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Comparative Approaches of Fast 360-degree Video-Based Survey of Inaccessible Heritage

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Abstract

Fast survey documentation of inaccessible environments often forces surveyors to choose between acquisition speed and geometric accuracy of digital databases. 360-degree panoramas go in the direction of this problem, as they can capture every visible surface in a single video, while the operator's movement through the space remains a variable factor. This paper explores whether changing the trajectory in a straightforward way has a practical impact on the final 3D record. The experiment was conducted in the cloister, church and upper and lower choirs of the abandoned Convent of Nossa Senhora da Saudação in southern Portugal. The instability of the site's structure leaves little tolerance for extensive fieldwork. Experience shows that a short, regular route is sufficient for a general overview, while a more complex route provides a richer description of recessed or highly decorated elements, despite longer processing times. Under artificial or evenly diffused light, the simpler route produces even better results because stable exposure eliminates many of the radiometric breaks that complicate outdoor footage. Therefore, this study provides the first practical recommendations: while path design is important, it can be adapted to suit the scope of the project. This enables 360-degree video-based photogrammetry to be used for tasks ranging from fast condition surveys to more detailed recording.

1. Introduction

Spherical imagery and 360-degree video have become essential tools for fast digital documentation, allowing a single operator to capture the complete visual environment of a space in just minutes. This capability is particularly valuable when working with fragile or inaccessible heritage sites (1), where conventional survey methods may be impractical. Recent research has demonstrated that individual frames extracted from panoramic video streams can support full photogrammetric workflows and achieve centimetric accuracy (Delis et al., 2017; De Marco and Parrinello, 2021; Fiorillo et al., 2024). However, these same studies also highlight challenges such as compression artifacts, stitching seams, and inconsistent lighting, all of which can impair feature matching and color consistency.

One important factor that remains underexplored is the influence of camera path geometry on the quality, completeness, and efficiency of 3D reconstruction. This study addresses that gap by investigating whether different acquisition trajectories, simple versus articulated, lead to measurable differences in photogrammetric performance. Specifically, does a more complex 360-degree acquisition path yield improved geometric completeness and fidelity, and at what operational cost, compared to a simpler trajectory?

To explore this question, field research was conducted on the medieval architecture of the Convento de Nossa Senhora da Saudação in Montemor-o-Novo (Southern Portugal), as part of the international training programme *Unveiling Medieval Monastic Dynamics. Traditional and Digital Approaches for Landscape, Architecture, Heritage (M_Dyn)*. The initiative, coordinated by NOVA University of Lisbon, in collaboration with the University of Pavia, the Polytechnic of Turin, The Cyprus Institute, and the University of Évora provided a multidisciplinary framework for field experimentation.

The article first traces panoramic photogrammetry’s shift from static images to 360-degree video, then introduces the Convent of Nossa Senhora da Saudação as the experimental site. It outlines the dual-path acquisition and processing workflow, compares the reconstructions for completeness, accuracy and cost, discusses how trajectory and lighting shape the results, and closes with practical implications and avenues for future work. The results, both qualitative and quantitative, contribute to theoretical and applied knowledge by clarifying the trade-offs between field efficiency and reconstruction quality. In this way, the study aims to support the development of optimized, path acquisition strategies for fast architectural documentation, especially in difficult-to-access historical contexts.

2. Panoramic photogrammetry in fast survey heritage documentation

Panoramic photogrammetry has become increasingly central in the documentation of cultural heritage, offering the ability to capture the entire visual envelope of a space with a single 360-degree exposure. This minimizes operator intrusion and reduces the number of required viewpoints. Proof-of-concept studies in interior and hypogeal environments have shown that spherical imagery can support metric survey tasks while relying on lightweight, handheld devices (Fangi, 2018; Pérez-García, 2024). When using static photographs captured with 360-degree cameras, the field phase is indeed faster than conventional Structure-from-Motion (SfM) workflows. Images must still be captured with adequate overlap to ensure robust tie-point generation, requiring the operator to follow a grid-like trajectory through the site. Field experiences suggest that, once these overlap constraints are respected, the total acquisition time approaches that of a traditional stop-and-shoot survey (Teppati Losè et al, 2021; Antinozzi, 2023; De Marco, 2024). Furthermore, post-processing is often complicated by stitching seams and compression artifacts introduced by consumer-grade hardware, which partially offset the efficiency gained from wide-angle coverage. These limitations have prompted a shift from simply accelerating acquisition to optimizing it. The pursuit of greater efficiency has recently turned to videogrammetry

(1) Inaccessible monuments refer to architectural or archaeological sites whose physical configuration, structural fragility or safety regulations prevent the installation of conventional survey equipment. A recent typological overview, with practical guidelines for selecting non-contact documentation methods in such contexts, is provided by Maietti (2022).

(Alsadik et al., 2015; Torresani and Remondino, 2019). By continuously recording at high frame rates, operators can traverse narrow passages or large volumes at walking speed, with each frame contributing a short, consistent baseline, sometimes every few centimetres. Studies in cloistered spaces have shown that this redundancy helps fill self-occluded recesses and preserves continuity across curved or complex elements (Sun and Zhang, 2019). Videogrammetry thus enhances surface completeness and reduces blind spots without the need for repeated stops. This gain comes at a cost. The large volume of extracted frames increases processing loads, making it impractical to align all images directly (Galasso and Picchio, 2025). Automatic frame selection is often used to reduce the number of inputs to the bundle adjustment process, but this can retain blurred or redundant frames, compromising reconstruction quality. Manual resampling is sometimes necessary to ensure that retained frames offer sufficient parallax and sharpness (Funtik and Mayer, 2021). Lightning adds another layer of complexity: with static panoramas, white balance and exposure can be manually controlled for each shot, especially when using calibration tools. In contrast, 360-degree video acquisition typically relies on automatic, per-frame adjustments of exposure, gain, and color temperature. As a result, sudden transitions between shaded arcades and sunlit courtyards cause visible shifts in tone and saturation, which can degrade dense matching and texture blending (Marcos-González et al, 2023). Despite these growing insights into the strengths and weaknesses of spherical imagery, the role of camera trajectory design remains poorly understood. Preliminary observations suggest that serpentine paths may better resolve occlusions around columns and capitals, while simpler perimeter walks suffice in less complex spaces. However, few studies have isolated the impact of trajectory geometry in a quantitative, controlled manner (Barazzetti et al, 2022). This knowledge gap is particularly relevant for inaccessible or fragile heritage sites, where field time is limited and efficient planning is essential. Operators need clear criteria to decide whether a more complex route is worth the additional time and computational effort. The present study addresses this question by comparing two contrasting closed-loop trajectories recorded under identical conditions, aiming to evaluate how path geometry influences the completeness, density, and operational efficiency of a 360-degree video-based survey.

3. The afterlife of the Convent of Nossa Senhora da Saudação

The Convent of Nossa Senhora da Saudação, located in Nossa Senhora da Vila (Évora), originated from an informal community of devout women who sought a contemplative life outside the formal structure of religious orders. In 1506, in pursuit of institutional recognition and spiritual alignment, they adopted the Rule of the Dominican nuns, formally entering the Order of Preachers. Construction of the convent likely began around 1502, shortly before this official affiliation. Over the centuries, the convent has undergone substantial transformations in both function and form (Fig. 1). Following the dissolution of religious orders in 1834, the site was repurposed as the *Asilo de Infância Desvalida* (Orphanage for Needy Children). The 1882-1883 renovations marked the first significant architectural adaptation: former monastic spaces were converted into kitchens, refectories, and service areas, reflecting a pragmatic overhaul to suit new social needs.

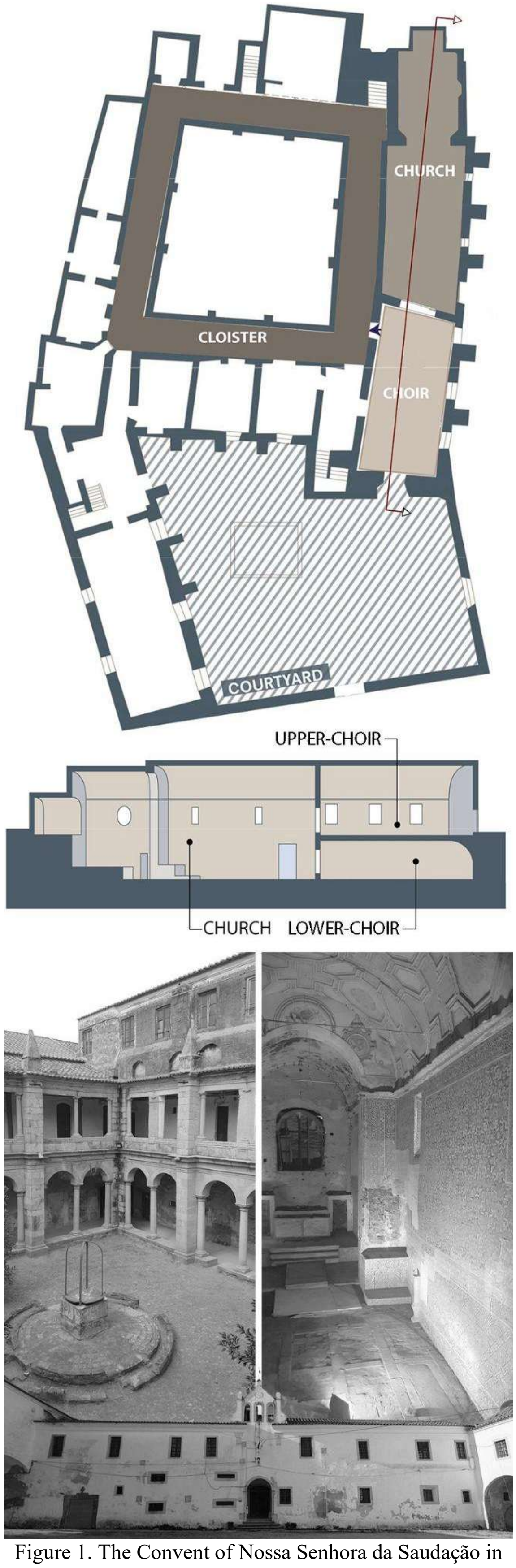

Figure 1. The Convent of Nossa Senhora da Saudação in Montemor-o-Novo, Portugal. Due to its inaccessible condition, the site is currently closed to the public and requires monitoring using fast documentation techniques of the cloisters and interiors.

Throughout the 20th century, the building experienced only localized repairs, until 1963, when administration passed to the Franciscan Missionary Sisters of Mary. By 1973, however, due to structural decay and declining viability, the institution ceased operations, and the convent was left abandoned. The ensuing decades saw widespread vandalism and material loss, including the deterioration of significant architectural elements and interior artworks. Conservation efforts began in the late 1990s. The Directorate-General for Buildings and National Monuments (DGEMN) issued a series of Risk Assessment Charters (1999–2006) identifying key vulnerabilities. In 2000, temporary occupation rights were granted to *Espaço do Tempo*, a transdisciplinary arts initiative led by choreographer Rui Horta. This marked a pivotal shift from institutional neglect to cultural reactivation. A subsequent public competition by the Portuguese Institute for Architectural Heritage (IPPAR) in 2005 proposed a permanent conversion into a cultural center (2). This goal was formally supported by zoning revisions ratified in the Municipal Master Plan (PDM) in 2007. Despite these initiatives, the convent remains in a precarious state. Structural instability is visible throughout the complex: dislodged tiles, detached masonry elements, and partial roof collapses threaten the integrity of key spaces, including the church and cloister. Some frescoes and architectural details are still discernible, but widespread material degradation and loss of spatial cohesion underscore the urgency of intervention. These constraints prompted the adoption of fast-survey methodologies and flexible digital workflows that can capture reliable geometric information while respecting the strict time, safety and access limitations of the site (Leon et al., 2020).

4. Digital approaches for fast survey of inaccessible heritage survey

The structural condition of the Convent of Nossa Senhora da Saudação makes it an ideal case study for testing fast and non-invasive survey methodologies. Its layered transformations – from monastic to civic to cultural use – combined with its current state of physical fragility, call for documentation strategies that are both efficient and sensitive to the site's complex historical fabric. The convent’s architectural layout, characterized by alternating open and enclosed volumes, offers a spatially rich yet technically challenging environment for evaluating fast-survey workflows. The increasing demand for quick and reliable heritage documentation has driven the development of digital tools aimed at reducing field time while preserving sufficient geometric accuracy for conservation and analytical purposes (Trizio et al., 2021; La Placa and Picchio, 2022; Parrinello and Picchio, 2023; Parrinello and Porcheddu, 2024). In this context, a fast survey should not be equated with low quality. Rather, it represents a deliberate methodological response to real-world constraints, designed to produce consistent and operationally useful documentation within tight timeframes (Galeazzo, 2024; Parrinello and Picchio, 2019). The methodological framework adopted at the Convento de Nossa Senhora da Saudação combined two fast-survey instruments whose operational profiles are well-suited to structurally fragile, partially inaccessible monuments: a handheld mobile laser scanner (Leica BLK2GO), capable of delivering an immediate (3) and a 360-degree video camera (Insta360 X3), whose continuous recording supplies an image stream dense enough for photogrammetric reconstruction without repeated stops. The fast survey campaign was built around a handheld mobile laser scanner because its simultaneous localisation and mapping capability provides an immediate, loop-closed point cloud (Fig. 2). This allows coverage to be verified in real time and acquisition to be completed in a single, uninterrupted traverse. This quick, minimally invasive process established a metrically reliable reference model while minimising on-site exposure. The high-resolution point cloud post-produced by the survey served as a spatial geometric reference database to test documentation strategies based on 360-degree video.

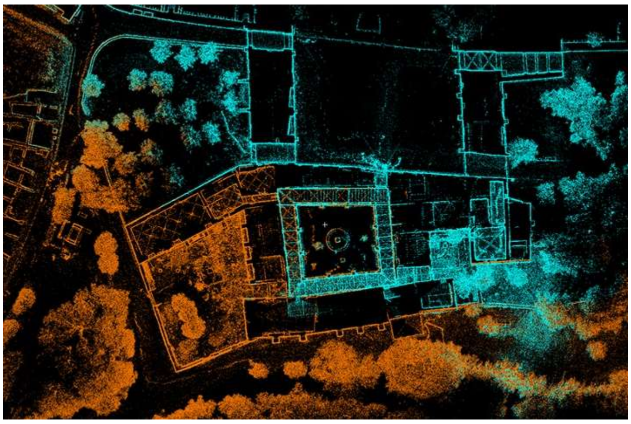

Figure 2. Above, fast survey operations with Leica BLK2GO Mobile Laser Scanner. Bottom, recording phase of two scans obtained because of closed loop acquisition.

4.1 360-degree survey outdoors: acquisition and processing

The cloister survey was structured around two distinct test scenarios, specifically designed to isolate the impact of path geometry on photogrammetric performance. Both acquisition sessions were carried out (4) on the same day under comparable lighting conditions, ensuring that the operator’s trajectory was the only controlled variable.

The first path, referred to as the linear path (L-path), followed a regular perimeter loop along the arcaded gallery at a steady walking pace. The second route, the spatial path (S-path), traced a double-crossing trajectory through the courtyard. This more articulated path was intended to generate a greater variety of oblique viewpoints and to bring the camera closer to elements such as capitals, mouldings, and intradoses that tend to remain partially occluded when movement is confined to the arcade (Fig. 3). Video durations differed only slightly between the two paths, approximately 7 minutes for the L-path and 10 minutes for the S-path, reflecting the additional distance covered in the latter. Frames were extracted at a uniform temporal sampling rate of 1 frame every 10 seconds (1/10 fps), yielding 750 still images for the L-path dataset and 812 for the S-path dataset. After an initial quality screening to remove blurred or overexposed images, the final working sets consisted of 707 and 756 usable frames, respectively (Table 1).

(2) These challenges are especially pressing in the rural Alentejo region of southern Portugal, where dozens of monastic complexes – often privately owned and difficult to access – are scattered across a wide and sparsely populated landscape. A recent inventory of 131 such sites revealed that nearly a quarter are either severely underused or entirely abandoned (Volzone et al., 2022).

(3) Leica BLK2GO Mobile Laser Scanner features compact form factor and 5/10 min acquisition cycles enabled a high-density, closed-loop point cloud of the entire cloister and its adjacent interiors during a single survey, providing the pragmatic combination of speed, safety, and metric reliability required by the project. For further study, see Dell’Amico and La Placa, 2019

(4) An Insta360 X3 spherical camera, recording in 5.7 K equirectangular format, served as the sole imaging instrument for both test routes.

Figure 3. Video-based acquisition activities in the outdoor environment through Insta360 X3 panoramic camera and L-path and S-path compared in the same convent cloister environment.

The device’s compactness and internal stitching make it ideal for confined heritage spaces, yet its interface provides no live map of the operator’s position or of the coverage already secured. This contrasts sharply with the BLK2GO mobile scanner, whose companion application displays the evolving trajectory and warns of gaps before the survey is completed. During the sinuous S-path the absence of real-time feedback led to a gradual drift in walking cadence. As the operator approached the closure of the loop, the forward motion accelerated imperceptibly, frame density fell below the target threshold, and the final five metres were covered by too few viewpoints to satisfy the convergence requirements of bundle adjustment (Fig. 4). When alignment was attempted, the remaining baseline proved insufficient to lock the start and end segments together, obliging the exclusion of the trailing sequence and leaving a narrow but measurable discontinuity in the model.
The limitation manifested differently along the linear perimeter walk. Here the operator traversed the arcade twice, so that complete coverage depended on maintaining a consistent offset from the cloister’s inner façade. Without an on-screen trace of the path, that lateral spacing could only be estimated by eye. The return leg was executed several tens of centimetres closer to the exterior balustrade than planned, reducing the stereo overlap with the first pass and relegating the innermost column faces to the extreme margins of successive frames. During dense matching these edge regions contributed few reliable keypoints, and the resulting point cloud displays a shallow data void along the internal face of the courtyard, an omission that would have been apparent had a real-time path monitor been available (Fig. 5).
The extraction density was selected according to criteria of image stability and total number of images, with the aim of ensuring a balance between quality and processing time. The derived set of frames was processed and optimised based on high-precision 3D metric data acquired with mobile laser scanners. The post-processing procedures also considered any differences in illumination, attempting to standardise the result through colour correction and blending algorithms.

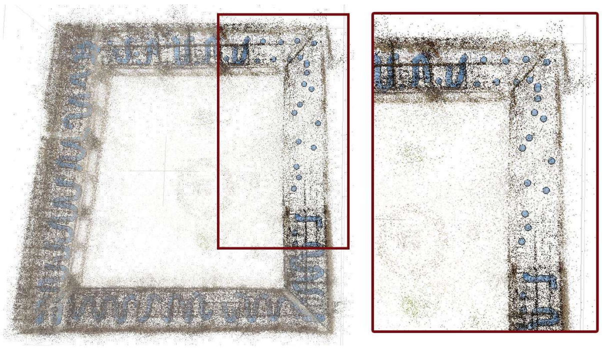

Figure 4. Without live feedback the operator accelerated subtly, leaving the last five metres with too few viewpoints to support dataset convergence.

Figure 5. View of the point cloud following photogrammetric processing from 360-degree panoramas, in which it is possible to see the lack of data at areas not affected by the survey.

Datasets were processed independently in Agisoft Metashape Professional following an identical pipeline. Photo alignment employed the high-accuracy preset with generic pre-selection disabled in order to maximise cross-matching; adaptive camera model fitting was activated to accommodate residual radial distortion characteristic of dual-lens stitching. A quantitative check on the internal calibration was performed by analysing the reprojection-error map produced after bundle adjustment. The field of residual vectors, colour-coded from blue (sub-pixel) to red (multi-pixel), confirms that the spherical model fits the imagery to within sub-pixel accuracy over the central two-thirds of the frame, where vectors remain short and largely isotropic. Errors grow radially toward the upper and lower margins (an expected consequence of the polar stretching inherent to the equirectangular projection) but reach their maximum along two vertical swaths that align with the stitching seams of the dual-lens camera (Fig. 6). In those bands the residuals exhibit a systematic outward orientation, signalling that the generic spherical camera model compensates the bulk of radial distortion yet leaves local mismatches introduced by in-camera fusion and compression.

Figure 6. Reprojection-error field after camera optimization. The vector field visualises the mean reprojection residual for each image cell, with colour shifting from blue (≈ sub-pixel) to red (several-pixel) and arrow length proportional to magnitude.

4.2 360-degree survey indoors: acquisition and processing

The interior campaign was designed as a complementary test to verify the behaviour of the 360-degree video-based acquisition under controlled artificial lighting conditions and under the severe logistical constraints imposed by an active construction site. Three architecturally distinct volumes were selected: the nave of the convent church, the adjacent upper-choir, and the barrel-vaulted lower-choir located beneath the choir. Debris, unstable flooring, and time restrictions imposed by the management of the construction site limited the duration of each visit to a single recording passage; consequently, the choice of trajectory was adapted to the morphology of each space rather than duplicated by experimental symmetry (Fig. 7).

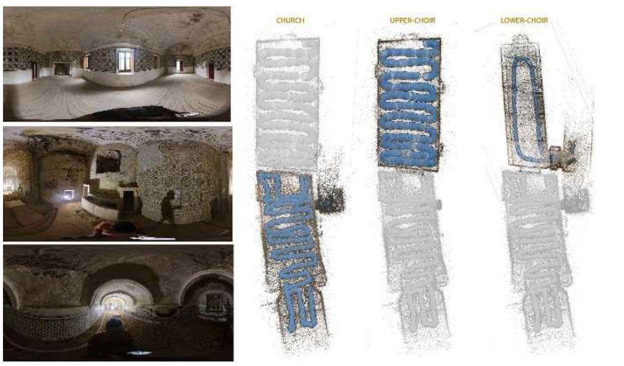

Figure 7. Acquisition of the rooms inside the convent. Given the impossibility of easy access to the area, potential routes were evaluated to accurately document as much as possible of the paths.

In the lower-choir, whose height barely exceeds 2.5 m and whose plan follows a single longitudinal axis, a perimeter walk would have offered little baseline diversity. An L-path was therefore adopted, keeping the camera halfway down the corridor and proceeding at a steady pace. A spotlight provided limited diffuse illumination that did not properly suppress the shadows cast by the operator onto the low barrel vault, but the slow walk allowed the camera's automatic exposure settings to stabilize along the way.

The church and upper-choir have a significantly higher vertical extension, reaching 10 meters in the first room and 7 meters in the second. To maximize the coverage of the sidewalls and the parallax of the ceiling in a single passage, an S-path trajectory was created, running along the nave. In the case of the church, a spotlight was used to illuminate the room, causing sharp shadows and dark corners, offset by a slow walk. In contrast, the presence of large windows provided soft light in the choir environment, allowing operators to focus less on the walking speed and more on the path to follow. Total recording time amounted to 3 min for the church and 2 min for the upper-choir, reflecting the need to negotiate debris piles and temporary scaffolding. Processing followed the same workflow adopted for the cloister datasets and the processing results are presented in Table 1.

	Cloister (L-path)	Cloister (S-path)	Church (S-path)	Upper-Choir (S-path)	Lower-Choir (L-path)
Time (min)	7:40	10:15	3:30	2:51	1:50
Frames (after manual selection)	700	756	500	350	250
Tie Point	412.586	519.426	172.670	122.035	81.676

Table 1. Comparison of different datasets acquired.

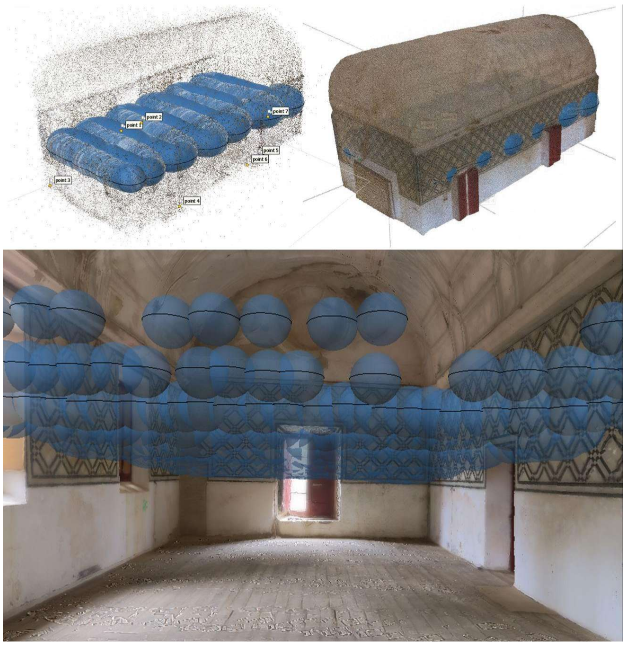

Figure 8. Documentation through 360° panoramic capture systems of the church choir inside the convent. Thanks to the good lighting conditions, the result of the processing provided reliable data for both the metric and material components, confirming that acquisition by means of panoramas is optimal for documenting indoors.

An initial visual inspection indicates that the linear survey of the lower-choir uniformly resolves the axial joints of the walls and floor covering, while the S-paths in the church and upper-choir produce denser sampling on the intradoses and improve the overall definition of the model, a result that is broadly consistent with the results obtained in the external test, despite the differing lighting conditions (Fig. 8).

5. Results discussion

Once processing was complete, each dataset, including the more computationally demanding S-path, was registered to the reference cloud acquired using mobile laser scanner (5) (Fig.9).
Visual inspection confirms the metric assessment: both outdoor datasets reproduce the inward-facing facades of the columns, the masonry walls without openings, the paved floor, and the wooden ceiling plane with high reliability. The S-path produces marginally denser sampling of the lower part of the continuous entablature and the ends of the beams, while the L-path shows small gaps in the narrow recesses between the column shafts and the overlying beam.

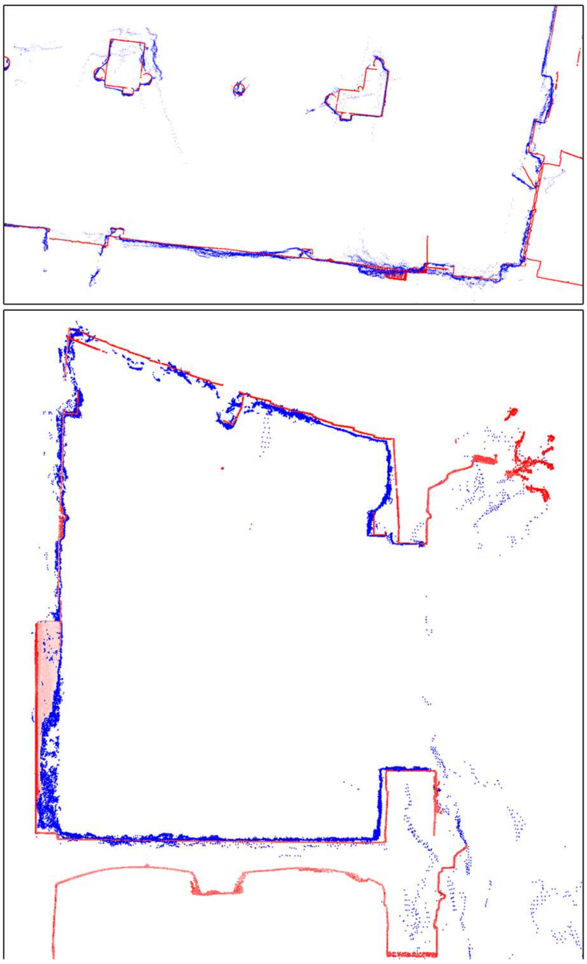

Figure 9. Alignment and comparison of point clouds obtained from mobile laser scanner (in red, used as reference) and photogrammetry from panoramic images (in blue). Above, the alignment on the XY plane (floor plan); below, a model section.

In both reconstructions, the main source of damage is the ceiling structure itself: the closely spaced beams and joists generate high-frequency noise during dense point cloud elaboration, thus lowering the overall quality of the point cloud in that area (Fig. 10). The data collected show how the complexity of the route affects both the geometric coverage and the stability of the alignment. In areas of the cloister characterised by complex structures, the S-path provided superior overlap of views, facilitating the reconstruction of details and vertical elements. This level of details required more frames to process and more time in the matching phase. The L-path, which was easier to execute, proved to be sufficient to guarantee continuous coverage, although less sharp geometries were evident in some areas.

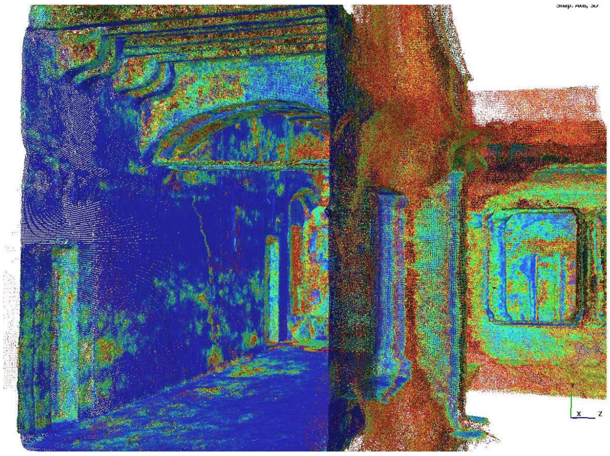

Figure 10. A summary assessment of the confidence and colorimetric component in one of the representative sections of the outdoor cloister.

The interior acquisitions paint a complementary picture. Due to the absence of sky pixels and the more homogeneous artificial lighting, both the lower-choir (documented using the L-path) and the church/upper-choir ensemble (documented using the S-path) provide point clouds that are markedly free of radiometric discontinuities; no joint-related voids or color-related keypoint failures are observed. In the lower-choir, the L-path provides continuous coverage of the walls and floor, while the low vault is reconstructed with uniform density. In the church and chancel, the S-path trajectory again enhances the ceiling details, without the noise artifacts observed in the exterior reconstructions. The residual analysis presented in the methodological section has already shown that, despite a generally satisfactory fit, systematic reprojection errors concentrate along the vertical stitching seams of the dual-lens camera. While the numerical magnitude of these residuals still supports centimetric precision at the average object distance of the cloister, the pattern suggests two possible refinements for future campaigns: masking the seam regions during alignment to prevent seam-borne points from biasing the solution, or calibrating the two lenses as independent sub-cameras so that seam deformation is modelled explicitly.
Illumination proved a critical variable. The arcade is alternately sunlit and shaded, and the camera’s automatic exposure responded to these gradients with abrupt jumps in gain and colour temperature. Residual tone shifts depressed keypoint strength of the frames captured during the transition. The effect was more severe in the L-path because the operator passed through the contrast zone only twice; in the S-path the same sector was viewed from multiple angles, so unbalanced frames were offset by well-exposed neighbours, bolstering match redundancy and alignment stability. Indoors, by contrast, the controlled LED flood in the lower-choir and the diffuse daylight in the upper-choir produced radiometry that remained within a narrow exposure band, sharply reducing the number of discarded frames and contributing to smoother alignment (Fig. 11).

(5) Few architectural vertices and beam edges were clearly preserved in both point clouds, and correspondences were established on these. Due to the limited definition of the video-based models, the registration residual was approximately 5 cm. This tolerance is considered acceptable given the intrinsic uncertainty of the photogrammetric data.

Figure 11. Evaluation of the overall data for artificial lighting conditions to assess the impact of operator's net shadows during video capture and the effectiveness of real-time light compensation by the 360-degree camera.

Despite these limitations, the experiment demonstrates several positive outcomes. First, even the more economical L-path delivers an essentially complete representation of columns, walls and floor within a single pass lasting only a few minutes, a clear operational gain over a traditional stop-and-shoot panorama survey reported for comparable cloisters. Second, varying the extraction density proved effective in balancing computational effort against geometric demand: subsampling frames in uniformly lit wall sections reduced processing time without eroding metric quality, whereas retaining the full sequence in areas of complex joinery preserved detail. Finally, the comparison confirms that path geometry can be adjusted to project requirements: a perimeter loop suffices for fast condition assessment, while a sinuous trajectory, though costlier in the laboratory, supplies the redundancy needed for high-resolution analysis of ornate or partially occluded features.
Ceiling reconstruction remains the weakest aspect of the exterior sets, where beam spacing and sky contamination jointly degrade dense matching. Interior ceilings do not suffer the same artefacts, indicating that the noise is triggered less by timber frequency per se than by the high radiometric contrast and lack of texture in the exterior zenith sector. Planar regression across the broader ceiling surfaces shows that global warping stays within tolerances acceptable for architectural appraisal, yet these findings underline the importance of lighting control and seam management in future fast-survey campaigns.

6. Conclusion

The experiment set out to determine whether the geometry of a 360-degree video path can influence the quality and efficiency of fast photogrammetric documentation in an inaccessible environment. The results show that path design does indeed affect both data completeness and processing load. A perimeter loop captured the entire cloister arcade in a single, short recording, generating a dense cloud accurate enough for preliminary assessment. The more articulated S-path, by contrast, supplied a denser and better-distributed baseline, resolving mouldings and beam ends that remained under-sampled in the linear set, but at the cost of a larger frame volume and a higher processing time. The results of the indoor trials, which were conducted under controlled lighting conditions, were more complex than they first appeared. The lower-choir, documented with an L-path, produced a uniformly dense pattern free of seam-related voids, while the S-path adopted in the church and choir provided superior ceiling and cornice detail without the noise artifacts observed outside. This contrast demonstrates that homogeneous lighting can partially compensate for the geometric limitations of a simpler path and that seam artifacts become critical only when high lighting contrast coincides with seam areas. Illumination proved a secondary yet significant factor: automatic exposure shifts introduced discontinuities that weakened keypoint extraction, particularly along the linear route, whereas the multiple viewpoints inherent to the S-path compensated for errant frames. Ceiling reconstruction remained problematic in both datasets, confirming that closely spaced timber members represent a worst-case scenario for dense matching. These findings supply an initial quantitative benchmark for 360-degree video surveys, demonstrating that a perimeter loop is adequate for fast evidence capture, whereas an articulated trajectory becomes advantageous when occlusions, or ornate details, demand higher fidelity. At the same time, the experiment lays a solid foundation for more extensive and statistically robust analyses, offering a preliminary roadmap for planning camera paths that reconcile operational speed with the depth of geometric information required in fast heritage documentation.
Future developments may further explore the use of even higher resolution 360-degree cameras, automatic optimisation of frame extraction density, and integration with artificial intelligence algorithms for frame classification, to further improve the trade-off between effectiveness and speed in expeditious architectural surveying in inaccessible environments.

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