Figure A. The now-deprecated Jet colour map

Figure B. Turbo

Figure C. Cividis

Figure D. Inferno

Figure E. Magma

Figure F. Plasma

Figure G. Viridis

Figure H. Plasma as it appears to someone with deuteranomaly

Colour Mapping

The use of colour to enhance images – be they graphs or photographs – is nothing new. You've probably seen it used to pick out details in astronomical or body scan images, while in the hi-fi context you may have seen colour used in spectrograms to represent signal amplitude in two-dimensional plots of time (on the horizontal axis) versus frequency (on the vertical axis).

You've perhaps not given much thought to the colour map (the transformation from data value to colour, via either an algorithm or a look-up table) that's used for this, but in recent years there has been considerable attention paid to the topic. Ideally a colour map should be perceptually even (with no banding or sudden colour transitions), be of equal brightness (luminance) throughout, and not give anomalous results when viewed by people with the most common forms of colour blindness (better termed colour vision deficiency, since a total inability to see colour is rare). The last requirement is, or should be, of obvious importance given that up to 1 in 12 men have red-green colour blindness (whereas only 0.5 per cent of women are affected because the condition is sex-linked, the mutated genes being on the X chromosome).

Some of the oldest, most familiar colour maps are bad performers in at least one, and sometimes all three respects. A prime example is Jet (Figure A) which until quite recently was the default colour map in Matlab (mathematical software with signal analysis functionality widely used by audio academics). In showing you different colour maps here I'm dependent on accurate colour printing, of course, but you should be able to see at a glance that Jet is not perceptually uniform. There is obvious banding in the light blue and yellow, and rather sharp transitions to the darker colours at either extreme. Less obviously (unless you are colour blind), it also fails the third criterion because it includes both greens and reds, and the second criterion too: it is much brighter in the middle than at either extreme.

If you insist on using a colour map that mimics the visible spectrum, running from blue to red via green, then Turbo (Figure B) is a better option as it eliminates the banding – but it still has uneven luminance and is, obviously because it contains red and green, poorly adapted to colour-blind viewers. Whereas the other five colour maps illustrated here (Figures C to G) are examples of alternatives that have been designed to meet all three criteria, even if they look a little less spectacular. I've used Plasma for the X-Y plots in this article.

There's a neat online tool called Coblis (colour blindness simulator) at https://www.color-blindness.com/coblis-color-blindness-simulator/, to which you can upload images to visualise – as a normally sighted person – how they appear to those with various forms of colour blindness. Figure H, as an example, simulates what the Plasma colour map looks like to someone with the form of red-green colour blindness known as deuteranomaly (a disorder of the retinal M-cones). While the colours have changed, the map remains unambiguous and perceptually smooth.