Resolution from an alternative dimension

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Summary

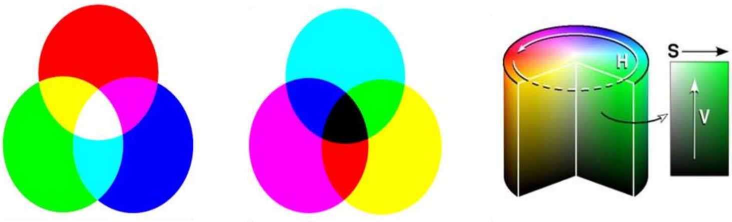
Seismic data contains a wealth of information, but it is often hard to get the complete picture by viewing a single attribute. Multi-attribute colour blending is an established technique that uses high resolution visualisation techniques to improve the way that information obtained from analysis of seismic data is presented to the interpreter. Multi-attribute colour blending can aid both stratigraphic and structural interpretation and this paper illustrates the improvements in understanding of facies heterogeneity and fault composition by using colour blending techniques. Stratigraphic variability is more easily identified using RGB colour blending models, whereas fault composition is most effectively viewed using a CMY blending scheme.

Introduction

Resolution in seismic data is normally associated with bin spacing, frequency content, and amplitude range. However, colour resolution and how we perceive colour adds another dimension to the resolution question and is critical to effective multi-attribute visualisation. Most human observers can perceive no more than 500 different grey levels yet can distinguish up to 10 million colours. Co-visualisation of volumes using opacity has been used for many years now and allows us to view volumes simultaneously, but the use of opacity tends to reduce the relative contrast of the information in each of the inputs. This is not the case with three component blending such as the RGB (Red-Green-Blue) and CMY (Cyan-Magenta-Yellow) colour schemes discussed in this paper. The benefit of multi-attribute visualisation is that it can communicate a lot more information than can be obtained by simply viewing the inputs sequentially or side by side. This is because we are seeing both the variation in response between the inputs at the same time as we are seeing the variation in response within each input. However, as all this information is contained within one image it can be assimilated just as easily as the information in a single attribute.

Colour Blending

RGB blends have been used to visualise multiple 2D seismic sections from 3D data for many years (e.g. Hall and Trouillot, 2004). More recently, this has been expanded to allow 3D RGB seismic images to be created and visualised (e.g. Henderson et.al, 2007), and several 3D interpretation packages now support RGB blending. CMY and HSV blending are less common but can be equally informative when used in the correct manner. RGB blending is an additive colour scheme where the values within three separate volumes are combined by mixing the Red, Green and Blue colour channels (figure 1a). This type of colour blending works well when there is a degree of correlation between the input volumes, such as frequency decomposition magnitude volumes or near, mid and far offset envelope volumes When all three inputs are high the resulting blend is light grey / white. When all three inputs are low the resulting blend is dark grey / black. Colours are produced when the relative values in each volume differ from one another. The exact hue of that colour indicates the degree of variation between the inputs. It should be noted that when all the inputs are identical the result of RGB blending is a greyscale image. Generally RGB blending works well when looking at stratigraphic features within seismic data. The CMY colour model is the inverse of RGB (figure 1b). So, when all three inputs are high, the resulting blend is black and when all three inputs are low it is white. As the human eye can more easily detect dark lineations against a light back ground than light lineations in a dark background, CMY blends are particularly effective at imaging faults and structural features in the data (Purves and Basford, 2011). The third colour scheme that is important is the HSV (Hue-Saturation-Value) model (figure 1c). This differs from the RGB and CMY models in that Hue is defined as a cyclical / rotary value. This is relevant when blends are created using cyclic attributes such as Phase, Azimuth or Trend. Incorporating either of these attributes into a linear RGB or CMY blend will lead to misrepresentation of the data and the potential to interpret the blend inaccurately.



a) b) c)

Figure 1 *Schematics of the three colour models a) RGB b) CMY c) HSV.*

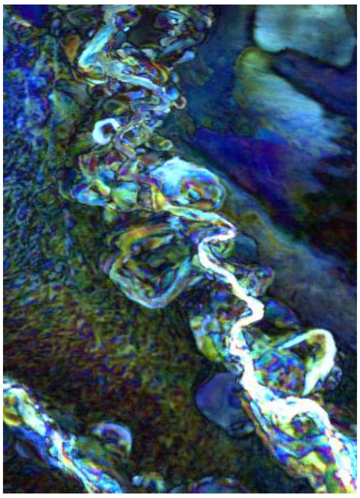


Figure2 *RGB blend of braided channel system.*

What can we resolve with colour blending?

From a stratigraphic perspective the RGB blend reveals more detail about the internal geometry of channel and carbonate systems, highlighting different facies and resolving both lateral and vertical heterogeneity. The CMY blend is similarly effective with fault analysis, in which using a combination of attributes reveals variability along the fault which can highlight the fault damage zone, the true location of the fault tip (beyond the obvious phase break), and the small scale faulting associated with larger tectonic movements. And finally the HSV is effective at co-visualising structure and stratigraphy simultaneously.

During the talk we will present examples using all three colour systems and we will illustrate the effect colour blending can have on the interpretation of seismic data. Particularly in channel systems we will illustrate how the layers of a braided system can be differentiated using RGB blends (Figure 2), and how the pointbars and sandbars can be discriminated as separate facies. We will show how viewing multiple volumes simultaneously provides previously unseen information on sedimentary packages and facies heterogeneity within them.

References

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