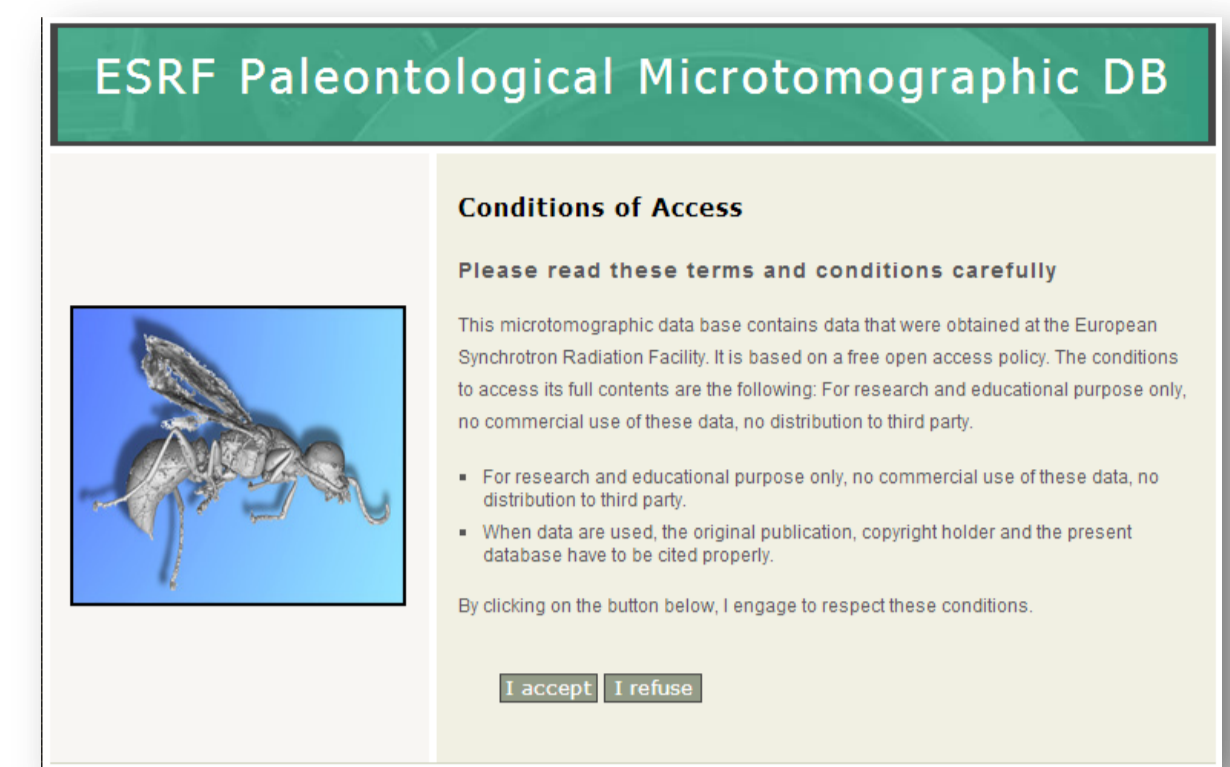
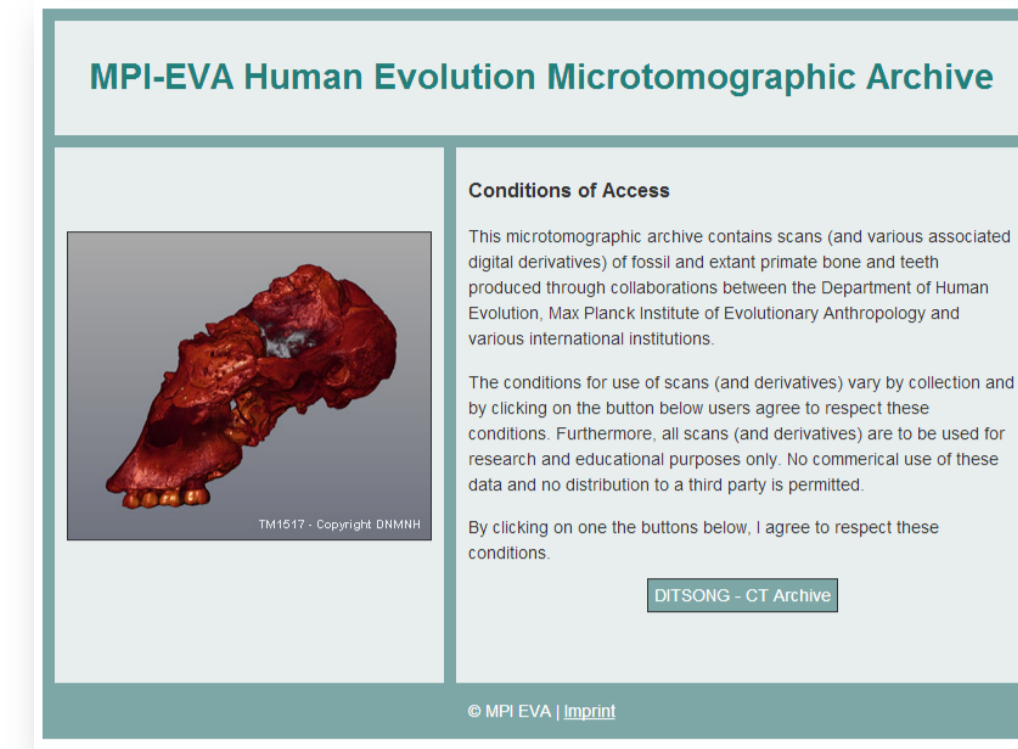


More and more μ -CT 3D images are exchanged through Internet. One major challenge is to introduce effective **Digital Rights Management**. Currently, they are mainly based on:

- Password to access databases
→ Once known... no more protection.
- File encryption to secure transfer and storage.
→ Dedicated format or decoding/reading application.



Another solution would be to insert the DRM system directly in an invisible manner into the 3D image itself:

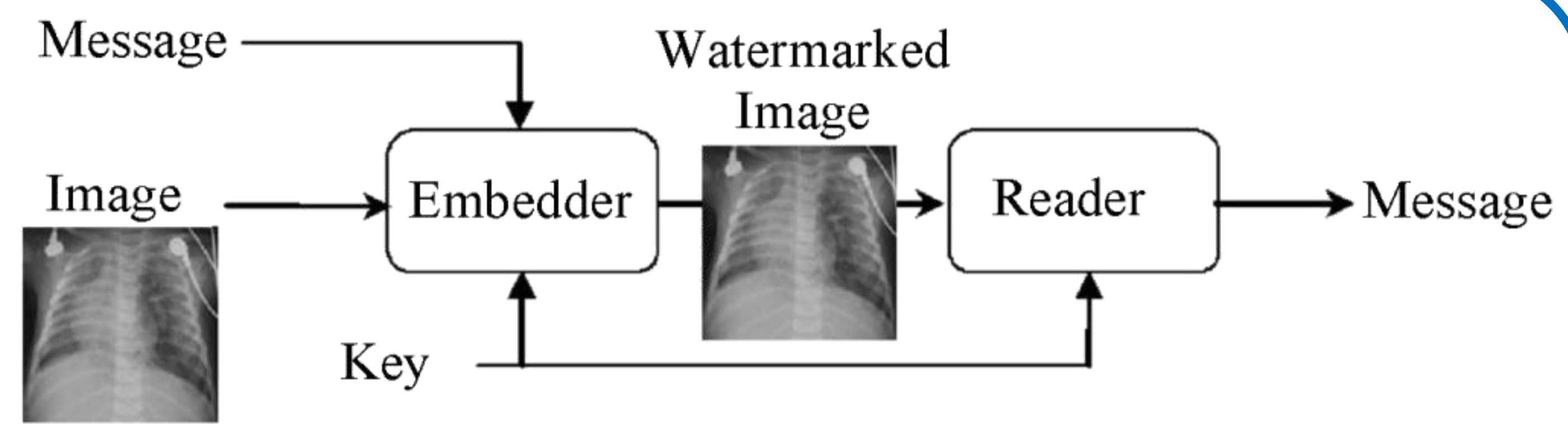
- No specific format or software to develop;
- No idea where the protection is;
- Any piracy attacks aiming to modify or delete the DRM distorts sensibly the image.



MM. Skinner, T. Kivell, S. Potze, J.J. Hublin (2013) Microtomographic archive of fossil hominin specimens from Kromdraai B, South Africa, *Journal of Human Evolution*, 64(5): 319-472.

Watermarking is the art to embed message in data:

- **Invisibility:** visually and statistically undetectable;
- **Robustness:** difficult to remove without distorting data;
- **Capacity:** size of the hidden message;
- **Complexity:** CPU time to insert/extract the message.



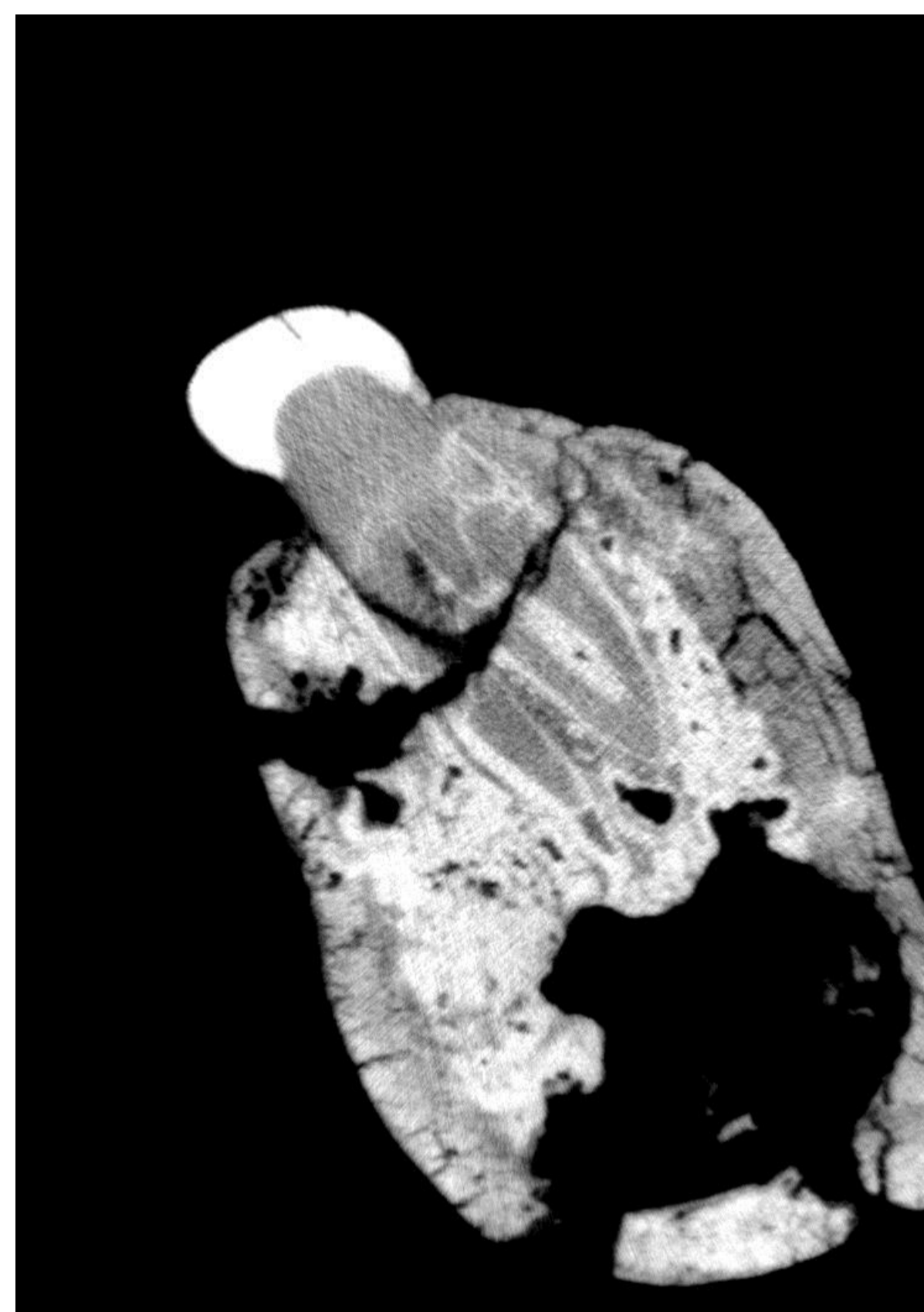
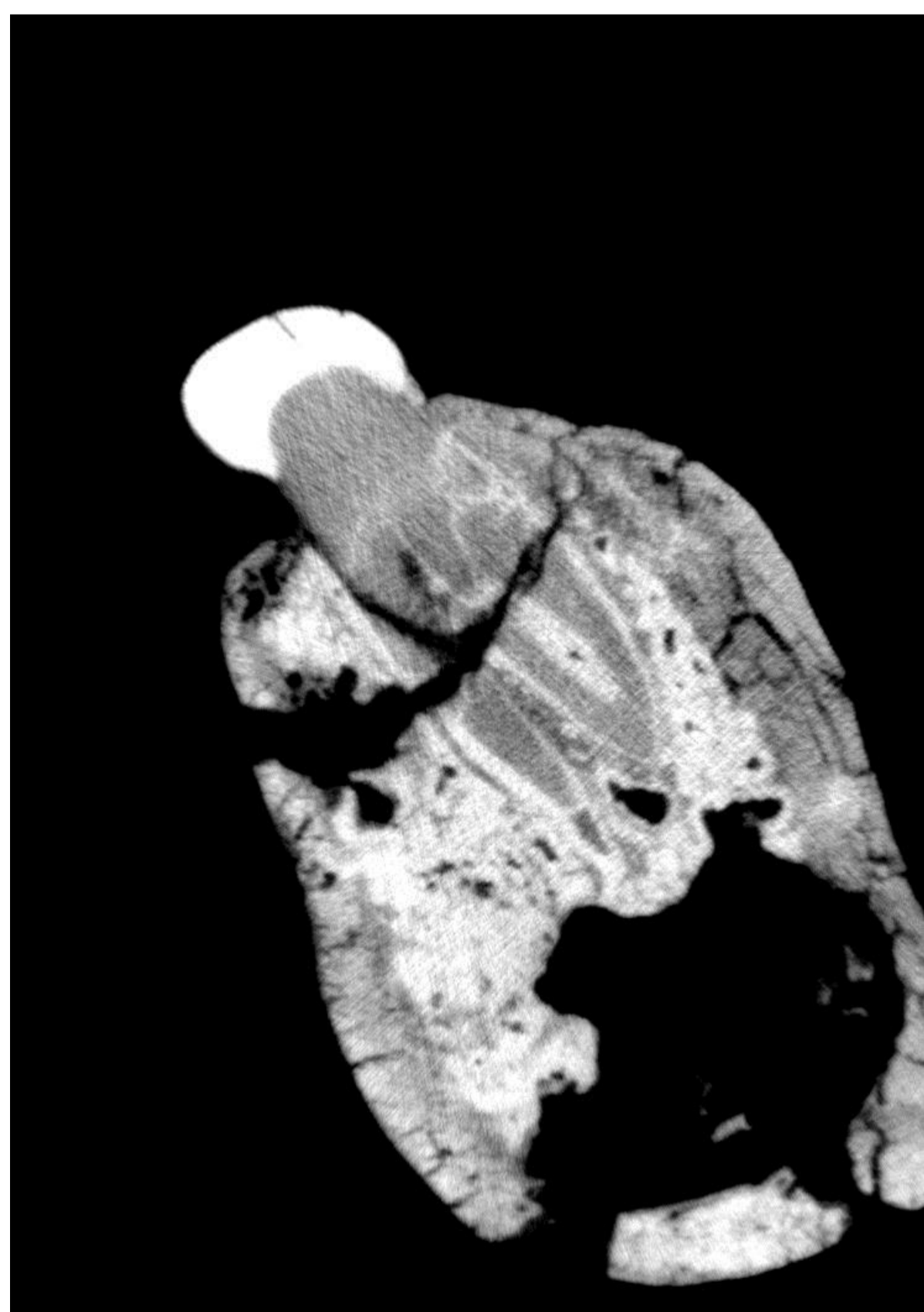
W. Puech (2008). "Watermarking 3D images and 3D meshes: Applications for cultural heritage". *Interdisciplinary Workshop on 3D Paleo-Anthropology, Anatomy, Computer Science & Engineering - Synergies for the Future, Toulouse, France.*

Watermarking a slice (741 × 1052 pixels) of a μ -CT of an *Australopithecus africanus* fossil (STS52, ~2.5 mya) using software **freely available** at http://www.lirmm.fr/icar/en_ligne/

Original slice

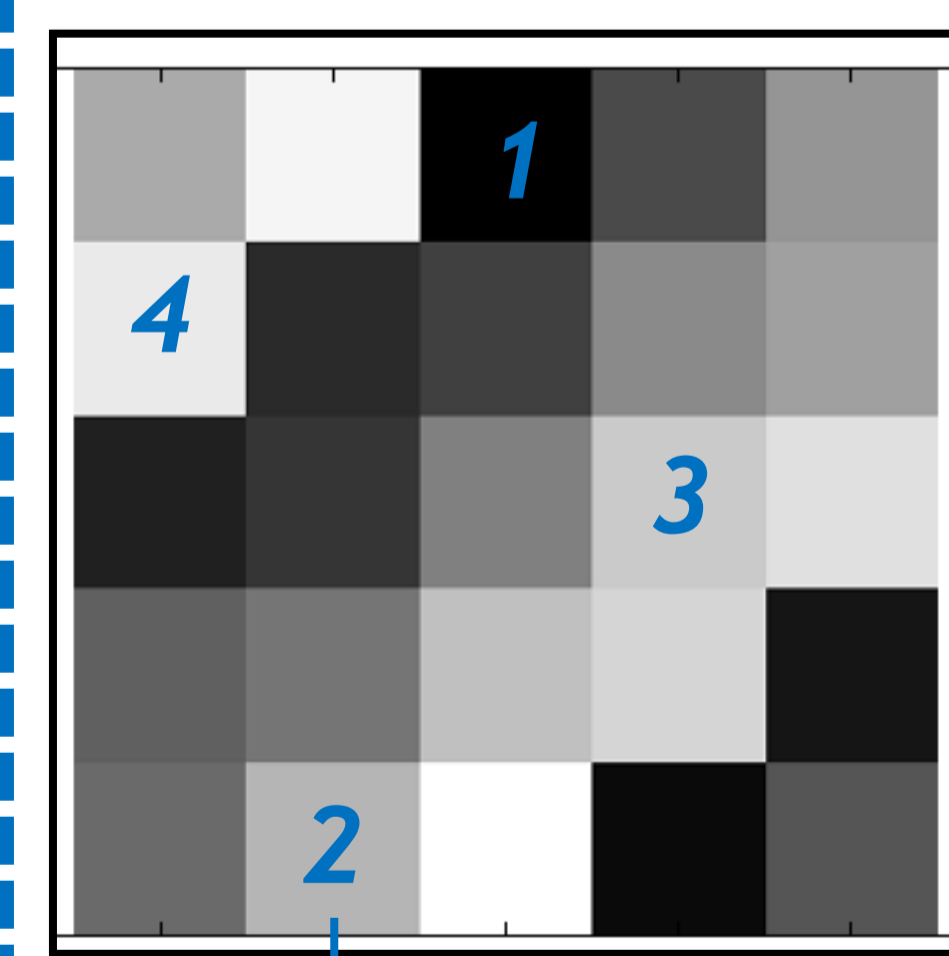
Watermarked slice

Difference (I × 255)



Example: LSB substitution

Selection of a list of n pixels (pseudo-random process initialized by the key);



Message coded on n bits = ...100111

The Least-Significant Bit of the intensity is substituted w.r.t. the corresponding message bit

$I=108 \leftrightarrow 01101100$
 $01101101 \leftrightarrow I=109$

Message = "This is an image watermarked by NECSA and given to LIRMM" (56 char.)

Challenging research to develop algorithms:

- dedicated to **3D images**;
- resistant to **cropping**, **rotation**, and even (slight) compression, resampling...
- with other application as **data hiding** (ROI, metadata) or **selective encryption** (embedding a HR representation of a sub-image).

A. Saillant (2013). "3D image processing: application to paleoanthropology". MSc Thesis.

