

Innovative diagnostic models of artefacts: the case study of Michelangelo's Pietà Rondanini

Cristiana Achille¹, Lucia Toniolo^{2*}, Gianluca Valentini³, Valentina Capogrosso³, Francesco Fassi¹, Sara Goidanich², Davide Gulotta², Alessandro Mandelli¹, Sara Mosca³, Austin Nevin⁴

¹ Politecnico di Milano, Department ABC, Piazza Leonardo da Vinci 32, 20133 Milan (Italy).

² Politecnico di Milano, Department CMIC, Piazza Leonardo da Vinci 32, 20133 Milan (Italy). +390223993042, lucia.toniolo@polimi.it (*corresponding author)

³ Politecnico di Milano, Department FIS, Piazza Leonardo da Vinci 32, 20133 Milan (Italy).

⁴ CNR-IFN, Piazza Leonardo da Vinci 32, 20133 Milan (Italy).

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In order to make an exhaustive survey of the Michelangelo's sculpture before its displacement in the new exposition room - the restored "ex Ospedale degli Spagnoli" - at Castello Sforzesco in Milan, a complete relief of the Pietà Rondanini was carried out to test and define innovative techniques of multi-digitalizing for the documentation and enhancement of Cultural Heritage. The goal of the survey is the creation of three-dimensional models of the Pietà in scale 1:1 aimed at geo-referencing the diagnostic and at monitoring the activities and results.

The sculpture surface was monitored since 2002, before and after the cleaning operations carried out by Dr. S. Vedovello (CBC Coop., Rome, Italy) in 2003-04 [1]; the evolution of the colour parameters over time was studied together with the state of conservation of the marble substrate in the years 2004-2015. Specific pilot areas were selected to monitor the different soiling phenomena, according to the finishing and orientation of the marble surface, by means of VIS spectrophotometry and digital microscopy. Multispectral Imaging of some of the pilot areas was carried out to assess the conservation state of the most critical parts affected by formation of *patina* and colour alteration. Some *patinas* were also monitored by Raman portable spectroscopy.

The 3D models were generated from the data of photogrammetric survey (images) and data acquired by structured light scanner¹ (range image). In a previous phase, some survey tests were performed both with photogrammetric approach and with a structured light scanner [2]. The objects of the survey tests were hand-made artifacts of different dimensions: from smaller ones, such as single body parts of statues, to whole sculptures. The aim was the definition of digitalization models, survey parameters, sensors, acquisition geometries and calibrations considering the characteristics of the objects and the surrounding environments. In fact, the results are mostly influenced by the texture of the artifacts, the dimension, the lighting conditions

¹The instruments are produced by Open Technologies, Rezzato Brescia, Italy

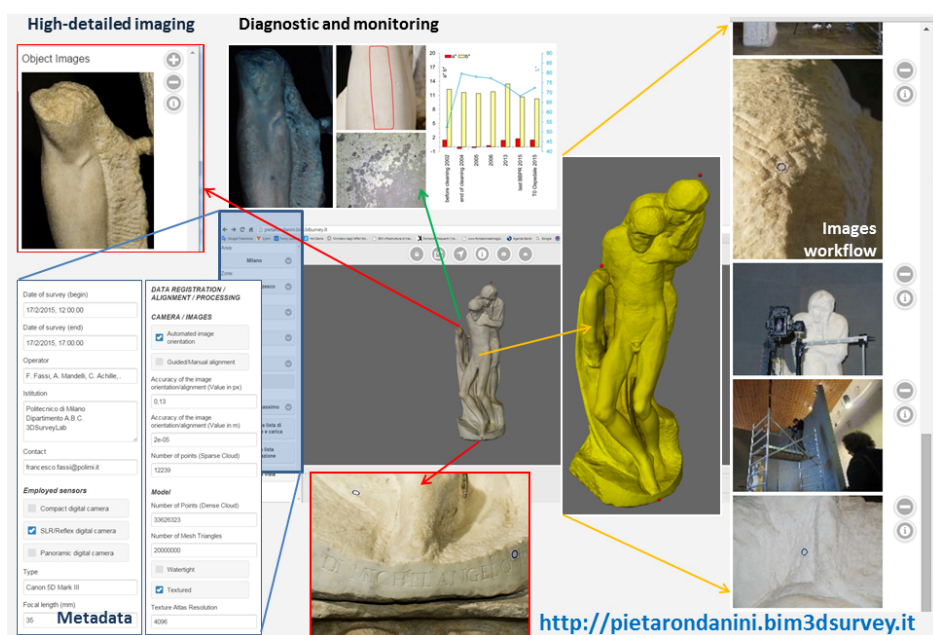
and the available time. The outcomes of the tests give some precise indications regarding the strategies to adopt in order to obtain digital models at 1:1 rendering scale. The obtained results suggested how to proceed to survey the whole statue applying the consolidated pipeline and the same working method in order to produce a high-detailed, accurate and complex 3D model of Pietà Rondanini. The models achieved through photogrammetric and scanner approaches were compared in order to validate the workflow and the results. The alignment of the models was possible thanks to some well-distributed targets on the surface of the sculpture. The scale of the photogrammetric model was acquired putting into the scene three different calibrated bars with a precision of hundredth of a millimeter. The circle, non-coded targets were automatically recognized both by the software of the scanner and by the photogrammetric one. The coordinates of the centers were sampled autonomously from the range-images model that was used as reference.

The obtained 1:1 scale model, integrated by the diagnostic and monitoring data, can be considered an effective and user-friendly tool for the activities of the different professionals involved in conservation and valorization: art historians, conservators and experts. Consultation via web (<http://pietarondanini.bim3dsurvey.it>) certainly contributes to spread the information and simplify the access to a complex of data which generally cannot be easily consulted by the scientific and public community.

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References

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Workflow for the implementation of the diagnostic model of the Pietà Rondanini