Becoming a NIR-Sensitive Aerial Archaeologist

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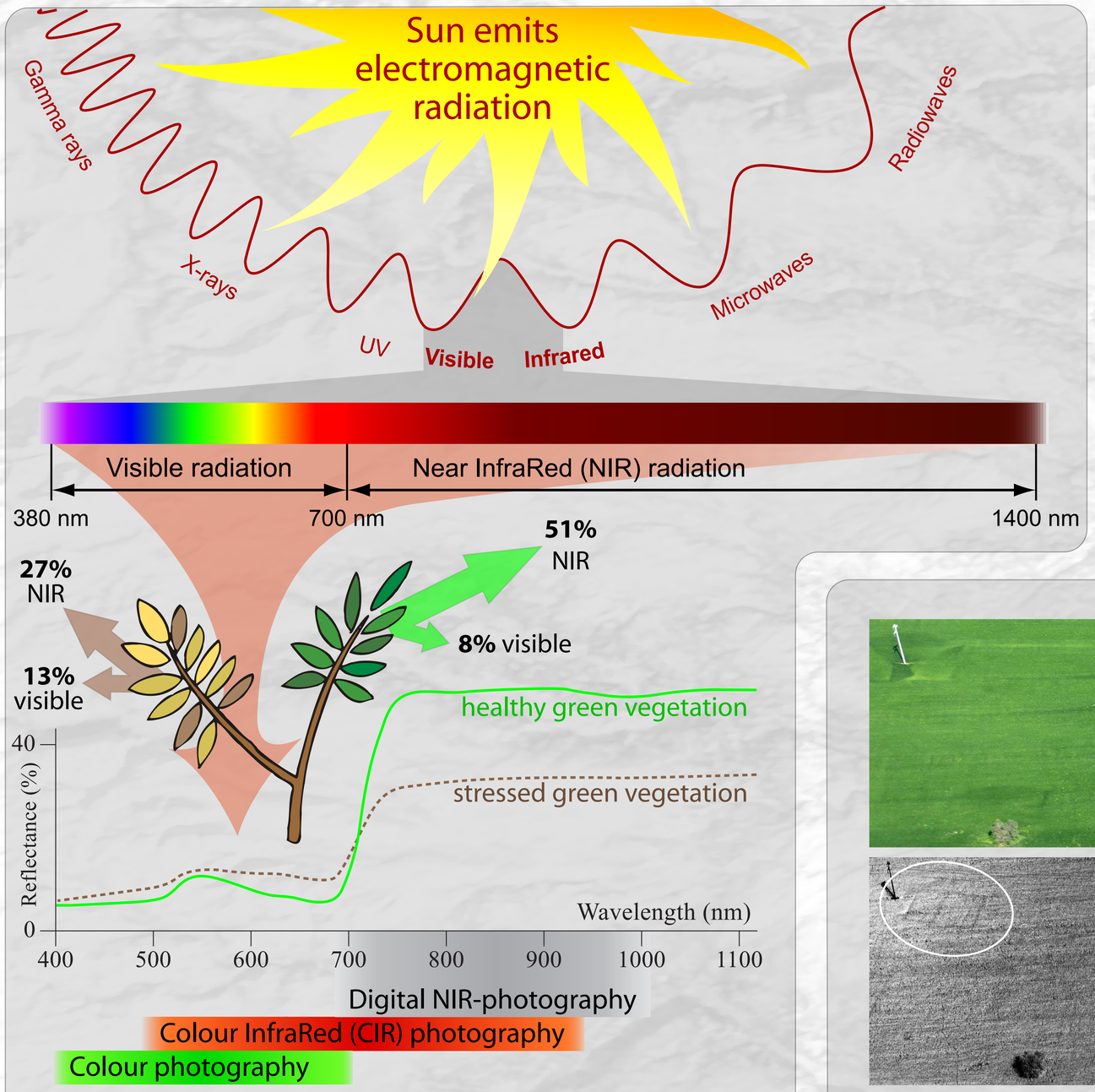


THEORY & PRINCIPLES ①

AIMS ②

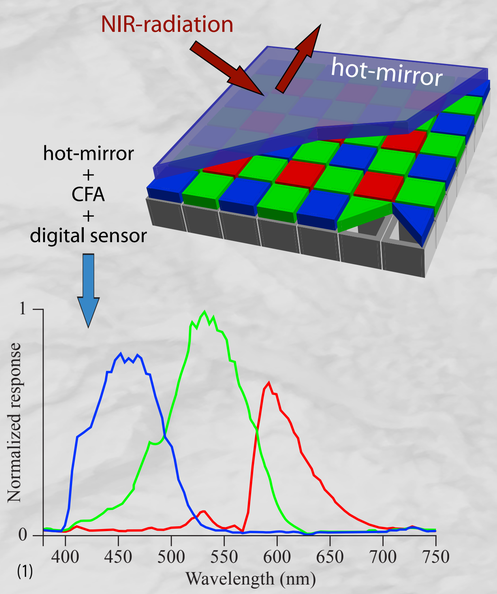
Archaeological features often can be discovered from the air by photographing **stress-induced discolorations** in vegetation, known as (positive or negative) **cropmarks**.

Negative cropmark showing a Roman rural temple

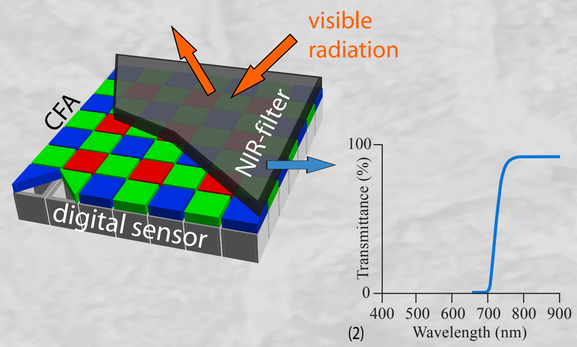
Due to the significant difference in NIR-reflectance between stressed and healthy green vegetation (see ①), NIR-photography should enhance these stress patterns, making them more pronounced (or visible at all).

③ EQUIPMENT

A normal digital camera contains a silicon image sensor covered with a **Colour Filter Array** (CFA) and a **hot-mirror**/NIR-block filter. This combination creates images with visible light only.



Replacing the hot-mirror with an NIR-filter permits the acquisition of NIR-photographs, because silicon is very NIR-sensitive.



The D-SLR used is a NIR-converted **Nikon D50** combined with a **Nikkor 20 mm f/3.5 AI-S** or **AF-S DX Nikkor 17-55 mm f/2.8G IF-ED**, two lenses that do not produce hot spots. As no filter is needed on the lens, the viewfinder will not be blocked, allowing to compose and focus as usual.

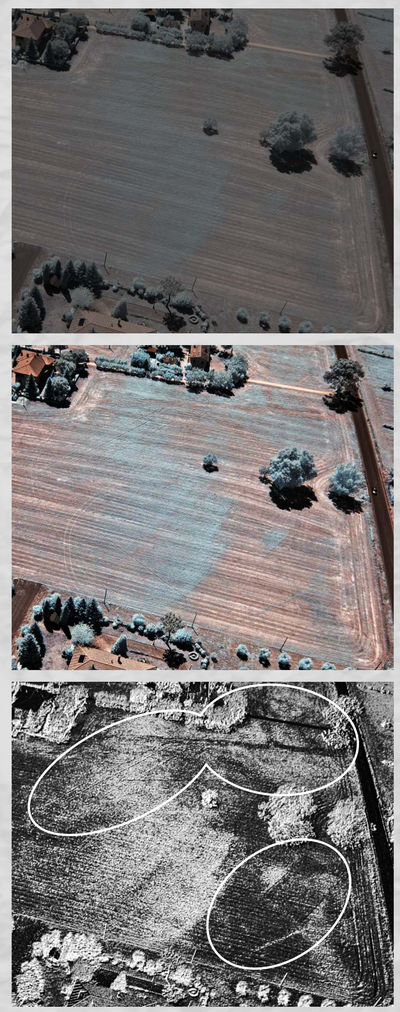
④ PROCESSING & RESULTS

Photographing NIR is performed by capturing RAW imagery, while a preset White Balance (WB), manual exposure, an aperture of *f*/8.0 and ISO 200 are chosen.

The images one the left show the same scene, shot simultaneously by a normal and the NIR-converted Nikon D50. Only the latter indicates archaeological features.

An aerial NIR-photo straight from the camera is shown on the right. The second image is the result after histogram stretching and local contrast enhancement.

For the third image, the pixels produced with the blue-sensitive photodiodes were divided by the pixels resulting from the red-sensitive diodes. This operation makes several linear features very noticeable.



FUTURE PLANS ⑤

Determination of the colour filter spectral response curves, which are essential in choosing additional filters and image algorithms.

Building a rig to capture simultaneously NIR and colour images, enabling false CIR-imaging and calculation of **Vegetation Indices** (VIs).

All pictures and illustrations by the author unless otherwise indicated.

(1) Adapted version of Moh, J. *e.a.*, Characterization of the Nikon D70 Digital Camera, *scien.stanford.edu/class/psych221/projects/05/joanmoh/index.html*

(2) Adapted version of HOYA Corporation USA Optics Division, Infrared Transmitting Filters (R72), *www.hoyaoptics.com/color_filter/ir_transmitting.htm*