6. Gaussian Splatting for the Documentation of Complex Architectural Environments: A Multi-Platform Sensor Comparison at La Scarzuola

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Three-dimensional documentation of architectural and landscape contexts characterised by high geometric complexity and rich surface detail poses significant challenges to traditional surveying methodologies. 3D Gaussian Splatting (3DGS), a volumetric representation technique based on Gaussian primitives optimised through machine learning, is emerging as a promising solution to simplify and accelerate documentation workflows while ensuring high visual and geometric quality. This contribution presents the case study of La Scarzuola (Montegabbione, TR), a visionary architectural complex designed by Tomaso Buzzi from 1958 onwards, whose dense layering of theatrical, sculptural and architectural elements makes it an ideal testbed for advanced acquisition technologies The acquisition campaign compared three workflows: XGRIDS PortalCam, a Stonex X120GO SLAM scanner coupled with Insta360 X5 panoramic imagery, and a DJI Matrice 4E UAV image-based workflow. The three 3DGS models were evaluated against an independent Leica RTC360 TLS reference using site-wide and local M3C2 analyses. Results show similar site-wide dispersion but clearer local differences, together with distinct trade-offs in workflow integration and processing flexibility, confirming 3DGS as a versatile technology capable of integrating heterogeneous sensor systems and delivering models suited both to immersive visualisation and to metric analysis in cultural heritage (CH) documentation.