

Science &gt;&gt; Physics

# Investigating the Artistic Process of Nikos Gabriel Pentzikis through Infrared Reflectography: An Analysis of the Layering Technique- Pentzikis.

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## Abstract

**Introduction :** The objective of the present investigation was to conduct a comprehensive analysis of the complex and intricate multilayered painting technique utilized by the Greek artist, Nikos Gabriel Pentzikis. The research expands upon previous research where the state-of-the-art iTomography platform was employed in order to obtain a thorough understanding of the underlayers of three selected paintings using the Infrared Reflectography Imaging technique. The findings of this study revealed clear patterns in the artist's unique technique, particularly in the underlayers of the second and third paintings, which presented significant results. The study highlights the importance of further exploration and investigation to gain a deeper understanding of the painter's technique and overall oeuvre.

**Keywords :** Pentzikis, IRR, Imaging, Painting technique, iTomography

**Introduction :** This study aims to analyze the multilayer painting technique of the Greek artist Nikos Gabriel Pentzikis and also employ the Infrared Reflectography (IRR) technique in order to examine the underlayers of three paintings "Simonopetra," "Transfer of the relics of Saint Bartholomew and other martyrs," and "Couple." Conducted at the Teloglion Fine Arts Foundation and the "ORMYLIA" Foundation in Greece, the study utilizes the iTomography platform which enables precise measurements for a wide variety of techniques. Our research builds upon prior research [1] and aims to contribute to understanding Pentzikis' artistic technique and vision, enriching art conservation knowledge and fostering greater appreciation for his artworks.

The infrared reflectography is a non-destructive technique that utilizes infrared radiation to delve beneath the paint surface, revealing hidden layers and providing visual access to compositional paint alterations and preliminary sketches [2]. Even though IRR is useful, it is important to note that the resulting images are in greyscale, which limits the ability to discern the distribution and nuances of color within an artwork. Additionally, the accuracy and interpretation of the results are influenced by a variety of factors, such as the wavelength of the light source, and the infrared activity of the material under investigation like the substrate,

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the pigments, the binding medium, the fillers and the contrast between the materials of superficial layers with the underdrawing.

Despite these limitations, infrared reflectography can be instrumental in documenting the materials employed in the creation of artworks. By observing the behavior of the materials under infrared radiation, researchers can obtain valuable information regarding the chemical composition of the pigments, as well as their interaction with the binding medium [3]. When coupled with other spectroscopic techniques, such as Raman, FTIR or X-ray fluorescence spectroscopy, a more comprehensive understanding of the artwork's composition can be obtained [4]. Two of the paintings (Transfer of the relics of Saint Bartholomew and other Martyrs, Couple) in this study have undergone prior examination, during which their pigments were subjected to characterization as documented in the preceding scholarly work [1].

Furthermore, the non-destructive nature of Imaging techniques like the infrared reflectography technique is a major asset for art conservation. The ability to investigate the underlying layers of the artwork without causing any damage, enables researchers to obtain crucial data while preserving the integrity of the artwork. This is particularly important for fragile or delicate artworks, where traditional methods of analysis like Chromatographic techniques, Mass Spectroscopy (MS) and Scanning Electron Microscope (SEM) may not be feasible or may result in damage to the work.

### Nikos Gabriel Pentzikis

Nikos Gabriel Pentzikis was a Greek artist born in Thessaloniki in October 1908. He studied optics, physics and physiology in Paris and later completed his studies in pharmacy and botany at the University of Strasbourg. He took over his father's pharmacy in 1930, which became a hub for the intellectual community of Thessaloniki [5]. He started painting in 1933 [6] and his works were first displayed in 1944 [7]. His early paintings were influenced by

impressionism and expressionism but later developed a technique he called "psifarithmisi" (Greek: ψηφαριθμησι; /psifarithmisi/) that was similar to pointillism [8]. His second period of painting, which started in 1967 and lasted until his death in 1993, focused on religious themes where his paintings were filled with thousands of brushstrokes and multiple layers of color using this unique technique. He died of a heart attack in 1993 and was buried in Ormylia, Halkidiki, Greece.

Pentzikis is of major importance in the cultural heritage of Greece, as a prolific writer as well as an artist with over 35 exhibitions, both in Greece and abroad [9]. He has influenced many artists, with the most prominent being Marios Spiliopoulos, winner of Grand Prix d' Alexandrie in the 18th Biennale of Alexandria and a professor and dean of Athens School of Fine Arts [10].

### The Technique of Psifarithmisi

N. G. Pentzikis developed the technique known as "psifarithmisi" during the second phase of his painting in 1967. The name originates from the Greek words "ψηφίδα" (mosaic tile) and "αριθμησι" (numbering) and according to his own description, the technique was a mathematical approach that provides the possibility of a different appreciation of the things in life [11].

The technique is based on an algorithmic process, where the order of steps is crucial. The method involves the following steps [8]:

1. Analysis of sacred texts, synaxaries, names of saints, and people.
2. Deconstruction of the analyzed materials into words and letters.
3. Translation of letters into numbers, where each letter corresponds to a specific number (e.g.,  $\alpha = 1$ ).
4. Conversion of numbers into colors, which may have different variations in shade.

The conversion of the numbers from 1 to 9 along with the identified pigments [1] can be seen in the following table (Table 1).

| Table 1: The analysis psifarithmisi's process from number to color. On the last column the identified pigments from previous research can be seen. |                                                                                         |                   |                       |                     |
|----------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|-------------------|-----------------------|---------------------|
| Number                                                                                                                                             | Letters                                                                                 | Speech Sounds     | Color                 | Identified Pigments |
| 1                                                                                                                                                  | $\alpha$ (alpha: /'ælfə/)<br>$\iota$ (iota: /'aɪə/)<br>$\upsilon$ (upsilon: /'ʌpsələn/) | Bi-modal vowels   | Blue                  | PB15:2, PB29        |
| 2                                                                                                                                                  | $\epsilon$ (epsilon: /'epsələn/)<br>$\omicron$ (omicron: /ə'mikrən/)                    | Short vowels      | Yellow                | PY1, PY3, PY4.2     |
| 3                                                                                                                                                  | $\eta$ (eta: /'eɪtə/)<br>$\omega$ (omega: /'əʊmɪgə/)                                    | Long vowels       | Light lilac or pink   | Not identified      |
| 4                                                                                                                                                  | $\pi$ (pi: /paɪ/)<br>$\beta$ (beta: /'betə/)<br>$\phi$ (phi: /fəʊ/)                     | Labial consonants | Shade of burned umber | Not identified      |

**Table 1: The analysis psifarithmisis' process from number to color. On the last column the identified pigments from previous research can be seen.**

|   |                                                                               |                                         |                                     |                 |
|---|-------------------------------------------------------------------------------|-----------------------------------------|-------------------------------------|-----------------|
| 5 | κ (kappa: /'kæpə/)<br>γ (gamma: /'gæmə/)<br>χ (chi: /'kaɪ/)<br>ξ (xi: /'zaɪ/) | Palatal consonants (except ξ)           | Orange                              | PO13, PO71      |
| 6 | τ (tau: /tə:/)<br>δ (delta: /'deltə/)<br>θ (theta: /'θi:tə/)                  | Dental consonants                       | Purple                              | Not identified  |
| 7 | μ (mu: /mu:/)<br>ν (nu: /'nju:/)                                              | Nasal consonants                        | Sea blue                            | PB15:2 with PW6 |
| 8 | λ (lambda: /'læmdə/)<br>ρ (rho: /roʊ/)                                        | Liquid consonants                       | Olive green                         | PG7/PG36, PG8   |
| 9 | σ, ς (sigma, /'sɪgmə/)                                                        | Voiceless alveolar fricative consonants | Shade of Tyrian purple or red ocher | Not identified  |

Words were also divided into parts of speech and assigned a color based on their meaning. Nouns were given a sea color, adjectives were given the color green to symbolize vegetation, verbs were given a red color to show action, and conjunctions, pronouns, and prepositions were given a purple color to symbolize mourning. Additionally, the shapes of the brushstrokes in his methodology were also significant, as they were proportional to the symbolism the artist wanted to convey. For instance, the cross symbolized life and death, the square expressed the body's ability to express form, the circle represented the relativity of everything, the semicircle signified the possibility of ascension, the crooked line expressed human emotions, and so on.

According to the methodology described by N. G. Pentzikis [11], the word "love" was subjected to analysis and was assigned a numerical pair based on the reduction of its constituent letters. Specifically, the set of letters that make up the word "love" (Greek: ἀγάπη) were assigned the numerical value of 5. As can be seen from table 1, this number derives from

$$\alpha + \gamma + \alpha + \pi + \eta$$

where  $\alpha = 1$ ,  $\gamma = 5$ ,  $\alpha = 1$ ,  $\pi = 4$ ,  $\eta = 3$  which results to 14. The result is then summed up by its digits,  $1 + 4 = 5$ . This number was referred to as the primary number of the numerical pair.

The artist used an additional sum where each letter was assigned a number based on its alphabetical order, where the resulted value was 30:

$$\alpha + ' + \gamma + \alpha + ' + \pi + \eta$$

where  $\alpha = 1$ ,  $' = 1$ ,  $\gamma = 3$ ,  $\alpha = 1$ ,  $' = 1$ ,  $\pi = 16$ ,  $\eta = 7$  which was then reduced to 3 ( $3 + 0 = 3$ ) and was referred to as the secondary number of the numerical pair. Based on this numerical pair, the color assigned to the word "love" was either orange, corresponding to the value 5, or either lilac or pink, corresponding to the value 3. His creative approach involves a unique way of rendering humble objects in his

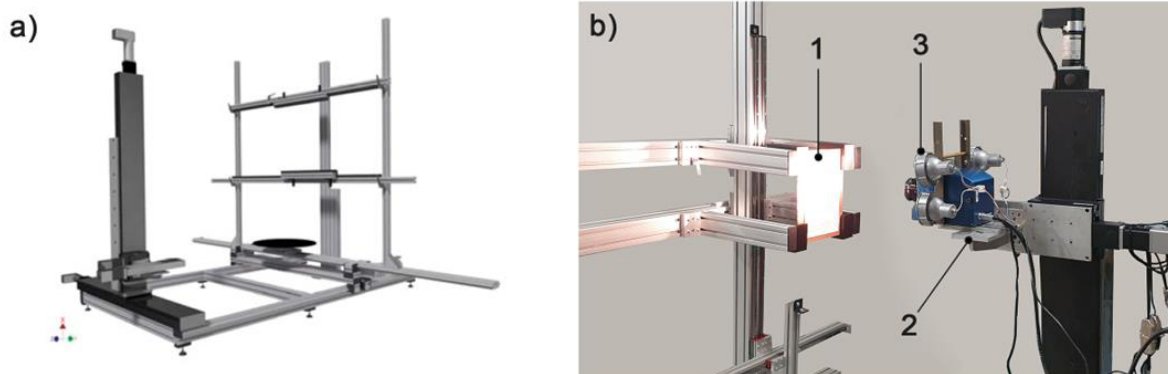
paintings without a fixed outline, thereby preserving their ambiguity and insignificance. Additionally, his paintings challenge conventional notions of time by representing the living and the dead without distinction, even viewing the dead as essential to his own life [12]. The meticulous nature of his creative process involves a careful transfer of designs onto paper through the use of rice paper. The resulting forms lack definable limits, as they are painted using multiple layers of color and brushstrokes of varying thickness and sparseness, often drawn from a range of designs, including those of the artist himself or others.

According to another reference [13], in his painting "Simonopetra" the artist utilized his unique method to combat mental apathy and add spiritual depth to his work. He began by constructing a cross as a compositional element and then used two reference plans, a forestry map and a bronze engraving of the Monastery from 1870 AD. After conducting a linguistic analysis of the text, dividing words into various parts of speech and counting their frequency, Pentzikis created squares with a cross inside for each category of part of speech. The border color of each square was determined by the category of the initial letter of the word, while the interior color (cross) was determined by the category of all letters of the word. The squares were then divided and distributed into the four quarters that were formed from the cross's lines, with the upper right quarter being the squares of the verbs, the lower right quarter the squares of auxiliary parts of speech, the upper left quarter the squares of the nouns, and the lower left quarter the squares of the adjectives.

In the second layer, Pentzikis applied a reddish-brown color (likely red sienna or burnt umber) to the area of verbs, cobalt blue to the area of nouns, olive green to the area of adjectives, and red/purple to the area of auxiliary parts of speech like conjunctions. The painting process of "Simonopetra" required 28 layers of paint, done over 42 days period, where each layer consisted approximately 7,500 brushstrokes. One notable aspect is that in the

twenty-first color layer, the artist exclusively employed an orange pigment as a primary color. This layer marked the commencement of the artist's enhancement of the preliminary design through the utilization of 213,934 geometric strokes, including but not limited to lines, curves, dots, crosses, rectangles, angles like shapes, as well as small and large circles.

## Materials and Methods



**Figure 1:** a) The iTomography infrastructure. b) The IR camera equipped with four lamps (3) on top of the platform (2) during the measurement process of an artwork clamped securely between two rails (1).

## Experimental Set up

In order to gain a more comprehensive understanding of Pentzikis' technique, the non-invasive method of infrared reflectography was employed. For implementing the measurements, the iTomography infrastructure (Figure 1.a) was used, which is carefully designed with a high degree of flexibility to enable the accurate and detailed analysis of cultural heritage objects [14]. It supports different focal lengths and geometries in order to achieve precise measurements of the artwork. The infrastructure employed two levels of positioning to ensure accuracy, consisting of coarse and fine positioning. For coarse positioning, each artwork was clamped with soft foam padding between two rails and manually positioned in the Y axis using four half-turn brake handles (Figure 1.b1). Then, for the X and Z movement, this frame that contains the artwork, was mounted on a moving dolly on rails and could be controlled manually or using a geared system. The fine positioning employed three linear stages with an accuracy of  $\pm 1\mu\text{m}$  and two rotation stages with 3 arcmin accuracy and 12 arcsec repeatability, providing yaw and pitch rotations. A platform that is placed on the pitch rotary stage supports different modalities which in our case was an IR camera (Figure 1.b2), while the yaw is performed by the stage on which the artwork is placed. In addition, the IR camera utilized in the study was equipped with four General Electric Quartzline Lamp H242 120V 150W (Figure 1.b3), emitting light at a center wavelength of 1100 nm.

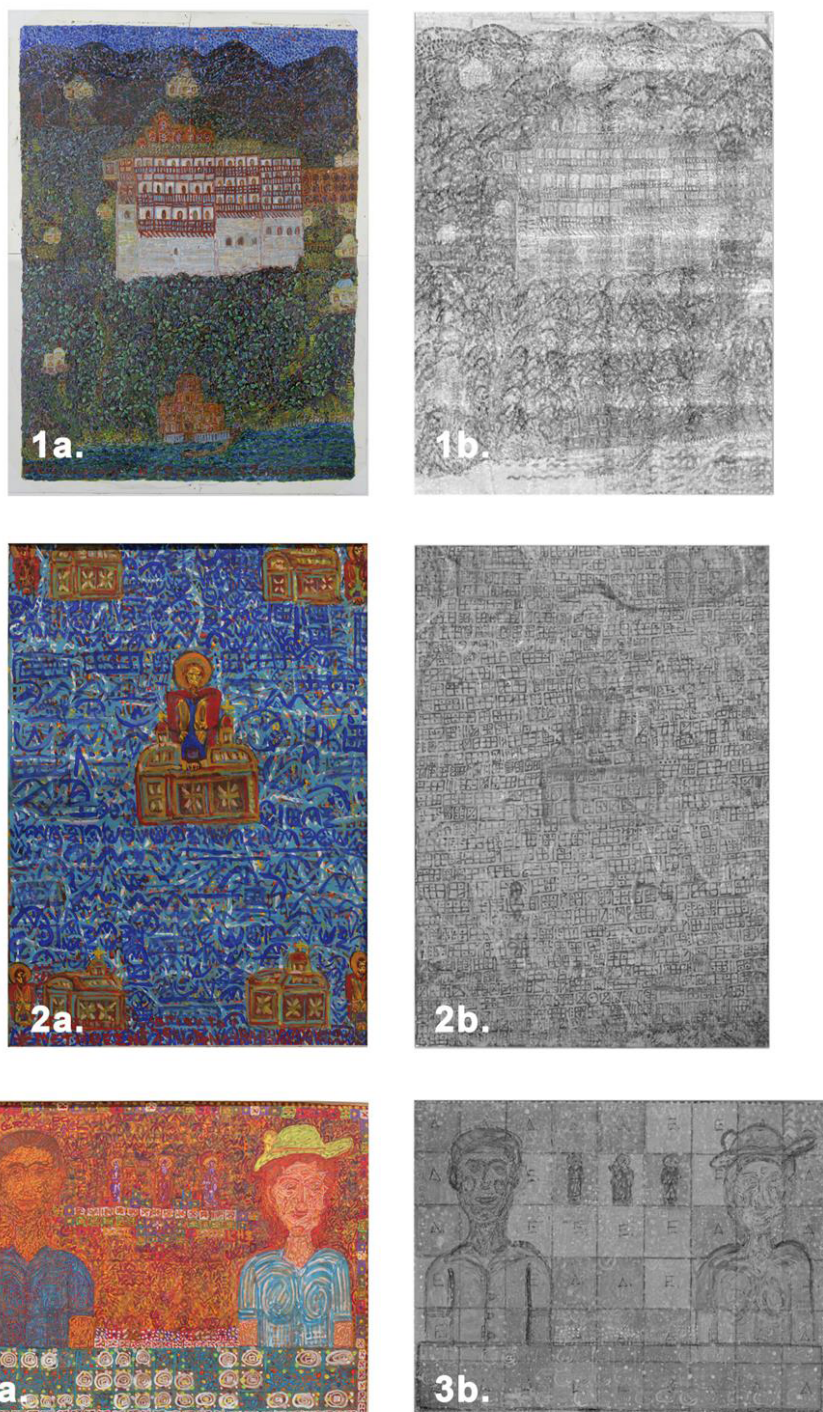
For each artwork, the creation of the image mosaic of the infrared reflectography involved the use of the XMID-FPA-640 IR camera that operates within the 1 – 5  $\mu\text{m}$

spectral range and is produced by XenICs. The camera is equipped with a highly efficient, thermo-electrically cooled InSb detector, control and communication electronics, enabling the acquisition of high-quality images [15, 16]. The resolution of each image captured by the IR camera was  $640 \times 512$  pixel at a pixel pitch of 20  $\mu\text{m}$ . In order to provide a higher resolution image, raster scanning was used. Then the series of images that were captured were algorithmically merged into one, in order to generate a final detailed image mosaic of the artwork's lower strata. The algorithm used, was the cross-correlation algorithm which transformed the IR reflectogram data and the diffuse visible light image data of the artwork into one coordinate system.

For the measurements, the IR camera was positioned at an approximate distance of 45 cm from the artwork (Figure 2). We conducted two experiments, one with no filter and one with the NYCTEA 40679-0049 filter, manufactured by Janos Technology Inc., which possesses a 50 mm focal length, an aperture of f/2.3, and operates within a wavelength range of 2.78 – 5  $\mu\text{m}$ . The implementation without a filter proved to yield optimal out-comes in terms of effectively revealing the underlying color layers of the psifarismisi. The increased penetration of the color layers with longer wavelengths caused the characteristic brushstrokes of the artworks to fade. The preceding paper [1] provides detailed insights into the artworks "Transfer of the Relics of Saint Bartholomew and Other Martyrs" and "Couple," presenting a comprehensive exploration utilizing different techniques such as Raman Spectroscopy, Fourier Transform Infrared Spectroscopy, X-Ray Fluorescence, and Ultra Violet Fluorescence.



## Paintings



**Figure 2:** The artworks “Simonopetra”, 1980, private collection (1a. Diffuse visible light, 1b. IRR), “Saint Bartholomew and other Martyrs”, 1969, Teloglion Museum collection (2a. Diffuse visible light, 2b. IRR) and “Couple”, 1975, Museum collection (3a. Diffuse visible light, 3b. IRR).

### Simonopetra, 1980, Tempera on Cardboard, 56.4 X 42.2 Cm

The painting “Simonopetra” (Fig. 2.1a) depicts the monastery of “Simonopetra” in the Mount Athos region. The colors that were applied have a semi-opaque but glossy look, which maintain the clarity of each brushstroke and form a dense single film. There are some regions like the monastery wall, in which the colors appear thicker similar

to the “impasto” technique. There is a variety of brush-stroke shapes like in the sky part of the painting that have simple dot brushstrokes. In lower parts there are shapes like “<”, “>”, “O”, “O” with a dot within it, lines, rhomboid, trapezoid and wavy shapes (Figure 3).



**Figure 3:** The different shapes of the brushstrokes in the painting "Simonopetra", from lower (left) to the upper part of the painting (right).

The artist's palette is comprised of various colors in earthly tones, including white, brownish-yellow, warm and cold shades of blue, magenta, pink, red, orange, and green. The white pigment is utilized in the depiction of the monastery and other edifices, while the brownish-yellow hue is situated on the right side of the monastery, and two other yellow shades are dispersed throughout the side areas of the painting. The sky features a warm-shaded blue, while two more distinct shades of blue are distinguishable in other parts of the composition, one resembling a warm blue tone and the other resembling a cold turquoise blue. The painting also incorporates hues of magenta and pink, as well as two shades of red. The former is a brownish-red hue, evident in the mountainous regions below the sky, while the latter is a brighter shade, observable on top of the buildings' crosses. Lastly, the painting contains a single shade of orange and green.

There were several cracks in the painting that revealed sublayers of different colors, the most evident being in the sky area in the upper left area, where a reddish-brown color was revealed as it was discussed in section 1.2. Also, some cracks were observed along pencil lines that seem to go below the painted area and were probably used as guidelines for different parts of the painting.

#### **Transfer of the Relics of Saint Bartholomew and Other Martyrs, 1969, Tempera on Cardboard, 24 × 17cm**

The "Transfer of the relics of Saint Bartholomew and other Martyrs" painting (Fig. 2.2a), created in 1969, showcases the unique artistic technique employed by the painter, N. G. Pentzikis. This painting is a testament to his second artistic period and is characterized by the utilization of a multitude of brushstroke shapes, including crosses, lines, semicircles, squares, rectangles, L-shaped "sharp" peaks and sinusoidal curves resembling waves. Furthermore, several brushstroke shapes are combined to form letter-like forms, such as the letter "E" (Figure 4). The dominant colors in the painting are light blue, blue, yellow, and occasionally yellow-green, yellow-brown, white, brown, red-brown, and in certain areas, purple shaded.



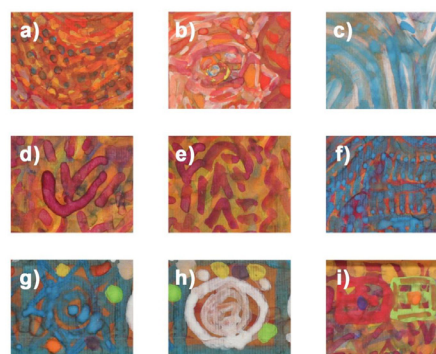
**Figure 4:** Shapes of strokes found in the background of the work that resemble Greek letters, from left: 1) "ξ" or "Σ", 2) "M", 3) "E", 4) "Q", 5) "O", 6) "X".

Pentzikis masterfully creates a spatial dynamic between the central figure, Saint Bartholomew, and the surrounding figures representing the martyrs. This space represents a metaphysical realm where immaterial beings interact with the material world. The blue tones, reminiscent of the sea, symbolize both the serenity and vastness of the metaphysical realm, as well as the turbulence of the material world due to human problems and sins. The blue tones are complemented by the contrasting colors of browns, reds, and whites, creating a harmonious interplay between the foreground and background colors.

The central figure, standing taller than the others, is further emphasized by the less dense brushstrokes surrounding it. Saint Bartholomew stands on his reliquary, which distinguishes it from the reliquaries of the other figures, having two domes compared to their one. All reliquaries, however, have a shared feature of three crosses. Additionally, the robes of the figures differ, with the central figure being blue (PB29), the upper right figure being yellow-green, and the rest of the figures having less defined shapes in their robes, with varying shades of red and yellow.

#### **Couple, 1975, Tempera on Cardboard, 26.5 × 36 cm**

The artwork titled "Couple" (Fig 2.3a) exemplifies the psifarithmisi technique, featuring orange-colored shades most due to PO13 that dominate approximately two-thirds of the canvas, while blue-colored shades (PB15:2) compose the remaining section. Symbolic shapes in reddish-blue hues are extensively employed against an orange background (Figure 5.d - 5.e), while blue and white colors (PW6) appear predominantly in circular shaped patterns. The colors in the painting are thinly applied, with multiple layers, resulting in a unique texture.



**Figure 5:** The different brushstrokes for the painting "Couple".



While the primary theme of the artwork depicts a couple, three figures resembling saints can be identified in the center of the painting. The male figure on the left, seamlessly blends into his surroundings, but his hair and beard are distinguishable by subtle brown brushstrokes, while his shirt features blue-colored brushstrokes from PB15:2 in the style of *tratteggio* (Figure 5.f). In contrast, the female figure on the right creates a more vivid contrast, with a bright yellow hat (PY1, PY3), orange-red hair (PO71), and white (PW6) and yellow-brown tones in her skin and blouse. The painting's lower and peripheral regions exhibit various decorative symbols consisting of squares with a variety of shapes (Figure 5.g - 5.i).

The artist used predominantly orange color, signifying "unbuilt light," typically reserved for use in temples [5]. Furthermore, the use of celebratory shapes and colors suggests that the couple may be experiencing joy, perhaps in the context of an engagement or wedding.

## Results and Discussion

The utilization of infrared reflectography (IRR) on the three paintings revealed the underlying layers of the unique painting technique utilized by N. G. Pentzikis.

### Infrared Reflectogram of "Simonopetra"

The analysis of the IRR images of the first painting showed that the design elements such as the peaks of the mountains were created using a dark pigment with high absorption in the infrared spectrum. Brushstrokes made with red, yellow, green, and blue colors were not as visible as those made with the dark pigment. In the diffuse visible light image, a mixture of blue and white can be seen in some brushstroke shapes that in the infrared reflectogram showed low levels of absorption and had great contrast with the darker background.

The analysis of the white pigments employed in the painting, revealed a reflection property. However, it was observed that in certain instances, such as on the monastery wall, there are several spots where the white pigment was applied and exhibited some level of absorption. This discrepancy in behavior may be attributed to the presence of impurities within the pigment composition or the interaction of infrared light with the substrate. Further investigation is required in order to elucidate the precise nature of these impurities and to determine their impact on the optical properties of the pigments. The identification and characterization of these impurities may provide valuable insights into the artwork's material composition, and may inform conservation efforts aimed at preserving the painting's integrity. The painting also displayed irregularities in the form of swollen areas with different absorption values than expected. This may potentially result in further damage, such as the formation of cracked lines along the surface of the paint. This finding could also prompt future research aimed at preventing the paint film from cracking.

### Infrared Reflectogram of "Saint Bartholomew and other Martyrs"

The application of the infrared reflectography (IRR) technique yielded significant insights into the second artwork. Specifically, the *psifarithmisi* technique was prominently visible in the IR reflectogram, revealing minimal absorption for the pigments employed in the upper layers. In contrast, the white pigment (PW6) displayed reflection. This enabled the identification of numerous rectangular and square shapes with a cross-shaped pattern within, extending across the entire panel. Furthermore, the fine lines present in these shapes suggest that a thin brush was utilized for the initial brushstrokes of the *psifarithmisi*, while a thicker brush was used for the upper layers. Additionally, the rounded shapes of the painter's writing further indicate that he utilized pointed brushes rather than broad squared brushes. The square and rectangular shapes evaluate the artist's claims, discussed in section 1.2.

### Infrared Reflectogram of "Couple"

Similarly, the third artwork, "Couple", also revealed the presence of the *psifarithmisi* technique in its early stages. As can be seen through the use of IRR, the artist used a pencil to create a 6 x 9 matrix composed of squares with Greek letters Delta ("Δ") or Epsilon ("Ε") at their center, except for the three central squares in the second row, which contain three figures. Notably, the artist also employed the pencil to outline the figures and the decorative pattern in the bottom of the painting, which show thick lines and suggest a sideways application of the pencil. This matrix represents a unique feature as it was not observed in other artworks or the literature.

The observation of the matrix in the artwork, in conjunction with the rectangular and square shapes found in the previous artwork, "Saint Bartholomew and other Martyrs", sheds light on the systematic approach employed by N. G. Pentzikis in creating these artworks. It is conceivable that the artist utilized grids and mathematical principles as a guiding framework for his brushstrokes, which allowed for the creation of intricate patterns. The absence of a grid pattern in the first artwork, "Simonopetra", may be attributed to the pigments employed by the artist, which may not have had the absorption property.

### Brushstrokes Shapes and Color Pallete of the Three Paintings

Further information about the brushstroke shapes of the technique, was provided by a student of Pentzikis, Dr. Menesidis, in an essay by Batsaras Thomas, a student of archaeology at the Aristotle University of Thessaloniki, which provided the numeric interpretations for these types of shapes (Figure 6).

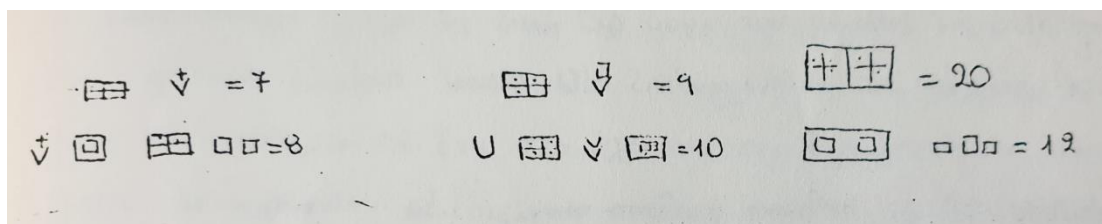


Figure 6: The rectangle shapes used for numbers 7 to 10 with the addition of 12 and 20.

This information provides insight into the potential approach utilized by the painter in question. As noted, the painter's utilization of square shapes in the "Simonopetra" artwork, as discussed in section 1.2 and seen in the painting "Transfer of the relics of Saint Bartholomew and other Martyrs" through the means of IRR technique, could serve as a fundamental element in his technique. The painter's statement regarding the utilization of different colors for these squares, although not distinguishable in either the visible or the IR spectrum, suggests that these shapes served as building blocks for the creation of more complex shapes in subsequent layers. Further investigation into this methodology with false-color IRR may prove valuable in deeper understanding the painter's technique and body of work as it has been used successfully for investigating the reflectance differences of pigments in different spectral bands [3, 17].

Moreover, the alphabet characters present in the middle of the cells comprising the grid pattern of the third artwork are open to multiple interpretations, some of which may be symbolic or linguistic in nature. It is possible that these characters represent the initials of the individuals depicted in the artwork or may have been used to indicate a particular order or sequence. For instance, the letter "Δ" may refer to the fourth letter of the Greek alphabet, or it may be associated with a specific day of the week, such as Monday, which is known as "Δευτέρα" in Greek. Similarly, the letter "Ε" may be associated with the fifth letter of the Greek alphabet or a particular day, such as Thursday which means the fifth day in Greek.

However, the precise meaning of these characters remains unclear, and there appears to be no observable pattern in terms of the use of specific colors or shapes corresponding to the letters within the squares. Further investigation and analysis may be necessary to shed light on the potential symbolism or significance of these characters within the context of the artwork and the broader cultural and historical context in which they were created. Lastly, a discernible shift in the color palette utilized by the artist is evident over the course of time, as can be observed by comparing two of the artist's works from earlier years, namely "Transfer of the relics of Saint Bartholomew and other Martyrs" (1969) and "Couple" (1975), with a later work, "Simonopetra" (1980). Notably, "Simonopetra" showcases a greater use of earthly colors,

which are reminiscent of the hues commonly employed in Byzantine iconography. It is worth noting that the artist's frequent travels to Mount Athos, where he visited 94 times by the end of his life [12], likely played a role in the influence of Byzantine iconography on his later works.

## Conclusions

Based on the previous information, it can be concluded that the unique technique of N. G. Pentzikis is a combination of traditional and contemporary methods, utilizing a blend of personal style, artistic vision, and mathematical analysis. His process involves converting sacred texts and names into numerical values, which he then assigns colors to base on his desired symbolism. The resulting layers of color are depicted through his signature brushstrokes and geometric shapes, reflecting the central theme of his artistic vision and creating a distinct representation of the metaphysical world.

The infrared reflectography was proven to be a valuable tool for revealing the early stages of the psifarithmisi in two of the three artworks, "Saint Bartholomew and other Martyrs" and "Couple". In these artworks' reflectograms, rectangular shapes were revealed in oppose to the "Simonopetra" which didn't have a similar pattern.

Additionally, the iTomography platform, capable of an efficient in-situ analysis utilizing the technique of IRR, has been useful in evaluating the layering technique of the subjects in question.

Its portability, has enabled the measurement of artworks to be conducted within the museum environment, without the need for the artwork to be moved from its designated location. Moreover, the ability to conduct precise measurements at the same point has facilitated the creation of an accurate representation of the artwork, through image registration where the IR reflectogram data and the diffuse visible light image data of the artwork can be transformed into one coordinate system using an algorithm, where in this case, the cross-correlation algorithm [18, 19]. This level of precision is particularly important for the analysis and study of artworks, as it enables researchers to obtain reliable data that can be used for further analysis and interpretation. It is important to note that the use of the iTomography platform has helped to streamline the measurement process, allowing for data to be obtained quickly and efficiently. This is particularly significant for



large projects, where the traditional methods of measurement can be time-consuming and costly. By utilizing this innovative technology, the process of data acquisition can be expedited, thus freeing up time and resources that can be allocated towards further research and analysis.

### List of Abbreviations

Infrared Reflectography – IRR

Fourier Transform Infrared Spectroscopy – FTIR Spectroscopy

PB – Pigment Blue

PG – Pigment Green

PO – Pigment Orange

PR – Pigment Red

PW – Pigment White

PY – Pigment Yellow

### Declarations

#### Availability of Data and Materials

Due to data ownership by the “ORMYLIA” Foundation, no data is publicly available for this study.

#### Competing Interests

The authors have no relevant financial or non-financial interests to disclose.

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