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Pattern Orientation in PIP/NEV Imaging: A Comparative Analysis of Pyramid Complexes and Natural Landscapes

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Abstract

Patterns appear before interpretation. That is where this work begins. A comparative observational analysis of pattern orientation in Polycontrast Interference Photography (PIP) and New Energy Vision (NEV) imaging is conducted using a dataset comprising more than 840 recordings collected across 15 countries. A series of PIP and NEV recordings, collected across different environments and continents, reveals a consistent contrast in pattern orientation. In open landscapes and urban settings, color-gradient structures tend to extend horizontally. This baseline behavior is visible in rural Serbia, along the Aswan roadway, and in the Sedona formation, despite its partial geometric resemblance to a stepped pyramid. Across the broader dataset, horizontally oriented patterns represent the dominant baseline condition in natural landscapes, urban environments, and archaeological sites, including megalithic complexes and temples. The situation changes over pyramidal structures. Recordings above the Bosnian Pyramids of the Sun and the Moon show vertically organized patterns, stable across different years and recording conditions. A comparable structure is observed at the Pyramid of Khafre in Egypt, suggesting that the phenomenon is not limited to a single location. This vertical pattern orientation is reproducibly observed across multiple pyramid sites in Bosnia and Egypt (including Giza, Dahshur, Abusir, and Hawara), and remains consistent across acquisition distances ranging from approximately 100 m to several kilometers. Between pyramidal features, the pattern shifts again. Oblique structures appear in transition zones, while panoramic imaging reveals clear spatial contrast: vertical organization above the pyramids, horizontal banding above the nearby urban environment. Across the full dataset, a smaller subset of observations exhibits oblique or mixed orientations, typically associated with transitional spatial zones or localized environmental conditions. The cross-site stability of these observations, across sites and instruments, points to a reproducible difference in pattern orientation linked to specific landscape forms. Whether these patterns reflect optical interference effects, environmental conditions, or other physical processes remains open. What is clear is that pyramidal structures exhibit a distinct, repeatable configuration not observed in the surrounding terrain. The analysis is based on visual classification of pattern orientation using standard PIP/NEV system outputs. No computational image analysis was applied, and the findings are therefore presented as descriptive and hypothesis-generating. The consistency of observed patterns across geographically diverse environments suggests a structured relationship between landscape type and pattern orientation, providing a basis for future quantitative investigation.

Keywords

PIP Imaging, NEV Imaging, Pattern Orientation, Pyramid Structures, Bosnian Pyramids, Comparative Analysis, Landscape Morphology, Visual Classification, Spatial Patterns, Geospatial Imaging

1. Introduction

In recent decades, a number of experimental imaging techniques have been developed to visualize patterns in optical and contrast-enhanced imaging environments. Among these are Polycontrast Interference Photography (PIP) and New Energy Vision (NEV), systems designed to enhance subtle variations in light intensity and color contrast [1].

These systems operate by applying digital contrast-enhancement algorithms to standard optical recordings, enabling visualization of spatial variations in light gradients that are not readily apparent in conventional photography [2].

Unlike conventional imaging, which captures physical structures directly, PIP and NEV systems generate color-enhanced representations that may reveal underlying spatial organization in the observed scene. While originally developed for biomedical and experimental applications, these techniques have also been applied to environmental and architectural contexts.

Despite their use in multiple domains, the interpretation of PIP/NEV imagery remains largely qualitative, and systematic comparative studies across different landscape types are limited.

The present study focuses on the orientation of patterns observed in such images. Specifically, it examines whether recurring directional structures—horizontal, vertical, or oblique—can be identified and compared across different types of sites.

The analysis is based on a dataset comprising more than 840 recordings collected across 15 countries, including pyramid complexes, natural landscapes, urban environments, and archaeological sites. This geographic and environmental diversity allows evaluation of pattern behavior across a wide range of conditions.

Particular attention is given to pyramid-shaped formations, both natural and artificial, due to their geometric distinctiveness and long-standing association with unusual physical and cultural phenomena.

In this study, pyramidal sites are treated as a distinct morphological category, allowing comparison with non-pyramidal environments such as mountains, valleys, settlements, and megalithic or monumental structures.

Previous studies and anecdotal observations have suggested that such sites may exhibit unique visual or energetic characteristics [3]. However, systematic comparisons using standardized imaging approaches remain limited.

To address this gap, the present work applies a consistent observational framework to evaluate whether pattern orientation differs between pyramidal and non-pyramidal environments.

The aim of this paper is not to propose a definitive physical mechanism, but rather to document and compare visual patterns in a structured and repeatable manner. By analyzing multiple locations under comparable conditions, the study seeks to determine whether consistent differences in pattern orientation can be observed.

The study is therefore positioned as descriptive and hypothesis-generating, focusing on reproducibility and cross-site consistency rather than causal interpretation.

If such differences exist, they may provide a basis for further investigation using more quantitative or instrument-based methods.

In particular, future work may incorporate computational image analysis techniques (e.g., frequency-domain analysis or edge-orientation detection) to objectively quantify the observed patterns.

At the same time, the limitations of the current approach—particularly the reliance on visual interpretation—must be acknowledged.

Accordingly, the findings presented here are intended as an initial structured assessment of pattern orientation in PIP/NEV imaging, providing a foundation for subsequent quantitative validation.

2. Materials and Methods

2.1. Imaging Systems

Polycontrast Interference Photography (PIP) and New Energy Vision (NEV) systems were used to acquire and process all images analyzed in this study. Both systems employ digital image processing techniques to enhance subtle variations in light intensity and color contrast [4] [5].

In practical terms, these systems apply contrast-enhancement algorithms to standard optical recordings, producing color-gradient images that emphasize spatial variations in reflected and ambient light.

The PIP system, originally developed by Harry Oldfield, utilizes a video camera connected to a processing unit and dedicated software. NEV operates on similar principles, with differences in color mapping and processing parameters [1].

For the purposes of this study, only the spatial orientation of resulting patterns (horizontal, vertical, or oblique) was analyzed, while color values and intensity variations were not quantitatively interpreted.

2.2. Data Collection

Data were collected across a range of geographic locations and environmental contexts, including pyramid complexes, natural landscapes, and urban environments.

The dataset comprises more than 840 images collected across 15 countries, including Bosnia and Herzegovina, Egypt, the United States, Germany, France, Italy, Austria, Slovenia, Croatia, Serbia, the United Kingdom, Israel, Vietnam, South Africa, and North Macedonia.

More than 300 recordings originate from the Bosnian Valley of the Pyramids and were collected over an extended period (2007-2021), allowing evaluation of temporal consistency.

Recordings were obtained under varying environmental conditions, including differences in weather, lighting, and time of day.

Typical acquisition conditions included clear or partially cloudy weather, daytime recording, and open-field visibility. Metadata such as viewing direction, distance to target, and environmental conditions were recorded when available.

2.3. Acquisition Parameters

The distance between the recording device and the observed structure varied depending on the location and terrain.

Across the dataset, recording distances ranged from approximately 100 m to 10 km.

Multiple recordings of the same site were obtained from different distances and viewing angles where possible, allowing evaluation of pattern stability across spatial scales.

No systematic dependence of pattern orientation on recording distance was observed.

2.4. Image Selection and Processing

Images included in the analysis were selected from a larger pool of recorded material.

To reduce selection bias, images were included based on predefined technical criteria rather than visual outcome. Inclusion criteria consisted of:

- adequate image clarity and focus
- stable framing without significant motion blur
- absence of extreme atmospheric distortion (e.g., heavy fog or precipitation)

Images were excluded if they did not meet these technical requirements.

Selection was performed prior to pattern classification to avoid outcome-driven bias.

All images were processed using the standard software associated with the PIP and NEV systems.

No additional post-processing or manual enhancement was applied beyond the default system output.

2.5. Pattern Classification

The primary variable analyzed in this study is pattern orientation.

Patterns were visually classified into three categories:

- horizontal
- vertical
- oblique

Horizontal patterns were defined as predominantly parallel, band-like structures aligned with the horizon. Vertical patterns were defined as structures exhibiting dominant orientation perpendicular to the horizon. Oblique patterns were defined as intermediate or mixed orientations not clearly aligned with either axis.

Classification was performed through visual inspection of each image. In cases of ambiguity, images were categorized conservatively as oblique.

2.6. Comparative Framework

The dataset was grouped into broad categories based on site type:

- pyramidal structures (e.g., Bosnia, Egypt)
- natural landscapes (mountains, valleys, plains)
- urban environments
- archaeological and megalithic sites

This grouping allows comparison between morphologically distinct environments, particularly between pyramidal and non-pyramidal structures.

2.7. Limitations

The methodology is based on visual interpretation of processed images.

No computational image analysis techniques (e.g., Fourier transform, edge detection, or orientation histograms) were applied to quantify pattern orientation.

The study relies on the standard processing algorithms provided by the PIP/NEV systems, which may introduce unknown transformation effects.

Accordingly, the results should be interpreted as descriptive and exploratory, pending future validation using objective quantitative methods.

3. Results

3.1. Overview of Dataset

The analysis is based on a dataset comprising more than 840 PIP and NEV images collected across 15 countries and multiple environmental contexts. Of these, more than 500 images exhibit predominantly horizontal pattern orientation, representing the dominant baseline condition.

More than 300 recordings originate from the Bosnian Valley of the Pyramids

(2007-2021), providing a longitudinal dataset for evaluating temporal stability of patterns.

3.2. Baseline Pattern Characteristics in Non-Pyramidal Environments

The baseline behavior of PIP/NEV imaging is established through observations in non-pyramidal environments. In Figure 1, recorded in a rural landscape in Serbia, the image displays predominantly horizontal color-gradient bands extending parallel to the ground surface. These bands form a layered structure with minimal vertical development.

Figure 1. PIP/NEV imaging of a non-pyramidal environment (Serbia). The image shows horizontally stratified color gradient patterns, serving as a baseline reference.

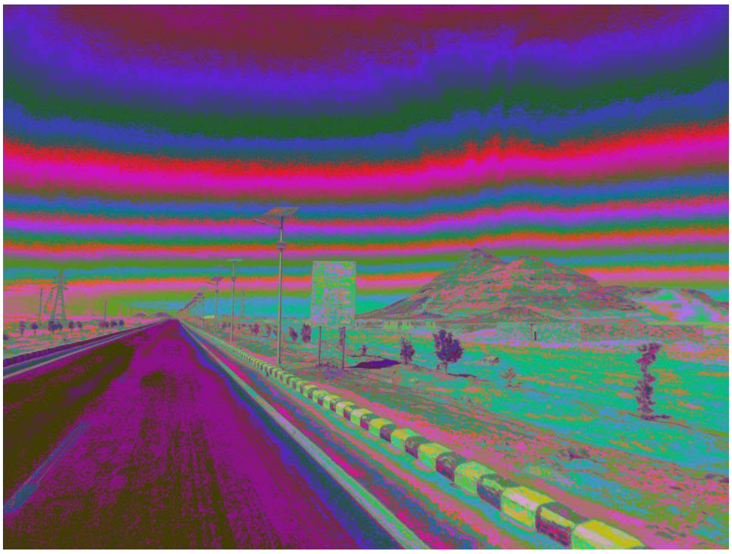

Figure 2. NEV imaging of a roadway environment near Aswan (Egypt). Clear horizontal banding under minimal structural influence.

A comparable pattern is observed in **Figure 2**, showing a roadway environment near Aswan, Egypt. The image shows clear horizontal stratification with relatively uniform band spacing. The absence of pronounced vertical structures in both figures suggests that horizontal patterning serves as a common baseline in typical environmental settings.

This baseline behavior is consistently observed across a wide range of environments, including mountains, valleys, lakes, rivers, coastal regions, and urban areas, as well as at archaeological and monumental sites.

Additional examples, such as recordings from temple complexes in Egypt (e.g., Abu Simbel and Philae Island) and environmental settings in Germany, further demonstrate the predominance of horizontal pattern orientation under non-pyramidal conditions.

3.3. Pattern Behavior in Archaeological and Megalithic Sites

Sites with significant archaeological or cultural features but lacking pyramidal geometry show no systematic deviation from the baseline horizontal pattern.

Recordings from megalithic complexes in the United Kingdom (including Stonehenge, Avebury, Silbury Hill, and Glastonbury) consistently exhibit horizontal pattern orientation. Similarly, temple structures in Egypt, Vietnam, and Europe display predominantly horizontal or weakly structured patterns.

These observations indicate that architectural complexity or cultural significance alone does not correspond to the emergence of vertically oriented patterns.

3.4. Pyramid-Like Morphology without Vertical Pattern Formation

In contrast to the baseline environments, **Figure 3** presents a PIP image of the Sedona formation (Bell Rock, USA), which exhibits partial geometric similarity to a stepped or pyramidal structure. Despite this morphological resemblance, the observed pattern remains predominantly horizontal, with only weak or diffuse vertical components.

Similar behavior is observed in other non-pyramidal elevated structures, including natural pyramid-shaped hills, where horizontal patterning remains dominant.

These observations indicate that geometric resemblance to pyramidal forms alone is insufficient to produce vertically oriented pattern structures.

3.5. Vertical Pattern Structures in Pyramidal Sites

A distinct shift in pattern orientation is observed in images of pyramidal structures. In **Figure 4**, showing the Bosnian Pyramid of the Sun, the image displays vertically oriented color-gradient structures extending upward from the summit area. These structures differ markedly from the horizontal bands observed in baseline environments [6].

Further evidence is provided in **Figure 5**, which presents two recordings of the

Bosnian Pyramid of the Moon acquired in 2011 and 2015. In both cases, the dominant pattern orientation is vertical. The similarity between the two images, obtained several years apart, indicates temporal stability in the observed pattern configuration.

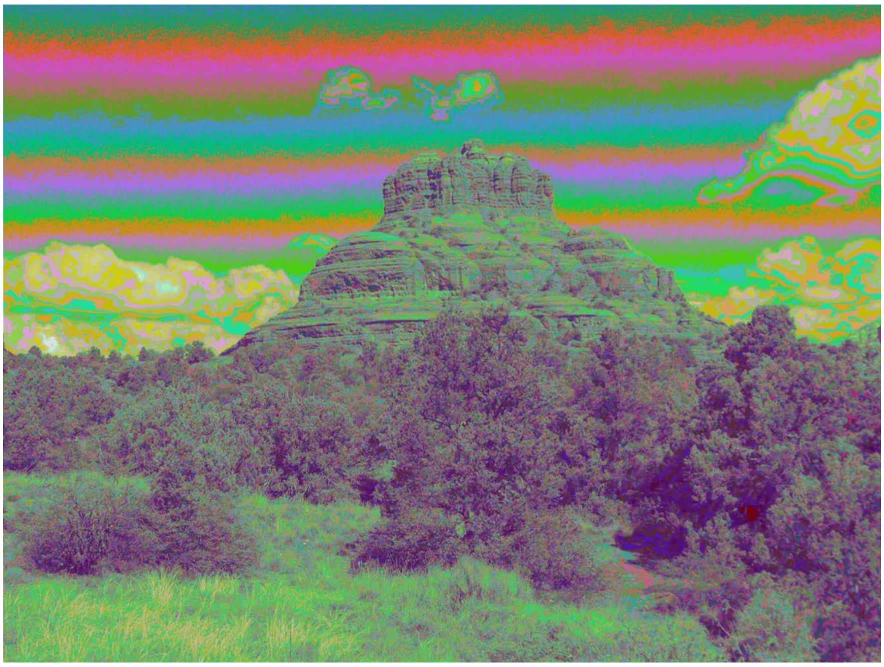

Figure 3. The Sedona formation exhibits partial geometric similarity to pyramidal structures, yet produces predominantly horizontal or weakly structured patterns, indicating that pyramid-like morphology alone may not determine pattern orientation.

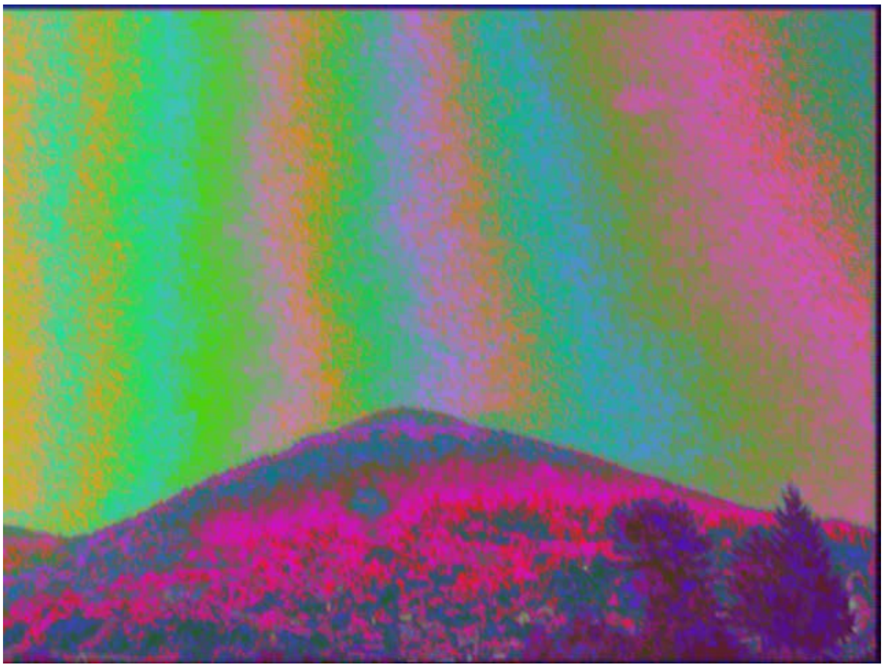

Figure 4. PIP imaging of the Bosnian Pyramid of the Sun. Vertically oriented structures above the summit.

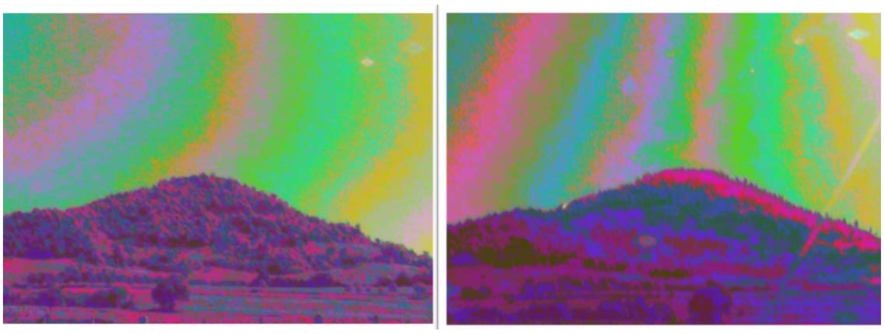

Figure 5. PIP imaging of the Bosnian Pyramid of the Moon (2011 and 2015). Consistent vertical pattern orientation.

Across the broader dataset, vertically oriented patterns are consistently associated with pyramidal structures in both Bosnia and Egypt, including sites at Giza, Dahshur, Abusir, and Hawara.

This vertical orientation is reproducible across multiple recordings, acquisition conditions, and viewing distances, indicating that the observed pattern is not dependent on a specific measurement configuration.

3.6. Cross-Site Consistency

The pattern observed in Bosnia is not confined to a single geographic location. In Figure 6, a PIP image of the Pyramid of Khafre (Egypt) reveals vertically oriented structures comparable to those documented in Figure 4 and Figure 5.

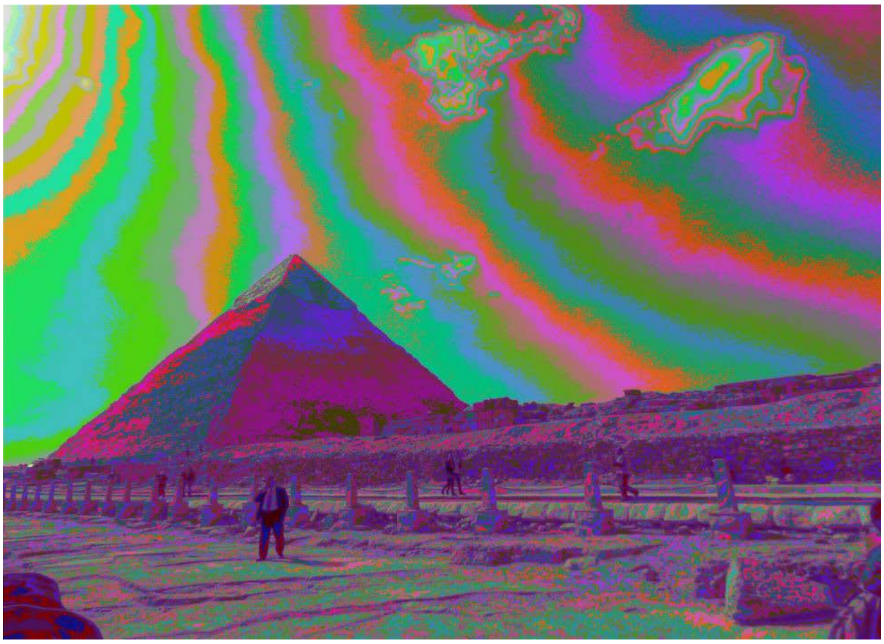

Figure 6. PIP imaging of the Pyramid of Khafre (Egypt). Vertical structures comparable to the Bosnian pyramids.

The recurrence of similar vertical patterns across geographically distant pyramid sites suggests that the phenomenon is reproducible across different environmental and recording conditions.

3.7. Transitional and Oblique Pattern Structures

Between major pyramidal features, pattern orientation becomes less uniform. Figure 7 shows the spatial relationship between the Bosnian Pyramid of Love (left) and the Bosnian Pyramid of the Sun (right). The image exhibits predominantly oblique (inclined) color-gradient structures, differing from both the vertical patterns above pyramid summits and the horizontal patterns observed in baseline environments.

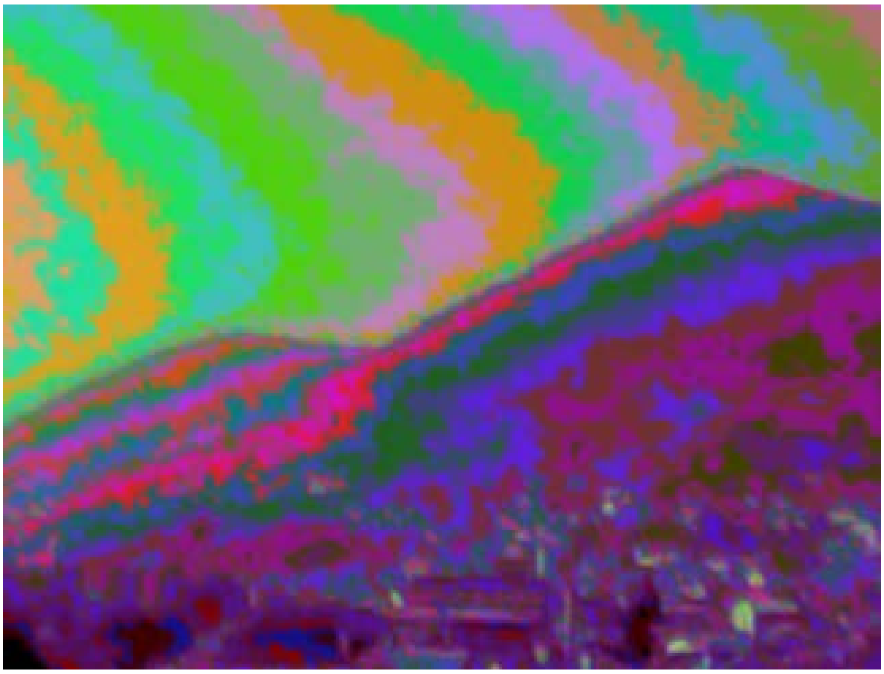

Figure 7. PIP imaging showing the spatial transition between the Bosnian Pyramid of Love (left) and the Bosnian Pyramid of the Sun (right). The image exhibits predominantly oblique color-gradient structures, suggesting an intermediate pattern zone between two pyramidal features with different dominant orientations and spatial influence fields.

Across the dataset, oblique patterns are observed less frequently and are typically associated with transitional zones between dominant structural features or localized environmental variations.

3.8. Additional Observations and Localized Deviations

While the majority of non-pyramidal environments exhibit horizontal patterns, a limited number of locations show localized deviations from this baseline.

Examples include specific sites, such as the pyramid-shaped mountain Rtanj (Serbia), and localized areas within Damanhur (Italy), where vertically or obliquely oriented structures are occasionally observed.

However, these deviations are spatially restricted and do not represent the dominant pattern within their broader environmental context.

3.9. Panoramic Spatial Contrast

A broader spatial relationship is illustrated in **Figure 8**, which presents a panoramic PIP image extending from the pyramidal sector toward the urban area of Visoko. Within a single continuous frame, two distinct pattern regimes are visible: vertically organized structures above the pyramidal features and horizontally stratified patterns above the urban environment.

Figure 8. Panoramic PIP image spanning the Bosnian Pyramid of the Sun and the Bosnian Pyramid of Love (left) toward the urban area of Visoko (right). The pyramidal sector exhibits predominantly vertical and structured color-gradient patterns, while the urban area shows horizontal and diffuse banding. The image is presented as a panoramic composite; any visual symmetry or edge processing is applied for clarity and does not affect the observed pattern orientations.

Because the image captures both areas under the same recording conditions, the contrast in pattern orientation is not attributable to changes in instrumentation or acquisition parameters. Instead, it reflects a spatial difference within the same observational context.

3.10. Summary of Observed Pattern Types

Across all analyzed images, three primary pattern orientations can be identified:

- horizontal patterns, dominant in natural and urban environments
- vertical patterns, consistently associated with pyramidal structures
- oblique patterns, observed in transitional zones

Quantitatively, horizontal patterns represent the majority of observations (>500 images), while vertical patterns are primarily confined to pyramidal sites and a small number of localized anomalies.

The panoramic image (**Figure 8**) integrates these observations, demonstrating that different pattern types can coexist within a single landscape, spatially organized according to underlying features.

Although classification was performed visually, dominant orientation was assessed based on the prevailing direction of pattern gradients within each image.

4. Discussion

The results presented in this study indicate a consistent relationship between large-scale landscape form and pattern orientation observed in PIP and NEV imaging. Across geographically diverse datasets and multiple recording periods, three primary regimes emerge: horizontal patterns in natural and urban environments, vertical patterns above pyramidal structures, and oblique patterns in transitional zones.

This structured distribution of pattern orientation is observed across a large dataset (>840 images) collected in 15 countries, suggesting that the observed differences are reproducible rather than site-specific or incidental.

4.1. Interpretation of Pattern Orientation

The predominance of horizontal banding in non-pyramidal environments can be considered a baseline condition of PIP/NEV imaging. Such patterns are consistently observed across rural, desert, and urban contexts, suggesting they may arise from common environmental factors, such as atmospheric stratification, light-scattering gradients, or sensor-processing characteristics.

The consistency of this baseline across more than 500 observations, including natural landscapes, urban environments, and archaeological sites, supports the interpretation that horizontal organization represents a default response of the imaging systems under typical conditions.

In contrast, the emergence of vertically oriented structures above pyramidal formations represents a notable deviation from this baseline. These vertical patterns are not only distinct in morphology but also stable across independent datasets, including recordings separated by several years and obtained using different operators and instrument versions.

The reproducibility of this configuration across multiple pyramid sites in Bosnia and Egypt, and across varying acquisition distances, suggests that it is not attributable to isolated environmental conditions or recording parameters.

Importantly, the absence of strong vertical structures in the Sedona formation—despite its partial geometric resemblance to a pyramid—indicates that visual similarity alone is insufficient to produce the observed effect.

Similarly, the presence of horizontal patterns at megalithic and monumental sites further indicates that architectural or cultural significance alone does not account for the observed pattern differences.

4.2. Spatial Transitions and Gradient Zones

The identification of oblique pattern structures in areas between pyramidal features provides further insight into the spatial organization of the observed phenomenon. Rather than abrupt transitions, the data suggest the presence of gradient zones in which pattern orientation changes progressively from horizontal to vertical.

The panoramic image (**Figure 8**) is particularly informative in this regard, as it captures multiple pattern regimes within a single recording context. The coexistence of vertical and horizontal structures under identical environmental and instrumental conditions strengthens the argument that the observed differences are linked to the landscape's spatial structure rather than to external variables.

Similar transitional behavior is observed in other locations where mixed or oblique orientations appear in spatially intermediate zones, although these represent a minority of observations.

4.3. Possible Physical and Optical Mechanisms

While the current analysis is limited to pattern recognition, several classes of mechanisms may be considered for future investigation:

- Optical interference and contrast enhancement effects:

Given that PIP and NEV systems rely on digital processing of light intensity gradients, it is possible that specific geometric configurations influence the resulting pattern structures.

- Atmospheric or environmental gradients:

Variations in temperature, humidity, or particulate distribution could produce structured optical effects, particularly in relation to large-scale terrain features.

- Electromagnetic or geophysical influences:

Previous studies have reported measurable phenomena associated with pyramid structures; however, the present study does not directly measure such parameters.

- Geometric amplification effects:

The consistent slope angles, orientation, and symmetry of pyramidal structures may influence the interaction between environmental conditions and imaging outputs.

At present, no single mechanism can be confirmed, and the observed patterns may result from a combination of optical, environmental, and geometric factors.

4.4. Methodological Considerations

A key strength of this study lies in its longitudinal and multi-site design. The integration of datasets collected over nearly two decades, across multiple continents and by independent operators, reduces the likelihood that the observed patterns are artifacts of specific instruments or recording conditions.

The inclusion of a large number of non-pyramidal control sites, including natural landscapes, urban environments, megalithic complexes, and monumental architecture, further strengthens the comparative framework.

However, several limitations must be acknowledged:

- Lack of quantitative measurement:

PIP and NEV systems provide qualitative visual outputs rather than calibrated physical measurements.

- Subjectivity in pattern classification:

Although classification criteria are defined, the assessment remains visually based.

- Dependence on system processing:

The analysis relies on the proprietary processing algorithms of the PIP/NEV systems.

No computational image analysis techniques (e.g., Fourier-based orientation analysis or automated edge detection) were applied, limiting the ability to objectively quantify pattern orientation.

- Unresolved physical interpretation:

  The study does not establish a causal mechanism for the observed patterns.

4.5. Context and Literature Limitations

Despite the growing use of PIP and related systems in exploratory contexts, the existing body of published research remains limited and methodologically heterogeneous.

In particular, there is no widely accepted quantitative framework for interpreting pattern structures generated by these systems in environmental settings.

Accordingly, the present study adopts a deliberately conservative and observational framework. PIP and NEV imaging are treated as contrast-enhancement systems rather than calibrated measurement instruments.

This approach allows identification of reproducible visual patterns while avoiding unsupported assumptions regarding underlying physical processes.

4.6. Localized Deviations from Baseline Pattern Behavior

An additional point of interest is the occurrence of vertically oriented pattern structures at a limited number of non-classical pyramid sites, such as Rtanj (Serbia), a mountain with a pronounced geometric morphology. In the present dataset, this site exhibits pattern characteristics similar to those observed at pyramidal locations. While independent studies have reported various geophysical measurements at this site, such data are not analyzed within the scope of the present work.

Similarly, localized deviations from baseline horizontal patterns were observed in specific areas within the Damanhur region (Italy), particularly in proximity to a geomorphologically distinct hill associated with subsurface structures. While the majority of recordings in this region exhibit horizontal orientation, these localized vertical or oblique patterns suggest that additional environmental or structural factors may influence pattern formation.

4.7. Implications for Future Research

The consistent association between pyramidal structures and vertical pattern orientation suggests that these formations may interact with their environment in ways that are detectable through contrast-enhancement imaging techniques.

At the same time, the presence of occasional deviations in non-pyramidal contexts indicates that additional factors may contribute to pattern variation.

Future research directions include:

- Controlled experiments comparing PIP/NEV outputs with standard imaging techniques
- Quantitative analysis of pattern orientation using computational methods

- Correlation with independent environmental or geophysical measurements
- Expansion of the dataset to additional sites and environmental conditions

4.8. Context within Existing Research

The findings of this study complement prior multidisciplinary investigations of pyramidal structures, particularly those reporting geometric regularity and environmental anomalies.

However, the present work does not test or confirm any specific hypothesis regarding the origin or nature of these structures.

By focusing on reproducible visual characteristics rather than interpretive conclusions, this study provides a framework for integrating alternative imaging methods into broader geospatial and environmental research.

4.9. Summary

In summary, the results indicate a consistent and reproducible difference in pattern orientation between pyramidal and non-pyramidal environments within the analyzed dataset.

These findings should be interpreted as descriptive and hypothesis-generating, providing a structured basis for future quantitative investigation rather than definitive conclusions regarding underlying mechanisms.

5. Conclusions

Patterns observed in PIP and NEV imaging across diverse environments reveal a consistent relationship between landscape type and pattern orientation.

The analysis draws on more than 840 recordings collected across 15 countries, encompassing pyramidal structures, natural landscapes, urban environments, and archaeological sites.

The results demonstrate a clear distinction: horizontal pattern structures dominate in natural and urban settings, while vertically oriented patterns are reproducibly observed above pyramidal formations. Transitional zones between such structures exhibit intermediate, predominantly oblique configurations.

Quantitatively, horizontal patterns represent the majority of observations (>500 images), establishing a baseline condition across non-pyramidal environments. In contrast, vertical pattern orientation is consistently associated with pyramidal sites in Bosnia and Egypt, and is reproducible across multiple recording conditions, time periods, and observation distances.

The recurrence of similar pattern orientations under varied conditions indicates that the phenomenon is stable and not attributable to isolated environmental factors, instrumental artifacts, or site-specific anomalies.

At the same time, a limited number of localized deviations from baseline behavior are observed at specific non-pyramidal sites, indicating that additional environmental or structural factors may influence pattern formation.

The findings remain strictly observational. PIP and NEV systems do not provide direct measurements of physical quantities, and no definitive causal mechanism is established within the scope of this study.

The classification of pattern orientation is based on visual assessment of system-generated outputs, and no computational image analysis was applied. Accordingly, the results should be interpreted as descriptive and hypothesis-generating.

While several possible explanations—ranging from optical interference effects to environmental or geophysical influences—are discussed, their evaluation requires dedicated experimental investigation beyond the present framework.

The primary contribution of this work is the identification of a reproducible pattern-orientation signature associated with pyramidal structures across a large, geographically diverse dataset.

Future research should focus on:

- Quantitative analysis of pattern orientation using computational methods
- Controlled experimental studies under standardized conditions
- Integration with independent environmental and geophysical measurements

Such approaches will be necessary to determine the underlying mechanisms and to evaluate the broader applicability of contrast-enhancement imaging techniques in geospatial research.

These findings should be interpreted as descriptive and hypothesis-generating rather than confirmatory.

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Statements

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Data Availability Statement

The data supporting the findings of this study, including PIP/NEV image datasets and associated acquisition metadata, are available from the corresponding author upon reasonable request.

Ethical Statement

This study did not involve human participants, animal subjects, or sensitive cultural materials requiring ethical approval. All analyses were conducted using publicly accessible landscape features and non-invasive geospatial data.

Author Contributions

Sam Osmanagich, Ph.D., conceived the study, conducted the analysis, performed the modeling, and wrote the manuscript.

Conflicts of Interest

The author declares no conflict of interest.

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