

Advancing Cultural Heritage Preservation: Non-contact 3D Acquisition and Image Restoration

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The primary objective of this research is to address the digital restoration challenges associated with small and ultra-small cultural heritage artifacts by developing a non-contact 3D acquisition system and image restoration technology. The proposed technology aims to fill the gaps in digital restoration, allowing for the preservation and analysis of cultural heritage items with dimensions of 10cm or less in width and height, and 3cm or less in thickness. The scope of cultural heritage includes both external and internal information, necessitating artifact-free and noise-reduced X-ray computed tomography (CT) image acquisition. For X-ray image acquisition and reconstruction, novel models and multi-layer ceramic capacitors (MLCC) were employed. The model, representative of actual cultural heritage structures, underwent X-ray imaging at 140kV and 0.5mA, capturing a total of 720 images at 0.5-degree intervals for 3D reconstruction. Additionally, MLCCs of similar dimensions to ultra-small cultural heritage artifacts were used to visualize internal cracks. Therefore, the X-ray CT technology developed in this study minimizes damage to cultural heritage while enabling the restoration of internal structures, manufacturing methods, functionality, and other information. This capability helps alleviate the constraints associated with traditional cultural heritage restoration techniques primarily focused on 3D cameras. The outcome of this research not only contributes to the preservation of small and ultra-small cultural heritage but also holds potential for application in cultural content creation and service technology development. The utilization of the proposed technology showcases its versatility and adaptability in enhancing cultural heritage conservation efforts.