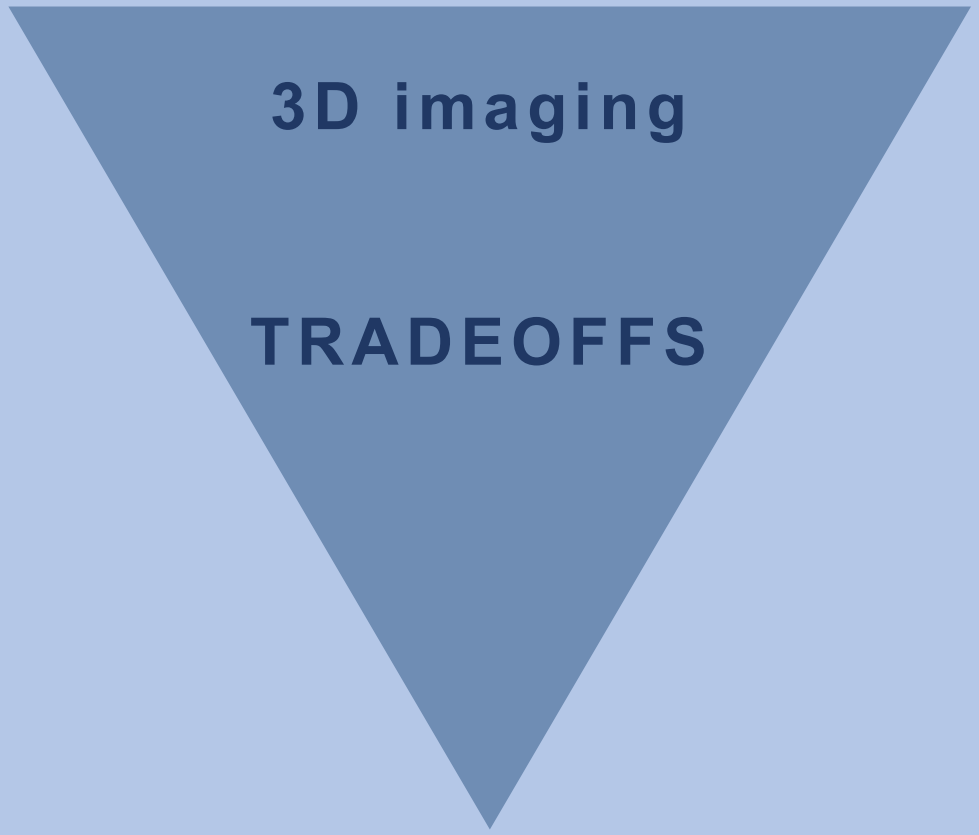

- Accessibility
- Cost
- Requirements
- Time scale
- Desired outcome
- Achievability
- Logistics

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Advantages

- We live in 3D
- Non-contact, non-destructive
- Increased ability for analysis
- Unlimited opportunities to share
- Ethical alternative to maceration/autopsy
- Digital ‘preservation’
- Form of sanitisation
- Contextual information
- Increased understanding

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Considerations

- Cost and accessibility issues
- Who is doing the imaging acquisition and post processing?
- Manipulation safeguarding
- Limited guidelines
- Logistics?
- No one size fits all approach
- Digital capacity for storage/curation
- Court room technology
- Impact on jury?
- User bias
- Ethics
- How do we classify/treat models?
- ISO

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3D imaging to printing

- Can show 3D model or animation or next step…

Rematerialise

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