MONITORING CULTURAL HERITAGE OBJECTS USING LASER AND OPTICAL 3D SCANNING

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The paper presents the results of experimental works devoted to the investigation of the possibility of applying 3D scanning technology for monitoring the state of preservation of historical and cultural monuments. Artifacts of history and culture, regardless of whether they are exhibited (in the open air or stored in museum collections), are gradually destroyed over time. This happens under the influence of adverse environmental factors, whose impact has increased significantly in recent decades due to a dramatic environmental deterioration. In this situation, regular monitoring of the state of conservation of artworks is becoming an increasingly urgent task in the field of preserving cultural heritage.

There were two objects of our study. Among are the marble sculpture of the mourner at the monument to A. Ya. Okhotnikov in the Necropolis of the XVIII century of the Alexander Nevsky Monastery in St. Petersburg and oil painting “Equestrian artillery company No. 13 barrages French columns during the retreat of the “great army” from Russia” (created by Russian artist P. Karyagin in 1912) with collection of the Military-Historical Museum of Artillery, Engineer and Signal Corps in St. Petersburg.

For scanning of the marble sculpture, laser triangular-type Konica Minolta Vi-9i scanner was used, which ensures the accuracy of measurements of the relief of the investigated surface at a level of 50-100 μm. The sculpture was scanned twice: before and after the completion of planned works for its restoration, which allowed modeling the change in the microrelief of its surface.

The painting was scanned using an optical 3D scanner Cronos 3D. The choice of this painting as an object of study was connected with the fact that its surface has a complex relief. This artist is characterized by the “volumetric” style of painting technique, which is manifested in the application of the paint layer by separate textured strokes of different thickness and width. It allows one to easily capture the 3D relief of the painting’s surface and track the changes of the paint layer’s state as the relief changes during the reference time interval.

It should be noted that the importance of monitoring the paintings is connected with the fact that defects in the paint layer usually occur at the “micro level”, and it is very difficult to detect them in a timely manner using photography (including high resolution one), which is traditionally used in museums to monitor the state of paintings. The scanning was carried out 2 times with time interval of 4.5 years. In
both cases we created computing 3D models of the same paintings, which then were
matched and compared using specialized computing software that gave information
about changes of the paintings.

Our studies have shown that both laser and optical 3D scanning can be recommended
for practical museum work as a highly accurate and informative method of
monitoring artworks. One of the most accurate criteria for changing the state of
preservation of sculptural monuments as a result of this type of monitoring is the
determination of the area of destruction of their surface. Another criterion by which
it is also possible to assess the degree of destruction of the monument during the
control interval of time is the length of cracks and chips on its surface. In case of
painting this approach to monitoring the artworks allows one to control the state of
the surface of the painted layer as well as the wooden frame with high accuracy
(fractions of a millimeter). Such information can be useful for the conservators of
paintings to decide on the need to change the conditions of storage and exposure of
paintings.