

LABORATORY: CNR-ISPC

NAME OF THE INSTRUMENT

X-Ray Digital Radiography developed at XRAYLab of CNR-ISPC

GENERAL DESCRIPTION

Digital radiography (DR) is an advanced imaging technique widely used within museums, with prime application on canvas and panel paintings. DR is particularly useful to qualitatively identify the materials, evaluate the state of preservation, to learn about the creative process of the artists and the techniques they used. Given its no-contact and not invasive nature, DR is exceptionally suited to investigate fragile and delicate works, such as for example paintings.

To obtain the radiography image the sample is illuminated by a not -collimated X-Ray beam, produced by a medium-power laboratory tube, so that the irradiated spot has linear dimensions of several centimeters. The incident beam is absorbed differently by the different layers of the sample, according to their thickness and density, thus producing a grey-scale image on an appropriate sensor situated behind the sample. The employment of detectors with wide active area (digital flat-panels of roughly 45x35cm² active area in the system of ISPC-CT) allows the acquisition of the radiography of a wide area of the sample in a single take and in reduced times (few tens of a second). In the case of large-scale artworks, several frames can be recorded in a mosaic-like pattern and the full image is later reconstructed by an automatic stitching software.

Synthetic guide for choosing the X-Ray Digital Radiography method of ISPC

Materials: inorganic materials with a high degree of opacity.

Optimal application: paintings on any support (except frescos), including large sizes (in stitching mode), (quasi) planar works in metal or wood.

Sample positioning: vertical.

Type of analysis: non-destructive and in-situ

Measuring times: variable, depending on sample size. Typically, less than a minute per single take (area of 43x35cm² or 46x38 cm² according to the detector used).

Active signal resolution: 2816 x 2304 pixel

Pixel Matrix: 2816x2304 or 2560x3072 pixels.

Pixel size: 154 or 140 microns.

Characteristics and parameters of the X source: Teledyne CPD160 tube, 160Kv e 6mA, Be or Al filters with different form factors.

Beam spot: a few centimeters.

Detection system: (a) Teledyne GO-SCAN 4335, aSi flat-panel, 43x35cm², 2816x2304 pixels, pixel size 154 microns or (b) VIVIX-S 1417N, aSi flat-panel, 2560x3072 pixels, pixel size 140 microns.

Gray-scale depth: 16 bits.

Data interface: GigaE or WI-FI

Frame rate: typically, 0.3sec

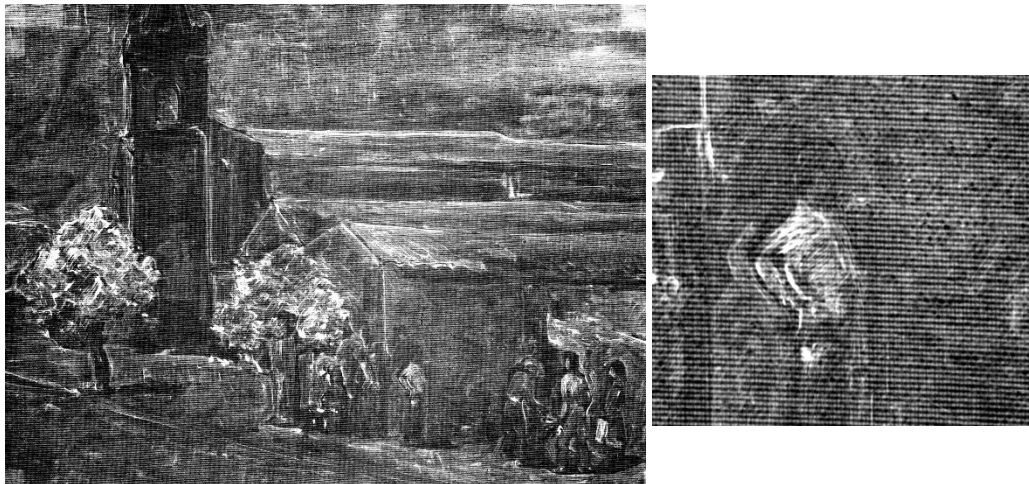
Security: as per usual for all X-ray based methods. The measurements take place following the prescriptions of the qualified radioprotection expert, in appropriate premises with thick walls.

TECHNICAL DESCRIPTION

The DR (digital radiography) system of the laboratory XRAYLab of CNR-ISPC comprises an X-ray source with maximum operating parameters of 160kV and 6 mA, equipped with filters of different shapes (circular and rectangular) in either Be or Al. The exit beam has angles of 60° and 40° in the Y e X directions, respectively.

The radiography acquisition is performed by two flat-panel detectors in amorphous silicon of active area 43x35cm² or 46x38cm², and pixel-size of 154 micron and 140 microns respectively. The radiography of works of larger sizes is acquired in successive frames, with the aid of an Al frame of 200x180cm² placed behind the painting, and the resulting mosaic is then assembled by a stitching software at the end of the measurements.

The two flat-panel detectors can operate with Giga-Ethernet or wi-fi interface and are equipped with a battery of up to 8 hours autonomy (which enables operation even in those cases where a direct connection to the electrical network is not available). The measurements take place with the sample positioned between the X-Ray tube and the detector, with typical distance between the source exit and the screen in the order of 1.0-1.5 meters. In the case of paintings on canvas, the X-Ray tube is routinely operated at 30kV and 6mA, with exposition times between 30 and 60 seconds. The frame rate of the available detectors is in the range of 0.3 seconds, and their grey-scale dynamic range is of 16 bits. The whole system is operated remotely through a laptop.



Radiography of a modern painting of size 60x40cm², and detail acquired in 30s at 30kV and 5mA

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