March 18, 2025
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THE ART NEWSPAPER

Conservation
Feature

How technologies applied in Florence are revolutionising fresco conservation

Traditionally, checking for damage was a manual job, but a combination of diagnostic technologies used in the restoration of the Brancacci Chapel offers much greater precision

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18 March 2025

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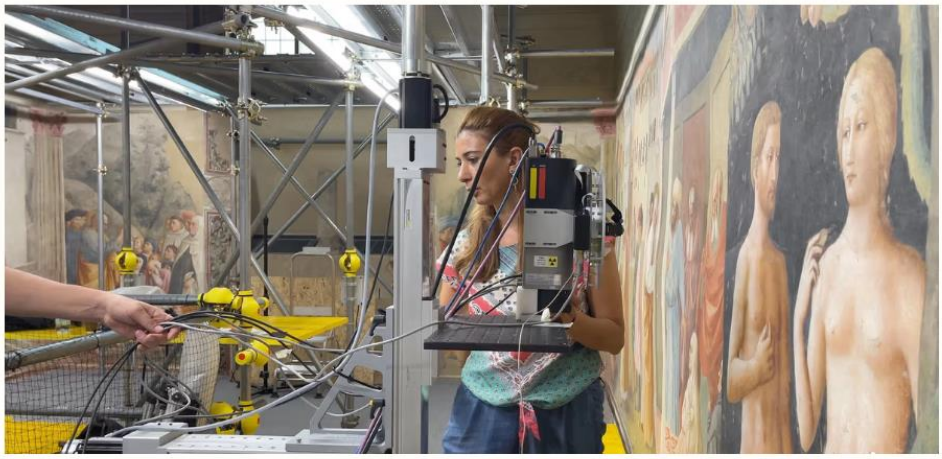

A conservator works on a section of fresco in the Brancacci Chapel using non-invasive technologies to discover and analyse vulnerabilities in the work
Photo: courtesy the National Research Council

One of the first tools that Alberto Felici, a restorer at the Superintendency of Archaeology and Fine Arts of Florence, used to assess the frescos in the Brancacci Chapel was his hands. Working methodically, Felici tapped the painted surface, letting small vibrations and muffled sounds hint at damage beneath the art.

This work guided Felici on how layers of the fresco—from the painted surface to the plaster to the arriccio, or second coat of plaster—were adhering to or detaching from the wall. It is a good first assessment that indicates weak areas, he says. Care was needed, given that a small

fragment painted by Filippino Lippi in the late 15th century had previously become detached—a signal that this inspection was necessary.

"But there is an issue at this point," Felici says. A restorer must be able to understand if damage "is ongoing, if it is something that happened one year, one week, or the day before. This is impossible with this assessment," he says.

This tap test, with its hands-on interaction with the art and intrusive scaffolding to access works in the vaulted ceilings, is a manual and highly subjective process. Experts like Cristiano Riminesi, a researcher at the National Research Council's Institute of Heritage Science, agree it could be improved by more data.

"Although detachments are often recognised by the tap test, this method is time-consuming for larger areas, and its accuracy of execution and interpretation is too discretionary and subject to the individual skills and experience of the restorers," he says.

Finding non-invasive techniques

Working with Felici, Riminesi's group looked at how a combined use of several portable, non-invasive tools could bring a scientific approach to condition reports that guide conservation by restorers such as Felici.

The Brancacci Chapel in the church of Santa Maria del Carmine in Florence is home to masterworks by the early Renaissance painters Masolino, Masaccio and Filippino Lippi. In its 600-year history, the chapel has endured structural changes, a devastating fire in 1771, and significant conservation efforts to restore the paintings or to reverse previous interventions—as in 1990, when over-paintings of leaves on Adam and Eve from the 1600s and an egg-based lacquer were removed.

This current project was initiated in November of 2020, when, in a routine check-up, the surface deterioration was discovered. Many organisations supported the restoration process, including the City of Florence, the Superintendency of Archaeology, the Opificio dell Pietre Dure, and Italy's National Research Council Institute for Cultural Heritage. The conservation project was funded by Friends of Florence and the Jay Pritzker Foundation. The work was completed in 2024 and the chapel remained open to the public throughout the process with the addition of elaborate scaffolding and a temporary elevator.

For conservators, one of the most concerning aspects of a fresco's condition is the presence of cracks, cavities, detachments or other structural defects, many of which are below the surface and invisible to the naked eye. Riminesi's group investigated how information from three specific modern technologies can be combined to explore the subsurfaces and analyse their condition with scientific precision.

The technologies—digital holographic speckle pattern interferometry, microwave reflectometry, and infrared thermography—are known in the conservation world for their advanced

diagnostic capabilities. Non-invasive and highly transportable, their set-up is reminiscent of an elaborate photo shoot with lamps, signalling and receiving devices perched on tripods, laptops and other equipment.

Optical and microwave

Riminesi's group brought these systems into the chapel and ran tests using optical and microwave technologies. They focused part of their analytical work on a detached area in Masolino's depiction of *The Healing of the Cripple and the Raising of Tabitha* (1424-28).

The section features a male figure painted in what restorers refer to as a *giornata*—an area of a fresco prepped, painted and allowed to dry in a single day. Even if the artist worked to blend them seamlessly, these areas are marked by edges that can be perceived, sometimes visually or with these advanced technologies. Their distinct size and overlapping patterns provide historians with insights on the artistic process. This one has been of concern at least since the 1990s.

The initial data gleaned from the new technologies suggested that the mortar behind the male figure was becoming thin. Riminesi then returned to the lab and created mock-ups of cracks, cavities and other wall defects and assessed them using the same technologies. By comparing these results, the restorers were able to refine the initial broad assessment of "unstable" to a more precise analysis of the area's vulnerability down to the millimetre.

Long-term, Riminesi says, these tools "may offer to conservators and restorers the crucial possibility to localise, characterise and classify the stability of defects, directly on-site and non-invasively on whole areas."

New insights

Beyond their diagnostic capabilities, the technologies are also providing new insights into the art and the artistic process.

"Some of these new findings are so surprising for us that we are still evaluating them," Felici says.

These advanced imaging devices have enabled the researchers to see details lost to the human eye and have revealed unexpected findings about palettes and fresco techniques. Felici explains that conventionally, artists work in dry or wet plaster conditions, using paints and pigments specific to each process. What the data showed were previously unknown textural features in the picture layer and a richer colour palette.

"What we have assessed, after this very in-depth investigation, is that the differences between these two main techniques is not so precise," Felici says. "The painters were able to manage the environment of mortar in a more complex and more complicated way."

The researchers plan to share these and other findings at a conference in April 2025 and apply this knowledge to ongoing maintenance of the frescos.

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