

Work Package: Upgrading and recovery of mural painting assets in Piedmont: the problem of reliability and durability of the media.

NUMBER: 4

TITLE: Upgrading and recovery of mural painting assets in Piedmont: the problem of reliability and durability of the media.

RESPONSIBLE: ALESSANDRO SCHIAVI

STARTING MONTH: 1

ENDING MONTH: 29

DESCRIPTION: Thermodynamics Division at INRiM (National Research Institute of Metrology) performs since many years a wide activity of acoustic and ultrasonic measurements, with applications in traditional fields, such as calibration of transducers, architectural acoustics, noise, and in innovative areas such as applications of ultrasound in medicine and metrology of mechanical properties by measuring speed of sound in fluids and solids. These experiences can be easily extended to the experimental techniques used in other applications, including the preservation of cultural heritage, in particular as regards the integrity of frescos.

For this kind of investigations a sound empirical method, based on the application of a slight stroke of knuckles on the area to be tested, is still widespread. This technique requires manual skills, but it can only provide qualitative results. Recently some instrumental non-invasive methods have been proposed, in particular adapting techniques used in the non-destructive testing area. The most common methods are:

- thermal imaging, based on detection, often using photoacoustic or photothermal techniques, of the different response of detached or intact zones to thermal waves;
- ultrasonic methods, where the diagnosis is based on the sound speed difference determination between areas with air in it and solid areas;
- the laser vibrometry technique.

The methods listed above, however, are often difficult to implement experimentally, particularly in situ.

Some authors have proposed easier experimental realization using pure acoustical methods, based on the determination of sound absorption coefficient of a local structure. The basic principle is that the acoustic wave reflected by a rigid and uniform surface is very different from the one scattered from a stratified area, in particular if one of the layers is made up of air. For the measurements in place the most suitable excitation is a short acoustical impulse, and the detection algorithm is based on appropriate analysis of the signal, such as "Cepstral analysis". Alternatively, the sound absorption coefficient can be determined, also in situ, adapting a rectangular duct in which standing waves are generated, to the frescoed surface. The behaviour of frequency response is analyzed for each area of the fresco where the duct is located.

The implementation of a technique for assessing the status of a fresco by measuring the sound absorption coefficient is described in the following points:

- measurement of sound absorption coefficient of a reference sample using the technique of standing waves, using a method which is traditionally used in acoustical measurements;
- realization of an experimental apparatus for the implementation of the measurement by using the method of "Cepstral analysis" and verification on the same reference sample;
- realization of a rectangular duct adaptable to fresco surfaces and validation of performance on the reference sample;

•Comparison of “Cepstral analysis” and rectangular duct techniques, operating in real situations.

OBJECTIVES: Thermodynamics Division at INRiM (National Research Institute of Metrology) performs since many years a wide activity of acoustic and ultrasonic measurements, with applications in traditional fields, such as calibration of transducers, architectural acoustics, noise, and in innovative areas such as applications of ultrasound in medicine and metrology of mechanical properties by measuring speed of sound in fluids and solids. These experiences can be easily extended to the experimental techniques used in other applications, including the preservation of cultural heritage, in particular as regards the integrity of frescos.

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ATTENDED RESULTS: 1) To provide an innovative and non-invasive method of investigation of the state of the frescoes conservation.

2) Provide a qualitative and quantitative map of the surface condition of the frescoes under investigation.

Participant to the Work Package: Upgrading and recovery of mural painting assets in Piedmont: the problem of reliability and durability of the media.

AGENCY PARTICIPANT: (Istituto Nazionale di Ricerca Metrologica) I.N.Ri.M.

STARTING MONTH PEOPLE ACTIVITIES: 1

ENDING MONTH PEOPLE ACTIVITIES: 29 **PEOPLE/HOURS ACTIVITIES FOR PARTICIPANT:** 840

TOTAL PEOPLE/HOURS OF ACTIVITY Upgrading and recovery of mural painting assets in Piedmont: the problem of reliability and durability of the media.: 840