Inverse Problems Symposium 2025

Name: Filippo de Monte Organization: University of L'Aquila

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Authors: Hai Zhang, Filippo de Monte

Solar Loading Thermography as a Non-Destructive Testing Method for

Cultural Heritage Artifacts

Hai Zhang ¹, Filippo de Monte ²

¹ Centre for Composite Materials and Structures (CCMS), Harbin Institute of Technology, Harbin 150001, China ² Department of Industrial and Information Engineering and Economics, University of L'Aquila, L'Aquila, 67100, Italy

Thermal radiation, emitted by all objects with a temperature above 0 K, occurs via electromagnetic waves generated by the molecular or atomic movements within a body. Radiative heat transfer requires no intervening medium, travels at the speed of light, and remains unaffected in a vacuum. This mechanism allows the Sun's energy to reach the Earth [1].

This study explores the application of Solar Loading Thermography (SLT) as a non-destructive testing (NDT) method to detect natural degradation and fabricated defects on two artifacts: a painting on canvas and an ancient book. Solar radiation, used as a natural thermal source (passive thermography), minimized the risk of artifact degradation compared to pulsed excitation typical of active thermography.

Optimal observation periods were identified by determining the artifacts' effective surface temperature, influenced by relative humidity, temperature, and irradiance, to maximize thermal contrast between defective and non-defective zone [1].

For the painting, analysed in summers 2022 and 2024, setups included tensioning cables to suspend it in front of a window and a wooden support to minimize mechanical disturbances. For the book, investigated in winter, spring and summer 2024, setups included an L-shaped tripod and a wooden support, with and without lateral restraints. The acquired thermal images by a FLIR T1020 thermal camera were cropped using a MATLAB script before analysis.

Environmental vibrations introduced noise for thermal images of the book, which was mitigated through a stabilization process. The setup without clips proved most effective for defect identification. For the painting, thermal imaging successfully revealed most fabricated defects on both the front and back of the canvas [2].

This research based on SLT has demonstrated its effectiveness as an NDT technique for identifying surface and subsurface defects in precious artifacts, with minimal degradation risk.

Acknowledgements

This work was supported in part by the Italian Ministry of University and Research (Grant No. PGR02110). The authors also thank the Ministry of Foreign Affairs and International Cooperation (Italy).

References

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