

# Futurist painters – Interdisciplinary research on written sources, artists' materials and paintings

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**ABSTRACT**

A three-year interdisciplinary project entitled FUTURAHMA – From Futurism to Classicism (1910–22). Art History, Painting Techniques and Material Analysis unites art historians, conservators, chemists and physicists and aims to explore the creative process, materials and conservation. A combination of in-situ imaging, non-invasive analysis of paintings using mobile instrumentation, the study of reference materials from artists' archives and

**INTRODUCTION**

The Futurist revolution marks a crucial moment in the history of art in a period defined by rapid and radical technical innovations. Although there have been various studies on the Futurist movement since the 1950s, painting technique still remains a significant and generally unexplored area (Pugliese 2002 and 2006). The understanding of the painting techniques adopted by the Futurists – who had at their disposal a range of novel and complex materials – is important for the appreciation of the expressive decisions made by artists, for the conservation and treatment of works and for the more precise definition of the cultural and historical context in which they worked and painted. This paper presents the three-year interdisciplinary research project entitled FUTURAHMA – From Futurism to Classicism (1910–1922). Art History, Painting Techniques and Material Analysis, funded by the Italian Ministry of Education, Universities and Research. It examines the analysis of paintings by Vittore Grubicy de Dragon, from the Collezione Benvenuti-Grubicy at the Fondazione Livorno, using the multidisciplinary approach which forms the basis of the project.

**THE FUTURAHMA PROJECT**

Within FUTURAHMA, the technical analysis of paintings and painting materials and the interpretation of results rely on the close collaboration between art historians, conservators and conservation scientists. Archival and scientific research is being carried out in parallel. The project will focus on the Futurist movement in the period between 1910 and 1922 and cover art history, painting materials, the study of paintings and the application of novel analytical techniques. The project, coordinated by the University of Pisa, also includes four Italian research groups and is uniquely interdisciplinary. Two institutions, the University of Pisa and the Scuola Normale Superiore of Pisa, have art-historical expertise and researchers focus primarily on the assessment of written sources and archival materials, as well as on the interpretation of the analysis and imaging of paintings. Art historians and painting conservators are working together in the selection of case studies of important paintings and collections; they are working to collect information related to the analyses of the paintings and to study their treatment history through

historical pigments, and the careful assessment of primary sources forms the basis of the project. As a case study of the methodology employed, selected results from a wide non-invasive campaign of measurements performed within the present project at the Benvenuti-Grubicy Collection (Fondazione Livorno, Italy) are shown. To facilitate research and exchange, an online resource has been created for sharing data among partners and to disseminate results to the community in the future.

the examination of past condition and treatment reports in museum archives, and the close examination of the painting surfaces in situ. The participation of the Opificio delle Pietre Dure (OPD, Florence) in the project is essential for the study of paintings in situ, for the interpretation of results and for the assessment of the conservation and degradation of the paintings and the materials studied.

Scientific research as part of FUTURAHMA is being carried out in parallel by research groups from the Italian National Research Council (CNR) – the Institute of Photonics and Nanotechnologies (CNR-IFN), the National Institute of Optics (CNR-INO) and the Institute of Molecular Science and Technologies (CNR-ISTM) – which together focus on the development of instrumentation, the analysis of materials in the laboratory, and the application of non-invasive instrumentation in situ. CNR-ISTM has focused on the analysis of materials of art-historical interest for many years and has developed a multidisciplinary approach based on complementary analytical techniques which comprise conventional laboratory equipment and innovative portable non-invasive instrumentation (Miliani et al. 2010). CNR-INO and CNR-IFN bring expertise in development of novel instrumentation and in-situ applications based on infrared scanning, fluorescence lifetime imaging, and fluorescence and multispectral imaging analysis (Daffara et al. 2010, Comelli et al. 2012). These groups are complemented by the University of Pisa – the Department of Civilizations and Forms of Knowledge, which is in charge of conducting photographic campaigns, and the Department of Chemistry and Industrial Chemistry, which is responsible for the micro-destructive analyses of laboratory samples and artists' materials (tubes, palettes, etc.) for the determination of the organic materials present in varnishes and paint.

National and international institutions are also involved with the purpose of the exchange of specific expertise and/or for the inclusion of paintings from collections in the project. Museums which are associated with the project include the Pinacoteca di Brera and the Museo del Novecento (Milan), the Galleria Nazionale d'Arte Moderna e Contemporanea (Rome), the Palazzo della Penna (Perugia) and MART (Museo d'Arte Moderna e Contemporanea di Trento e Rovereto), the Estorick Collection (London), the Nardondi Galerie (Prague) and the Hermitage Museum (Saint Petersburg).

### **ARCHIVAL RESEARCH**

Research on written sources focuses on careful examination of published works and manuscripts in both private and public collections. Starting from the programmatic manifestos, the research examines the artists' correspondence, published volumes and journals and historical treatises of painting techniques read, copied, commented and written by the Futurists. Among the historical studies of painting materials, central themes for archival research are the transition from Divisionism to Futurism, the coherence between programmatic writings and painting practices, the dialogue between Cubism and Futurism in terms of working methods, choice of pigments, materials and media, the international circle and influences of Futurism, and the adoption of methods for laying out and planning the use of space.



Figure 1

Analysis using transportable instrumentation in situ at the Benvenuti-Grubicy Collection of the Fondazione Livorno, Livorno, Italy



Figure 2

Researchers examine historical palettes at the Benvenuti-Grubicy Collection

Archival research has been conducted both on Vittore Grubicy de Dragon's papers at the archives of MART and on the materials from Grubicy's atelier conserved in the Fondazione Livorno, and has focused on Grubicy, a painter and critic, a theorist of the Divisionist movement and an influential figure in Milan until 1920 who was particularly concerned with issues of materials and techniques. The context of the turn-of-the-century literature on techniques is represented by Gaetano Previati's texts, Jean Vibert's book *Science of painting* (1891) and other coeval treatises read by Divisionist painters and the young Futurists, as is documented by Umberto Boccioni's notebooks. The debate that developed in specialized magazines which targeted painters and amateurs (*Cronaca d'Arte* at the beginning of the 1890s, *Arte e artisti* in the first decades of the 20th century) is also examined and can be considered contextually with Grubicy's publications and correspondence. These writings highlight his trials of industrially synthesized pigments and Vibert varnishes, as well as his role as a promoter of the French firm Lefranc, which is confirmed by the predominance of paints, tubes and varnishes bearing the Lefranc trademark in his studio.

Within this context, the FUTURAHMA group is examining the Lefranc archives to assess the relationships with the artists and Italian retailers, and the synthesis and introduction of new pigments and paint media. In order to examine the artist's working methods and to better understand the relationship between his writings and his painting techniques, a non-invasive diagnostics campaign has been carried out on Grubicy's paintings and his atelier's materials. The outcome of this research, based on the analysis of the materials from Grubicy's atelier, of his paintings, writings and letters, will be published in 2014 in a thematic volume funded by the Fondazione Livorno.

### SCIENTIFIC INSTRUMENTATION AND METHODOLOGY

The scientific investigations of paintings and painting materials are carried out by exploiting a non-invasive multi-technique and multi-analytical approach based on the combined use of both imaging and point analysis portable instruments (Figure 1). A key aspect of FUTURAHMA is the integration between imaging, photographic documentation and point-like analyses. Advanced imaging techniques (photography in raking and diffuse light, in retro-illumination, multispectral imaging, UV-fluorescence imaging and fluorescence lifetime imaging, x-radiography and multispectral infrared reflectography) can provide information on the composition, preparation and underdrawing, the presence of *pentimenti* or modifications in painting, the distribution of surface treatments and the spatial distribution of general classes of materials, but rarely can they be used to identify specific materials.

Analyses during the project have been carried out both in the laboratory and on samples prepared by the Opificio delle Pietre Dure, on materials from artists' archives and studios, and on paintings in situ within museums and collections, as shown for the Collezione Benvenuti-Grubicy (Figure 2). The study of reference materials and palettes is crucial for the calibration and interpretation of data from in-situ analysis of real paintings, and is also fundamental for studying pigment degradation and pigment-binder



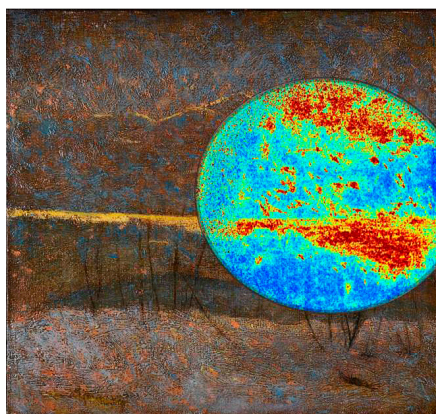


Figure 3

Vittore Grubicy de Dragon, *Dopo due giorni di nevicata a Miazzina* (1897), canvas, Benvenuti-Grubicy Collection

Figure 4

Fluorescence-lifetime imaging of *Dopo due giorni di nevicata a Miazzina* represented in false colour over an image of the painting, with shorter lifetimes seen in blue (10 ns) and areas which are associated with a long lifetime in red (50 ns)



interactions. The model approach is illustrated with examples of information which can be obtained through the integration of different non-invasive techniques which yield complementary information, with specific reference to analysis of the collection of paintings by Grubicy.

#### Analysis of model samples and pigments

The luminescence of pigments containing Zn and Cd has been studied in depth in order to determine the fluorescence-lifetime and fluorescence-emission properties of the pigments. For example, while pure ZnS commercially available today is not luminescent in the visible range, analysis of historical ZnS, which contains metal ion impurities, has identified the presence of inclusions which give rise to strong emissions which depend on the impurities in the sample. Cobalt was added to lithopone, for example, to improve its light fastness (Bacci et al. 2007). Phosphorescence emissions have been documented in historical Zn-based pigments which can be useful for the detection of the pigment in paintings (Nevin et al. 2013). In parallel, analysis of CdS and CdSe using picosecond-lifetime spectroscopy has indicated that the fluorescence of the pigment is strongly related to the intensity of excitation, and laser-induced fluorescence of semiconductor pigments may give rise to differences in emission based on different photo-physical properties (Cesaratto et al. 2013). Laboratory studies of these pigments are fundamental for the successful and useful application of time-resolved fluorescence spectroscopy and imaging in situ.

As part of FUTURAHMA, paint models have been prepared using pigments (including transition metal-based pigments containing Cr, Zn and Cd) and common organic binders which have been documented in the Grubicy atelier. The analysis of model paintings has focused on the detection of spectral markers to be considered for the in-situ study of Futurist paintings, as well as on the determination of the interaction between pigments and binders. Key questions regard the formation of Zn and Pb soaps, the degradation of amorphous Cd-based pigments and the fading of Cr yellows. These critical degradation phenomena are being studied using laboratory instrumentation as well as portable equipment, so that degradation can be better documented in situ.

#### In-situ analysis of paintings

The imaging of paintings in situ is the first step in analysis, and provides key information regarding the presence of heterogeneities on the surface of paintings (for UV fluorescence and fluorescence lifetime imaging – FLIM, and false-colour infrared imaging). For example, examination of the painting *Dopo due giorni di nevicata a Miazzina* (Figure 3) using FLIM highlights the presence of luminescence of areas of the painting with a lifetime of tens of nanoseconds. These areas are tentatively attributed to a Zn-based semiconductor pigment. The long lifetime is observed both in the yellow-coloured lake, as well as in the blue brushstrokes and highlights applied to the mountain and the sky (seen in the false-colour red FLIM image, Figure 4). This emission has a significantly longer fluorescence lifetime than that measured in other areas which have a fluorescence lifetime of approximately 10 ns, typical of varnishes (Nevin et al. 2009). While FLIM and other imaging techniques are useful for mapping differences



Figure 5

Reflection Fourier transform mid- and near-infrared analysis at the Benvenuti-Grubicy Collection; the instrument is mounted on a stable tripod

in composition, point-like analysis is needed for the identification of specific materials.

Chemical analysis with non-invasive methods includes the analysis of paintings and models using broad-range fibre optic reflectance and fluorescence, reflection Fourier transform mid- and near-infrared (mid-FTIR and near-FTIR), Raman, and x-ray fluorescence (XRF) spectroscopy. Analysis allows the identification of pigments and binding media, varnishes and the presence of surface treatments and repainting. The point-like investigation generally starts with XRF measurements carried out with the aim of revealing the atomic composition; in some cases, this analysis may provide information which is sufficient for pigment identification. When the elemental composition is not specific for the material speciation and when mixtures of pigments are suspected, further complementary molecular spectroscopies are exploited. Among them, FTIR in the near and medium infrared range is able to identify both organic and inorganic materials in paintings (Rosi et al. 2010, Miliani et al. 2012) (Figure 5). Regarding the inorganic materials, the technique is able to identify and discriminate among the different carbonates, sulphates, silicates and chromate-based pigments. As an example, the infrared spectra recorded from areas of blue hues in the painting *Dopo due giorni di nevicata a Miazzina* (1897) by Grubicy, shown in Figure 3, are reported (Figure 6). In Figure 6, the graph shows the vibrational mode of the cyano group in the mid-IR range at about  $2090\text{ cm}^{-1}$  linked to the presence of Prussian blue, which is found in the blue shades of the sky (Figure 6, left). In addition, near-infrared profiles also indicate the presence of Thénard's blue in the investigated areas of the sky (Figure 6, right). In contrast, the blue hues in the mountains are a mixture of Thénard's and cerulean blue, which were detected by XRF (indicating the simultaneous presence of cobalt and tin) and clearly identified by near-FTIR, which highlights the typical electronic spectral profiles of the two Co-based compounds (Rosi et al. 2007, Rosi et al. 2009). Zn is also identified with XRF, which supports the interpretation of FLIM data.

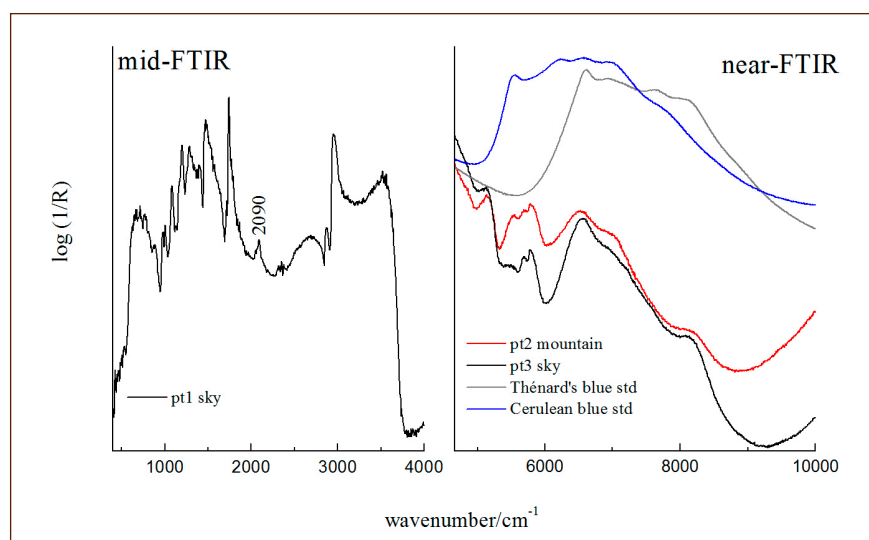


Figure 6

Reflection FTIR spectra acquired from the blue areas of *Dopo due giorni di nevicata a Miazzina*: (left) mid-IR profile recorded from the sky (the band at  $2090\text{ cm}^{-1}$  is assigned to Prussian blue); (right) near-IR profiles recorded from the mountain (red line) and from the sky (black line); for comparative purposes, the reference spectra from Thénard's blue and Cerulean blue are also reported

The infrared spectrometer is able to distinguish classes of traditional and synthetic organic binders: lipids, proteins, acrylics, vinyl resins and alkyds. Analysis of the same painting with non-invasive infrared spectroscopy revealed the presence of an oil-resin varnish applied by Grubicy in one of his later interventions; the multiple use of varnish and paint layers by the artist has been reported by Bestetti et al. (2005). Although generally during analysis the varnish layer may compromise the detection of original materials, as it is usually present as a surface layer and hence masks signals from binders and pigments, in the present case the identification of the main components of the varnish was one of the objectives of analysis. Further analysis of small samples using mass spectrometry coupled with gas chromatography at the University of Pisa will allow the precise identification of the components of the varnish and will be compared with commercially available varnishes and reference materials.

When the signals of surface organic materials hinder the identification of pigments and binders, an alternative technique which can be employed is Raman spectroscopy. It is generally employed for the identification of inorganic materials, as the use of different laser wavelengths may overcome the well-known competition with fluorescence. As an example, in the study of Grubicy's paintings, the use of Raman allowed the yellow pigment in *Veduta dal lago Maggiore* to be identified. XRF analysis revealed, among the different elements, the combined presence of lead, chromium and strontium, indicating the possible use of chrome yellow, namely lead chromate, and/or strontium chromate. In order to identify the yellow compound with certainty, Raman measurements were carried out in the yellows and confirmed the presence of strontium chromate.

### ONLINE WORKING METHODS AND DISSEMINATION

One of the main purposes of the research project is the sharing of data and information between the research groups. Computer scientists at the Scuola Normale Superiore created a Content Management System (CMS) in order to host and manage different kinds of data, such as textual sources and images (for example, the results of the research campaigns in situ). The CMS enables dialogue among the project participants thanks to the exchange of comments and data. Furthermore, it allows the integration of scientific and art-historical information, as well as discussion of questions related to specific paintings by different artists from a broad standpoint. The public website ([www.futurahma.it](http://www.futurahma.it)) containing data and images will be updated over the course of the project.

### CONCLUSIONS

The ongoing collaboration between scientists, art historians and conservators is crucial for the interpretation of results of the analysis within the context of the Futurist movement, and yields information of direct relevance for the prospective conservation of paintings by an important group of painters. Analysis in situ relies on the careful combination of molecular and elemental spectroscopic techniques following imaging analysis. The possibility of investigating several paintings by numerous Futurists, the access to archives and the study of historical documents provides a



unique opportunity for advancing the knowledge of this important but still relatively unknown artistic period, in terms of both technical art history and treatment. Forthcoming results of the project will be shared online.

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