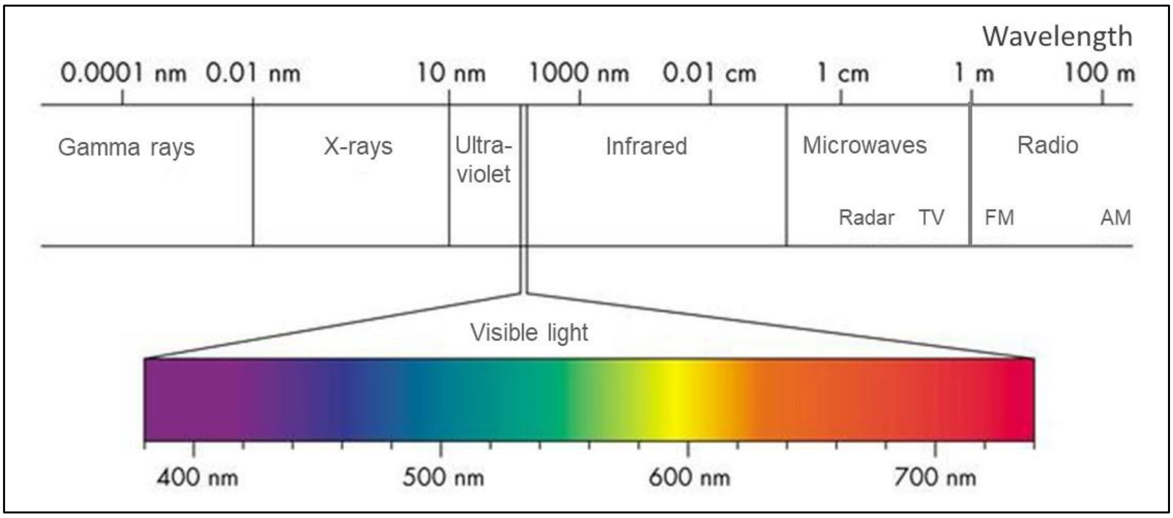
Princes Risborough U3A Photography Group - Infrared and Ultraviolet Photography

Introduction

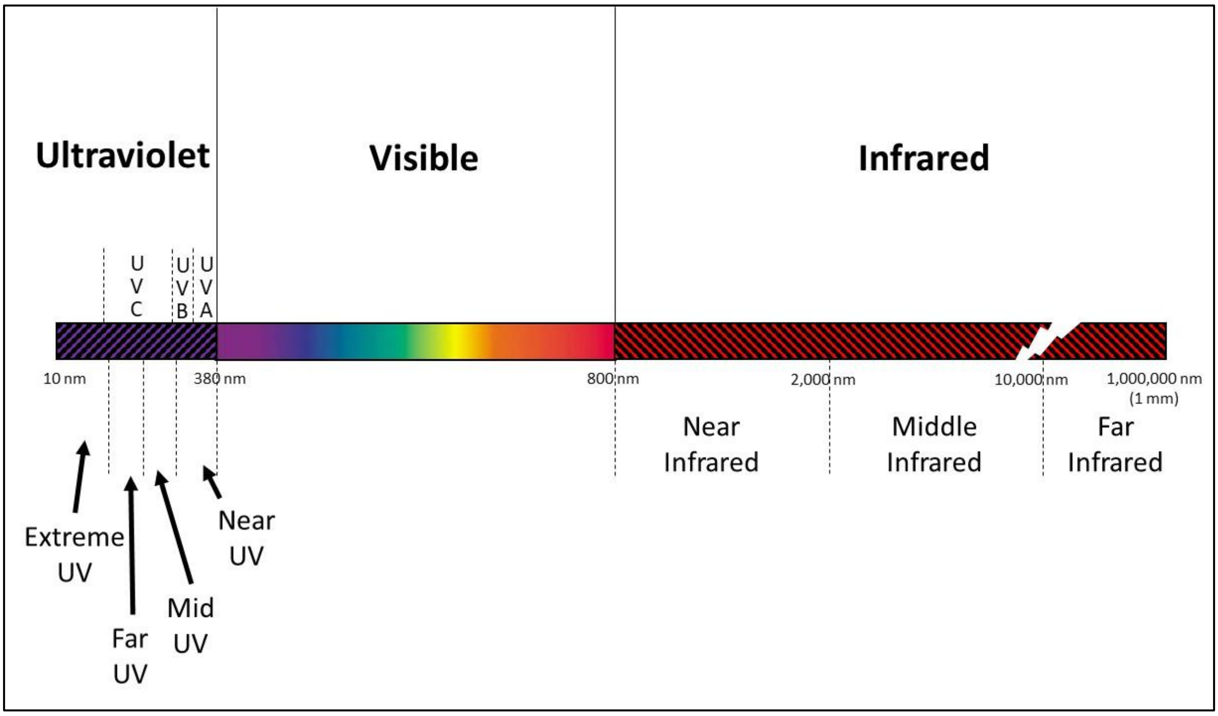
The notes here are by necessity brief – please contact me if you want to go into more detail.

The visible spectrum that we can see with our eyes is a narrow band in the middle of the electromagnetic spectrum. The regions on either side of this visible band are the infrared and ultraviolet bands.



You can think of ultraviolet (UV) and infrared (IR) as colours that we cannot see – an object that was purely infrared coloured would appear black to us.

In fact, UV and IR are themselves spectra rather than a single "colour":



When we are talking about UV and IR photography in these notes we are talking just about the UVA and Near IR regions.

Why bother with UV/IR photography?

To be honest, this is a somewhat geeky aspect of photography, and one of the reasons that I do it is that I am interested in the science and technology of it – but there are other reasons as to why you might want to do it. We need to discuss IR and UV separately.

Infrared photography

Amateur photographers have been taking IR photographs for over 75 years. One reason is the interesting landscape effects you can get because vegetation is recorded as snow-like white and blue sky is recorded as black:

And stunning false colour images can be created (see later):

Infrared is also good at seeing through haze:

If you use a light source which provides only IR light and no visible light, you can photograph in apparent darkness, e.g. to capture animals at night:

Infrared also has penetrative powers, for example to see what is going on under paintings or to see through ink which has obliterated something underneath:

You can use infrared to penetrate the skin:

And even to penetrate some types of clothing (discretion is advised!):

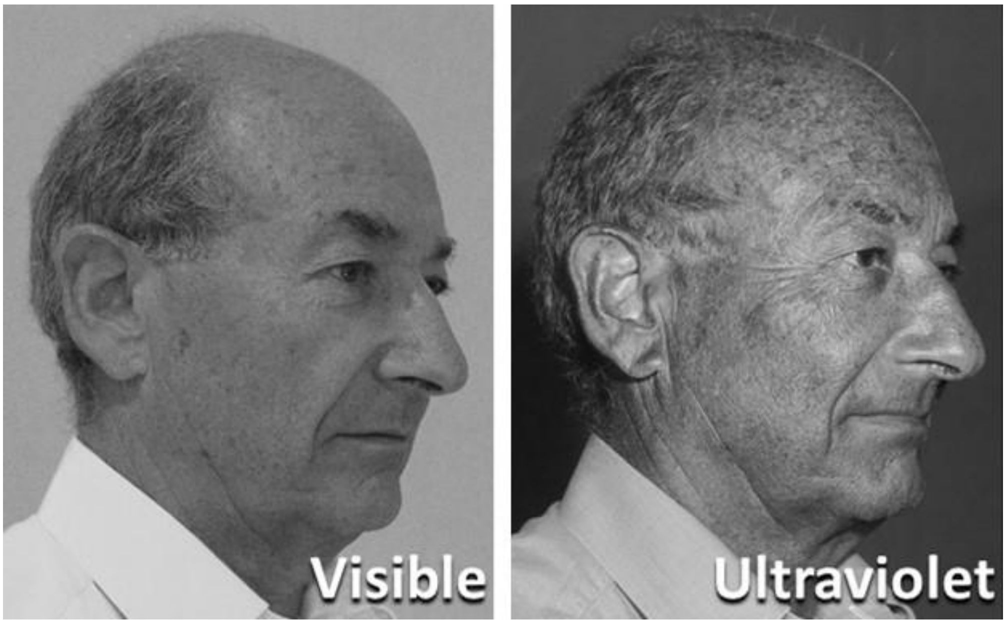
Ultaviolet photography

There are less uses for UV photography for the amateur than there are for IR, and most of the applications have a scientific bent. UV is useless for landscape work, for example, because it has exactly the opposite effect to IR – it gives images which are very murky in the distance.

Most people who do UV photography concentrate on flowers. Because flowers are coloured to attract insects – many of which can see UV – they often look quite different in UV. For example, here is a snapdragon:

And many flowers exhibit a dark central target for the insect to aim at when photographed in UV, like this coneflower:

UV photography is also good at showing skin blemishes, esp. of sun damage:



What do you need for IR and UV photography?

Camera

The sensors in digital cameras are sensitive to the UVA and near IR region (up to about 1,500 nm in the spectrum diagrams shown earlier). But unfortunately in order to get good colour rendering in normal photographs the camera manufacturer builds a filter into the camera that strips out UV and IR light. So in order to photograph in UV and IR you need to get the camera adapted by having the UV/IR-cut filter replaced. There are two options:

- Getting the camera adapted specifically for IR photography. This replaces the UV/IR-cut filter with an IR-pass filter. This has the benefit that you do not need to put an IR-pass filter in front of the lens (see below) but has the drawback that the camera cannot be used for UV photography.
- Getting a "Full Spectrum" conversion, where the UV/IR-cut filter is replaced with a clear UV/IR-pass filter. This has the benefit of allowing the camera to be used for both UV and IR photography, but requires the fitting of an opaque filter in front of the lens (see below).

Because these conversions mean the camera is not usable for normal photography, most people buy a low-cost second-hand camera for UV and IR photography. An SLR is probably not a good choice:

- with an IR-specific conversion the focussing of the IR image is slightly different from the visible image you see through the viewfinder, and
- with full spectrum conversion, you have to put an opaque filter in front of the lens.

So you really need a camera where you focus using the display (i.e. using LiveView). I use a Canon EOS M with full spectrum conversion, and this is ideal. (*The EOS M10 that replaced* *the EOS M is not so good because it does not allow use of external flashguns and does not have a B(ulb) shutter setting.*) Various companies advertise conversion services, and on ebay you can generally find second-hand cameras that have already been converted.

Lens

For IR photography, you can use your normal lenses (as long as they have a filter thread at the front).

For UV photography, there is a problem. Any lens made in the last 60 or 70 years is unsuitable because it will not transmit UV very well. So you have to buy an old lens and an adapter to use it on your digital camera. Various sources on the internet recommend suitable lenses, and you can find them on ebay for £20-100.

Filters

If you have gone for a full spectrum conversion, you will need to screw an opaque filter into the front of your lens.

For IR photography you will require an IR-pass filter. These are readily available on Amazon with prices from about £20.

For UV photography you will need a UV-pass filter (not the clear UV-cut filter you may well already use in normal photography). These are more expensive and difficult to find. I ended up buying mine from a US vendor on ebay. (*If you are an astronomer and have a Baader U (Venus) filter, then use this – this filter is what most of the experts use, but is out of my price range!*)

Light sources

For IR photography, you can use:

- daylight (sunshine is much better than overcast conditions),
- tungsten lights, and
- flashguns.

But modern household lights such as LEDs and CFL (Compact Fluorescent Lights) are not suitable.

Again, UV photography is more of a problem. The camera's sensitivity to UV is a lot less than to visible or IR light, so you need a ***lot*** of light. Your options are:

- daylight – although exposures may be too long for hand-held photography.
- Modern household lights such as LEDs and CFL (Compact Fluorescent Lights) – but again exposure times can be long. Tungsten lights are not suitable.
- flashguns. But you need to modify these by removing the lens, which absorbs UV. I have modified a number of modern low-cost made-in-China flashguns very easily. Because of the camera's low UV sensitivity, you will need several flashguns close to the subject.
- UV light bulbs. These are available on Amazon and ebay, but still need quite long exposure times.

Colour

As we cannot see UV and IR light, we cannot really associate any colour with it, and a purist would therefore make only black and white images when photographing in UV and IR. However, it is possible to make false-colour images which can give interesting results or help to highlight something. There are two ways of doing this.

White balancing.

If you take an IR or UV photograph, it will come out pretty well as a pink and white image (or black and white if you convert the image to monochrome). But you can get some colour into the image if you use white balancing (as described in a separate set of notes). For IR, you can use a sheet of paper as a reference object. But again UV is problematic, because most man-made white objects do not reflect uniformly across the UV spectrum. So you should use a general UV photograph as your white balancing reference, or a sheet of white PTFE (Teflon).

After you have white balanced, your UV and IR photographs will largely appear black and white – so you will need to ramp up the saturation to get any colour into the photograph. The picture of a flower below is a UV image taken in this way: the inset shows the same flower photographed in visible light.

Overlaying multiple exposures

With photo-processing software such as GIMP it is possible to overlay multiple exposures and change their colouring.

For example, you might want to simulate a bee's view of a flower. Bees cannot see red, but they can see blue, green and ultraviolet. So one way to do this is to take a normal colour photograph and strip out the red, and then overlay on this a UV photograph which has been coloured red. Then in the final image, red areas indicate where there was UV present, and turquoise (cyan) areas indicate where there was no UV, as we can see in these photographs of a tiny Speedwell flower:

You could also create full spectrum images, covering the spectrum from UV through visible to IR. In the photograph below, three images have been overlaid: a UV image coloured blue, a visible image coloured green, and an IR image coloured red:

In the full spectrum view, vegetation is reddish because of the high reflectance of IR by chlorophyll. And the white paintwork comes out yellow, because the masonry paint used (like most white paints, paper, and plastic) does not reflect UV very well.

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