



COMMUNICATING THE VALUE OF KNOWLEDGE: “VENUS AND MARS” WHISPERING TO OUR SENSES



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The Context: *Experimentation - Participation*

The Territory

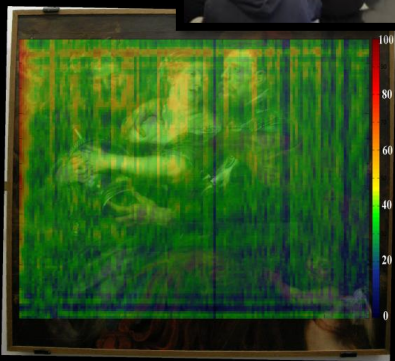
Re-interpreting the territorial aptitude

Venus and Mars by Pieter Paul Rubens (1632-1635)

The acoustic imaging technique

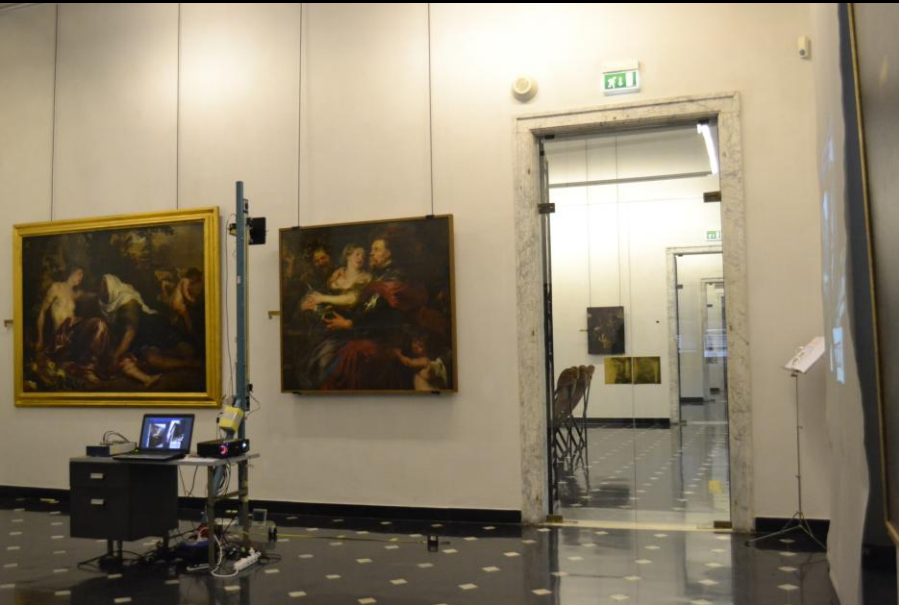
The experimental results

Conclusion





The Context: *Experimentation - Participation*



In the Strada Nuova Museums, one of the major oil paintings hosted in Palazzo Bianco Gallery, *Venus and Mars* by Rubens, was analysed on site in its standard location, for identifying its current state of conservation after a number of restoration interventions and the installation of controlled microclimate

(<http://www.museidigenova.it>)

... involving the visitors during usual museum exhibition time:

an opportunity to transmit an extended knowledge regarding both the cultural patrimony and the scientific advancement in the conservation process





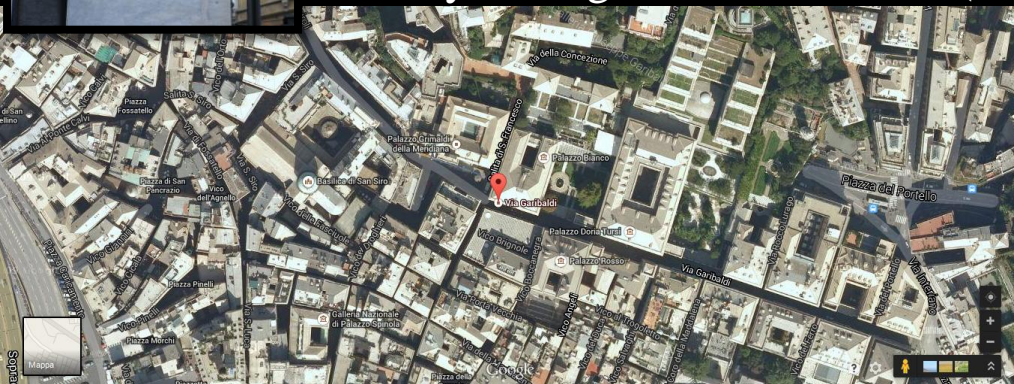
The Territory

The legacy of the Genoa Territory finds its major expression in the tradition of the Strade Nuove and the Palazzi dei Rolli

UNESCO World Heritage Site since 2006 as the first European modern system of unitary urban architecture (<http://www.rolliestradenuove.it>)

Renaissance and Baroque palaces representing the financial power of the Republic of Genoa, with an urban plan defined by a public authority. They belonged to official lists (called Rolli) and were chosen to host state visits and exponents of the international culture

... a model of a finely distributed hospitality for the promotion of the culture, the economy and the patrimony of an entire territory





Re-interpreting the territorial aptitude



The traditional hospitality of the *Palazzi dei Rolli* revives nowadays in a new and more extensive hospitality for the promotion of the scientific culture

The Genoa Science Festival generates an intensive participation of the whole city

All the activities are distributed throughout the city hosted in historical buildings and museums



... answering to the public's curiosity towards
 “the science around us”



Re-interpreting the territorial aptitude

Art and Science

in a field experimentation participated by both the professionals of the CH domain and the visitors

... promoting a new form of art fruition, not separated from the diagnostic activity or the conservation process, offering to anyone a deeper interaction with the artworks



As the value of such masterpieces resides in the ability to penetrate history, the employment of scientific tools is able to penetrate their tangible aspects,

letting these objects become fascinating *story tellers* that unveil the hidden tracks that time has left on them



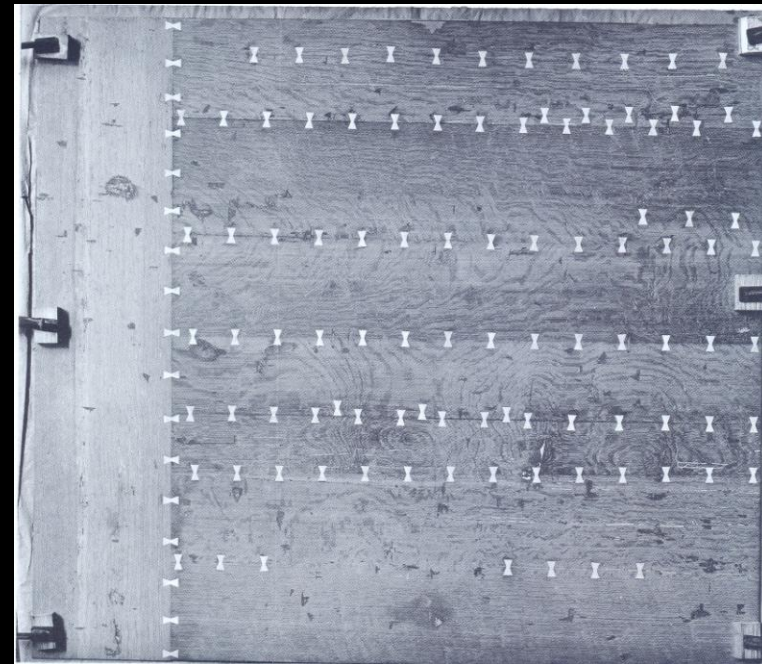
Venus and Mars by Pieter Paul Rubens (1632-1635)



Initially inventoried as “Lansquenet with his Sweetheart”
 (*Corpus Rubenianum Ludwig Burchard*)
 and only recently in terms of mythological subject

(Cordaro et al., ICR, 1985)

oil on panel
oak substrate
142 × 133 cm²
thinned (3.5 mm)
heavily cradled



The support presents four horizontal boards and a vertical one having grain running normal to the first; the arrangement of the boards thus denotes a high sensitivity to possible change of the environmental parameters.



Venus and Mars by Pieter Paul Rubens (1632-1635)

The painting undergoes, for unknown reasons, a reduction of 60 cm in the lower part



The Duchess of Galliera donated her entire private collection of paintings and the Palaces to the Municipality of Genoa



Venus and Mars by Pieter Paul Rubens (1632-1635)

Restoration interventions: between 1909 and 1939 only partial restorations are carried out. The major interventions are later:

1952-55 – the chestnut cradle is removed, disclosing the actual arrangement of the support. Butterfly inserts and a new oak wood structure are placed. Surface conservation is accomplished.

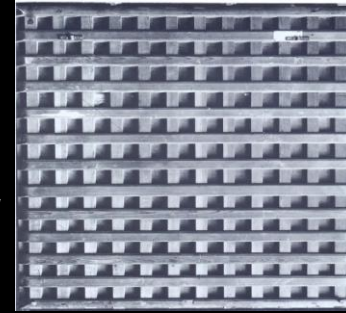
1965 – constraints by the new cradle are present, substituted by a third one in pitch pine, guaranteeing independent movements of the vertical board with respect to the other ones.

1981 – relative humidity as low as 23% is revealed in some rooms of the Gallery.

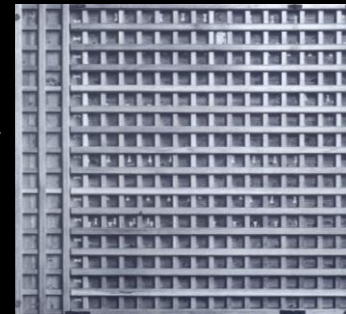
1981-84 – restoration realized by the Istituto Centrale del Restauro. The substrate is treated for infestation (gassing) while the cradle is left unchanged. Although it is not completely adequate, it is considered in equilibrium with the thinned panel, and the risks due to its displacement are avoided. Surface conservation is accomplished.

Reverse with the cradle structures

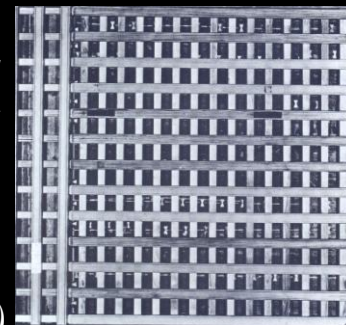
*chestnut wood
up to 1951*



*oak wood
1952-55*



*pitch pine wood
1965-66*



(Cordaro et al., ICR, 1985)



The acoustic imaging technique

The Acoustic Energy Absorption Diagnostic Device reveals sub-surface cavities behaving as a selective acoustic absorber (mass - air spring system)

mass - air spring system

$$f_0 = \frac{1}{2\pi} \sqrt{\frac{k_{air}}{M}} = \frac{c_0}{2\pi} \sqrt{\frac{\rho_0}{\rho_s t d}}$$

fundamental resonance frequency

in multilayer structures by measuring, on site, the acoustic absorption coefficient extracting the impulse response $h(t-\tau)$ of the analysed surface and scanning the surface using a non contact setup



For each analysed point the result is expressed in terms of:

$$\Sigma_i = \int_{\text{TimeWin}} |h(t-\tau)|^2 dt$$

the amount of total reflected energy Σ_i

$$\text{ABS}\%_i = (\Sigma_R - \Sigma_i) / \Sigma_R$$

the absorption percentage ABS%

with respect to the most reflecting point Σ_R



The resulting images can be also analysed in the frequency domain

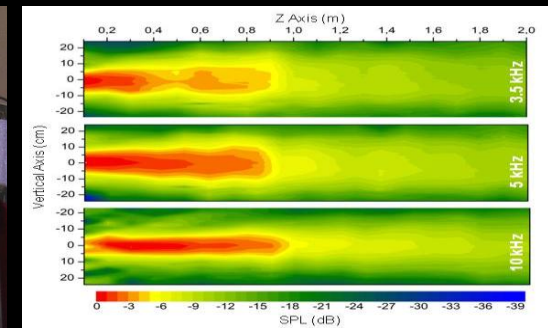
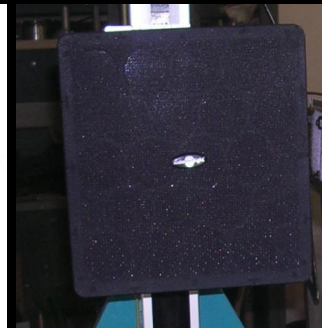
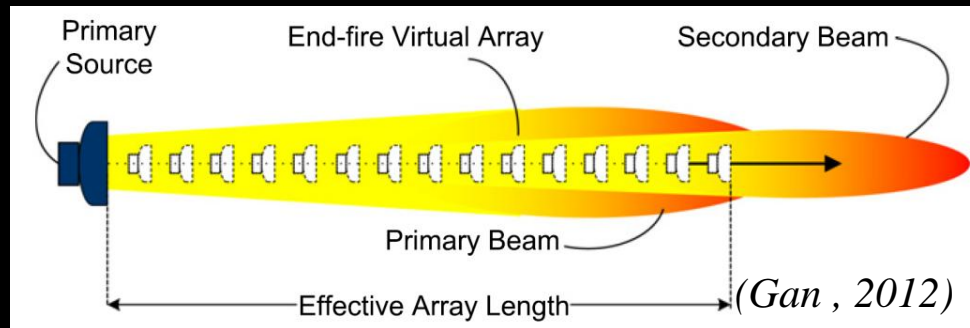


The acoustic imaging technique

The acoustic imaging system is presently equipped with an innovative acoustic source, the parametric acoustic array PAA, showing a great potential in on site non-destructive applications thanks to its small size and its high beam directivity

The PAA generates audio frequencies in air by emitting ultrasonic waves modulated in amplitude, based on the nonlinear propagation of finite-amplitude waves.

The ultrasonic primary beam generates a *linear array of virtual sources*: the secondary beam with low (audio) frequency is less attenuated and presents a directivity pattern as narrow as the primary beam



(Calicchia, Di Marcoberardino, De Simone, Marchal, 2014)

(Calicchia, De Simone, Di Marcoberardino, Marchal, 2012)



The experimental results

Measuring conditions: $T = 22^{\circ}\text{C}$, $\text{RH} = 56\%$

Wide band signal: (4 – 16)kHz

Analysed area: $(1.36 \times 1.1) \text{ m}^2$

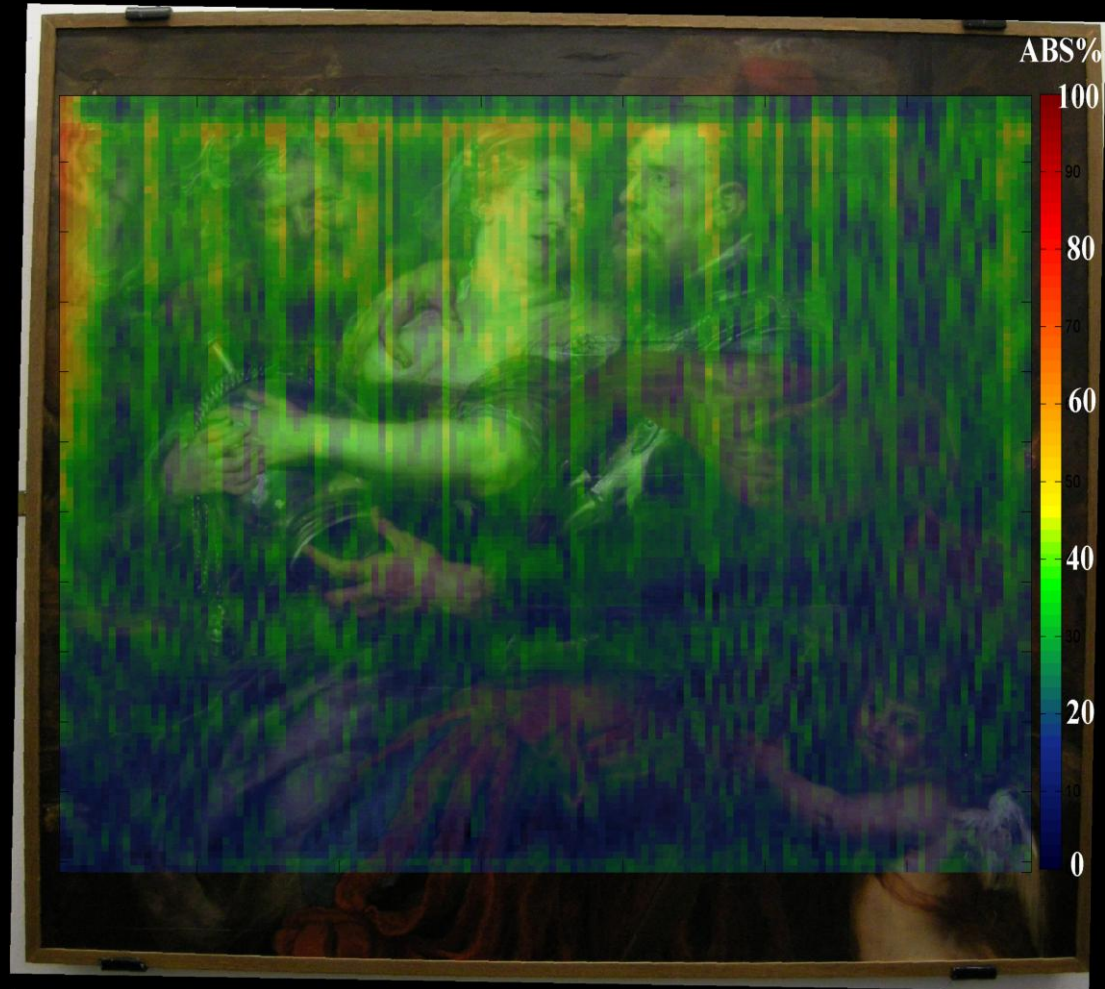
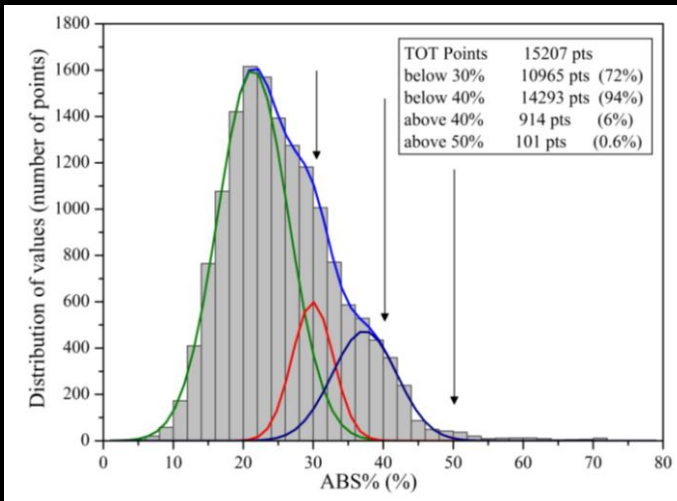
15207 analysed points

Repeatability test on a small portion,

compared with results from laboratory test

Post-processing to obtain a suitable accuracy

(Σ_1 distribution with σ equal to 6%)





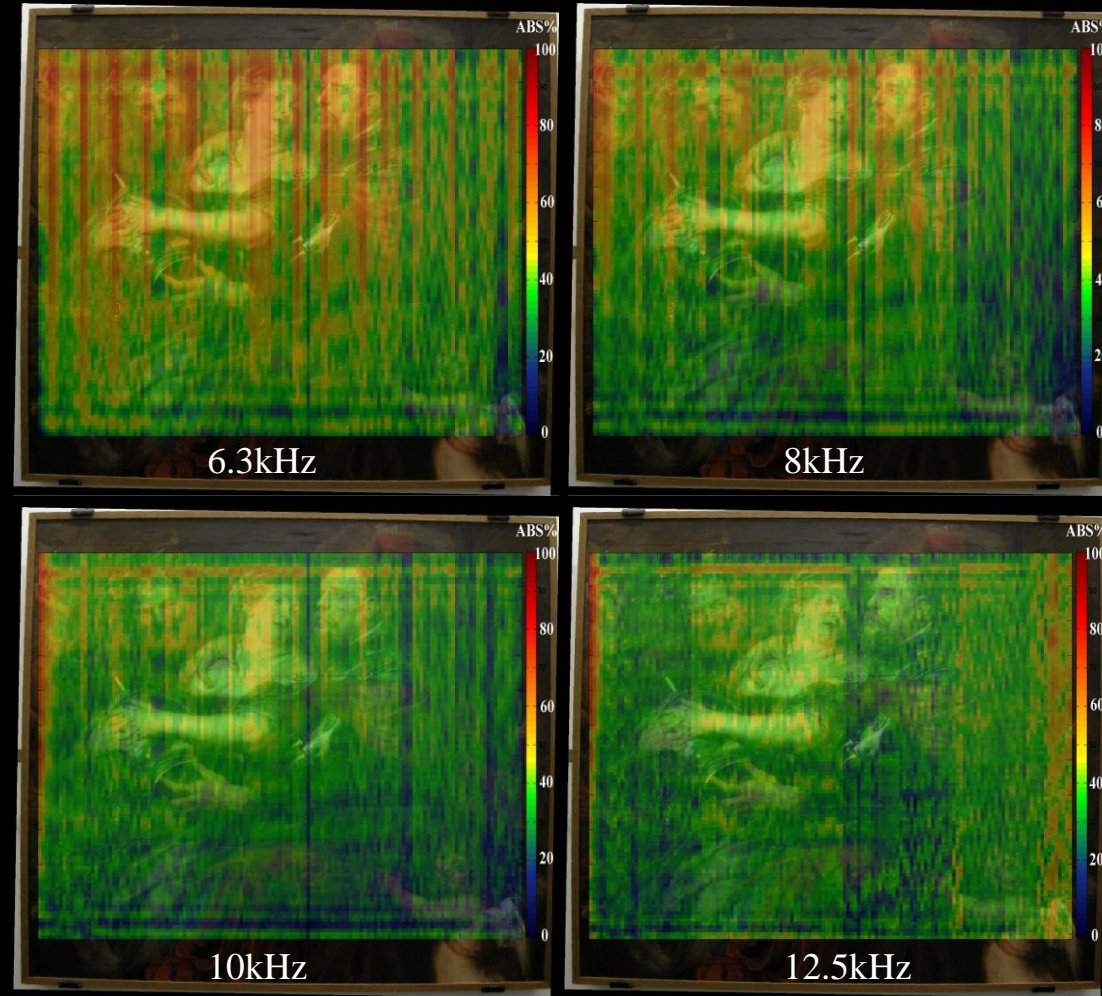
The experimental results

Frequency resolved acoustic images (the frequency is expressed as 1/3 octave bands)

A weakness in the upper half of the panel emerges, disclosing an unexpected periodic structure.

Question:

is it an effect due to the cradle structure? ()*

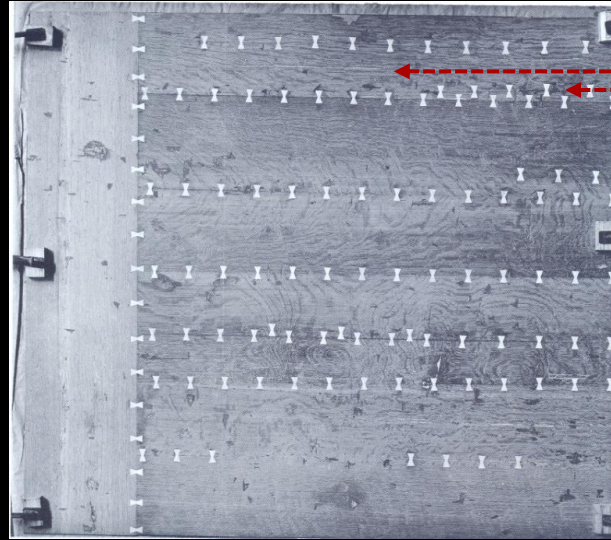


As frequency shifts towards higher values, the narrow horizontal flaw in the upper board becomes more and more evident

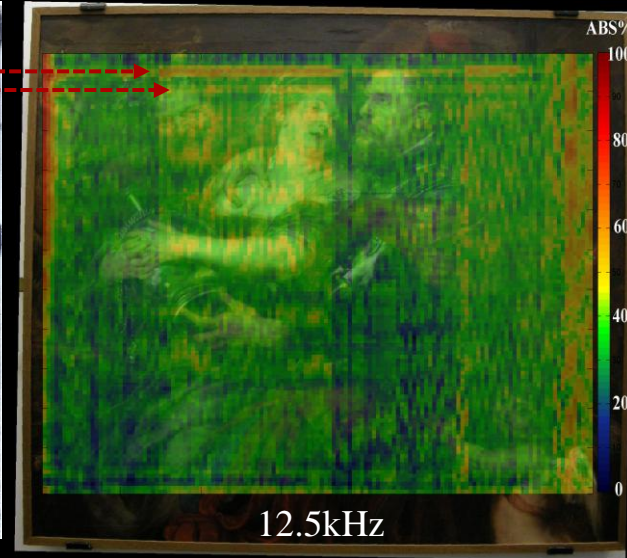
(*) Panel Paintings Initiative of The Getty Foundation
<http://www.getty.edu/foundation/initiatives/current/>



The experimental results



(Cordaro et al., ICR, 1985)



Observing the reverse of the panel, the most damaged portion corresponds to a flaw inside the upper board between the two lines of butterfly inserts

This defect slightly appears in the photograph taken during the '50s but, on the basis of the present investigation, it can be assumed that the deterioration process in this area is becoming more significant



Conclusion

From the technical point of view ...

- the acoustic imaging system conjugates a low cost equipment and a great flexibility for diagnostic investigations on site, avoiding to move the artwork and helping the monitoring
- the study confirms a relatively good state of conservation of the *Venus and Mars*, but a structural weakness in the upper board may require periodic test in the future
- the defects of the wood support may be discriminated by those of the pictorial film by studying the acoustic images in the frequency domain

With this experience we intend to promote ...

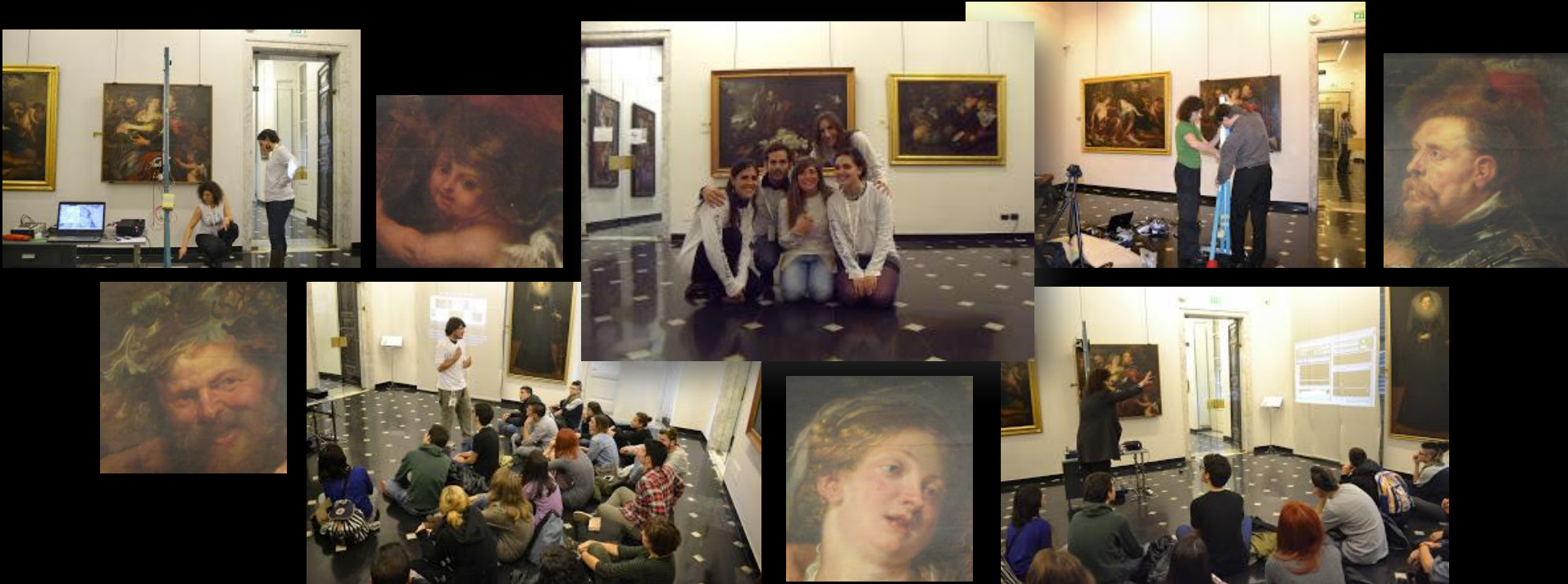
- the diagnostic activities and the conservative practices as part of those cultural assets that need to be conveyed to the general public
- a new form of art fruition, not separated from the diagnostic activity or the conservation process, offering to anyone a deeper interaction with the artworks
- the enhancement of the public awareness regarding the synergy between Cultural Patrimony and Science, representing a great potential for the human experience, adding dimensions to the traditional perception, knowledge and interpretation of an artwork



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... and all the visitors who shared with us this exciting experience

THANK YOU FOR YOUR ATTENTION!