



## MOLAB Access

### MOLAB User Report

**Project Title: Terahertz Imaging of a Concealed Wall Painting at the Church of St Gregory the Great, Morville, Shropshire, UK (TIMOR)**

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**Venue:** Church of St Gregory the Great, Morville, Shropshire, UK

**Report text:** 1-2pages (*This report will be made public*)

The aim of the project was to locate and image concealed wall paintings in the 12<sup>th</sup> Century Church of St Gregory the Great. During renovation work in 1842, a painting had been discovered under whitewash on the inside of the south wall of the Church. A description and sketch of the painting exist in a book from 1859 (Rev. G.L. Wasey, *Our Ancient Parishes, or a Lecture on "Quatford, Morville and Aston Eyre 800 Years Ago"*). There had been two separate paintings, one above the other, the most recent consisting of a series of figures around 4 feet (1.2 m) high. The painting had subsequently been covered again with whitewash and, possibly, plaster. The account in the book is the only surviving record of the painting, although it is ambiguous with regard to its location on the south wall.

Over the period 29<sup>th</sup> June – 4<sup>th</sup> July, a team of researchers from MOLAB worked with the user group to carry out terahertz (THz) imaging, stimulated infrared thermography and digital holographic speckle pattern interferometry (DHPSI) within the church in an attempt to locate and image the wall painting. This was the first time that these three techniques had been used together and an additional outcome of the project was an evaluation of the complementarity of these techniques in this context.

THz imaging is capable of producing images of paintings that have been covered by layers of plaster and whitewash and, because it is based on the generation and detection of ultrashort pulses of THz radiation, time of flight information contained within the received signal can be used to distinguish between signals from different layers within walls. However, with current technology, the THz image acquisition process is relatively time consuming and only small areas of wall can be imaged within a reasonable time, making the technique impractical for surveying large areas of wall in situations where the location of a painting is uncertain.

Thermography and DHPSI were used in an attempt to overcome this limitation. While these techniques cannot provide direct images of concealed paintings, they can provide valuable clues of their location. In addition, as voids, cracks and delaminations within a wall can result in optical artefacts that can degrade a THz image, both thermography and DHPSI were used to identify these features within the imaged area to enable them to be removed from the THz image.

Extensive measurements on the western, central and eastern parts of the south wall, to both sides of the south door, were made using all three techniques. Additionally, further measurements were made in an



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area adjacent to an exposed area of 13<sup>th</sup> Century fresco on the north wall, to provide a reference for processing data from elsewhere in the church.

Good agreement was seen between all three techniques, indicating areas with structural defects and deterioration and other areas which were more solid and devoid of features. It had been thought that regions coloured pale brown in the sketch in the 1859 book might represent regions in which patched repairs to the wall plaster had been carried out and that these might be detectable. However, no clear indication of these regions could be seen using either thermography or DHSPI.

Nevertheless, DHSPI indicated a high degree of localised anomalies in the central area of the south wall. While, these anomalies could indicate structural defects, they could also indicate the existence of a processed, more elaborately structured subsurface layer, such as a painted layer. An added layer of colours used to generate a painted surface is expected to age and deform differently to other layers of pure plaster, producing interference patterns similar to those observed. This finding was corroborated by observations of similar patterns in the area adjacent to the exposed fresco on the north wall. Both the thermography and THz measurements also indicated these areas to be of high interest.

While some exploratory THz measurements were made in other regions, the terahertz imaging was concentrated in these high interest areas on the south and north walls. The presence of up to three internal layers within the wall, each with a thickness of around 700  $\mu\text{m}$  times the refractive index of the layer material, was detected in these areas. The visibility of these layers varied across the imaged regions, which would be consistent with the presence of localised areas of pigment within the concealed wall painting. Although the presence of voids needs to be discounted, there was some indication of a continuation of the leaf motif seen in the exposed fresco on the north wall into the adjacent area.

These measurements, together with the presence of small regions of exposed pigment where covering plaster has chipped off, are strongly indicative of the central region of the south wall as being the location of the concealed wall painting. On this basis, it now seems clear that the statement in the 1859 book that the fresco “was discovered on the inside of the south wall on the right hand side of the porch” refers to the portion of the south wall that is *on your right* as you *enter* through the south door. In contrast, the portion of wall to the right of the south door *as seen from inside the church* was found to be devoid of features using all three techniques, with no indication of an underlying wall painting. However, it should be noted that there was an extra thick layer of plaster on some portions of this wall, which could obscure weak signals from underlying painting. That this is the correct location of the painting is further corroborated by scale information from the 1842 sketch. Unfortunately, the addition of wooden roof supports added after 1842, during the introduction of a clerestory, will have destroyed some areas of the painting, although the measurements indicate that other areas remain.

In the coming months, further data processing will be carried out in an attempt to extract images of the concealed wall painting from the terahertz data, some of which will necessitate the development of new image processing techniques. In addition, detailed correlation between the different techniques employed will be used to assess their complementarity and to confirm the findings. The results will be published in the scientific literature in due course, will contribute to conservation decisions for the Church Building Trust and feed into the Church’s 900<sup>th</sup> anniversary celebrations in 2018.