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# Phase Preserving Dynamic Range Compression of Aeromagnetic Images

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Geoscientific images with a high dynamic range, such as aeromagnetic images, are difficult to present in a manner that facilitates interpretation. The data values may range over 20000 nanoteslas or more but a computer monitor is typically designed to present input data constrained to 8 bit values.

Standard photographic high dynamic range tonemapping algorithms may be unsuitable, or inapplicable to such data because they are have been developed on the basis of statistics of natural images, feature types found in natural images, and models of the human visual system. These algorithms may also require image segmentation and/or decomposition of the image into base and detail layers but these operations may have no meaning for geoscientific images.

For geological and geophysical data high dynamic range images are often dealt with via histogram equalization. The problem with this approach is that the contrast stretch or compression applied to data values depends on how frequently the data values occur in the image and not on the magnitude of any data features themselves. This can lead to inappropriate distortions in the output. Other approaches include use of the Automatic Gain Control algorithm developed by Rajagopalan, or the tilt derivative. A difficulty with these approaches is that the signal can be over-normalized and perception of the overall variations in the signal can be lost.

To overcome these problems a method is presented that compresses the dynamic range of an image while preserving local features. It makes no assumptions about the formation of the image, the feature types it contains, or its range of values. Thus, unlike algorithms designed for photographic images, this algorithm can be applied to a wide range of scientific images. The method is based on extracting local phase and amplitude values across the image using monogenic filters. The dynamic range of the image can then be reduced by applying a range reducing function to the amplitude values, for example taking the logarithm, and then reconstructing the image using the original phase values. An important attribute of this approach is that the local phase information is preserved, this is important for the human visual system in interpreting the image. The result is an image that retains the fidelity of its features within a greatly reduced dynamic range. An additional advantage of the method is that the range of spatial frequencies that are used to reconstruct the image can be chosen via high-pass filtering to control the scale of analysis. A relatively low cutoff frequency allows large overall trends in the data to be observed. As the spatial cutoff frequency is progressively increased the analysis becomes more localized and the relative magnitudes of features become more equal.