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Reimaging Past Worlds: Issues and Challenges in the Use of 3D Graphics for Historical Reconstructions

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For years, hand-drawn reconstructions were the primary way to translate scholarly findings about historical eras into visual examples. But with the advent of 3D computer rendering technology, researchers from many fields in the humanities and social sciences could move beyond drawings and diagrams to instead present their audiences with fully navigable and interactive virtual environments. These computer graphics (CG) technologies now allow creators to show the original finish of a weathered sculpture, the once bustling street of a long-buried town, or even the lay of a landscape before erosion, each in three dimensions. Completing an accurate and effective CG reconstruction is a complex and time-consuming process, in which researchers must carefully balance many important and interdependent factors to meet their illustrative goals. This paper will outline common issues and challenges for historical reconstructions and recommend practical strategies to create a vibrant and effective final project.

A major early consideration in developing a virtual reconstruction is defining whether the chief purpose of the project is to illustrate or to interpret the past. Illustrative models are the simpler option, as they seek only to represent scholarly findings visually. These reconstructions may be no more involved than orthographic or perspective views of architectural plans, and will aim to present usable data to the reader. Illustrative reconstructions will typically show complete views of buildings or objects, and display consistent and accurate proportions and scale. In the interest of clarity, these projects will often forgo depicting materials and textures, or dramatic lighting. This is very different from interpretative models, which aim to completely reconstruct every possible aspect of a past environment. Because such a reconstruction will always require creators to fill in empty gaps in available evidence, these models move beyond the findings of a scholar to make new and often less reliable arguments about the past. These reconstructions will aim to recreate physically past environments using accurate shadows and reflections, photorealistic surfaces and texture images, and natural features such as skies, vegetation, and terrain. Interpretative projects will also often compose their frame of view from the natural perspective viewpoints of the people who once used the space, and may even include renderings of period individuals inhabiting the environments. Once a scholar decides whether their priority is to illustrate precise and accurate data or to interpret a past space to convey the social and emotional significance, he or she may begin planning the research agenda.

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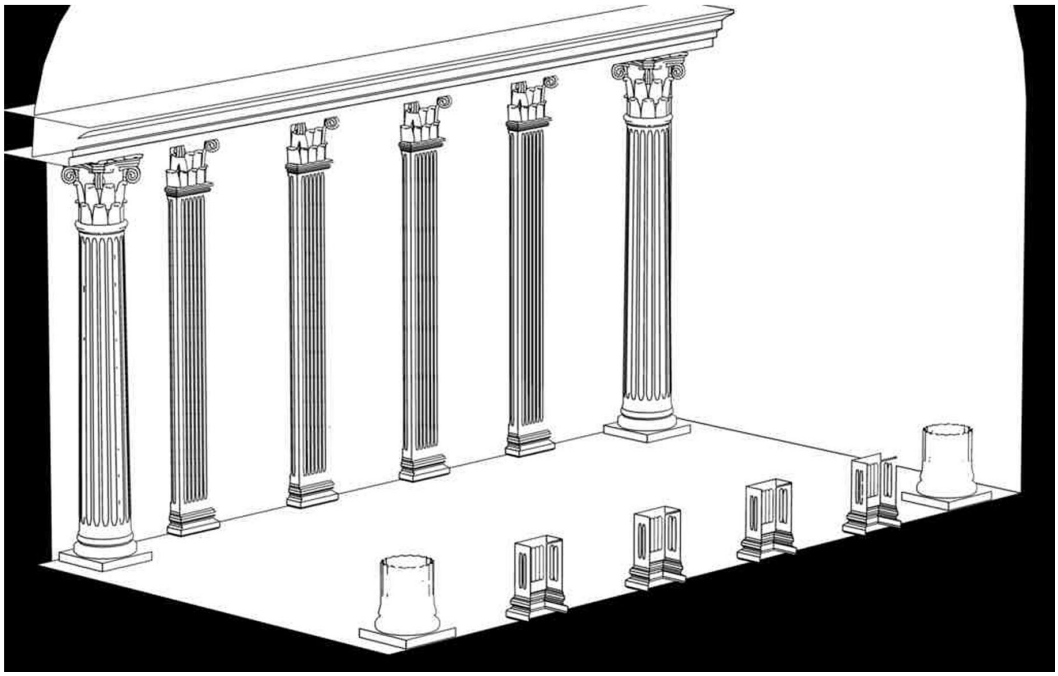

Figure 1

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The most difficult element of researching a historical reconstruction is deciding which types of evidence will receive priority in a visual representation. Consider the example of the original Byzantine Church of the Holy Sepulcher in Jerusalem, which was damaged during Muslim conquest and then destroyed during the Crusader era. A virtual reconstruction of this important historical building would depend on sometimes conflicting evidence from many different media. Archeology of the original church under the modern site is scant, and proves little more than the locations of a few foundation stones. Some period depictions from eyewitnesses exist, but the language used is often vague in describing architectural features, and prone to mistranslations. A few visual representations exist, from a Jordan mosaic showing the Jerusalem skyline, to medallions, rings, and models made by returning European pilgrims to showcase the memory of the church's shrines. While many of these artifacts are extremely useful in suggesting long-past aesthetic forms, they too are often contradictory or extremely stylistic or simplified. Finally, scholars might look to other extant sites from the same period or culture in other locations like Byzantine churches in Italy or Turkey, which might give a good idea of common building practices, materials, or motifs, but would still be inadequate to completely inform a reconstruction. Analyzing so many conflicting, diverse, and incomplete materials is a common tax for scholars, but becomes even more crucial during a virtual reconstruction, where a creator must still represent certain building features, even when no piece of evidence is truly persuasive.

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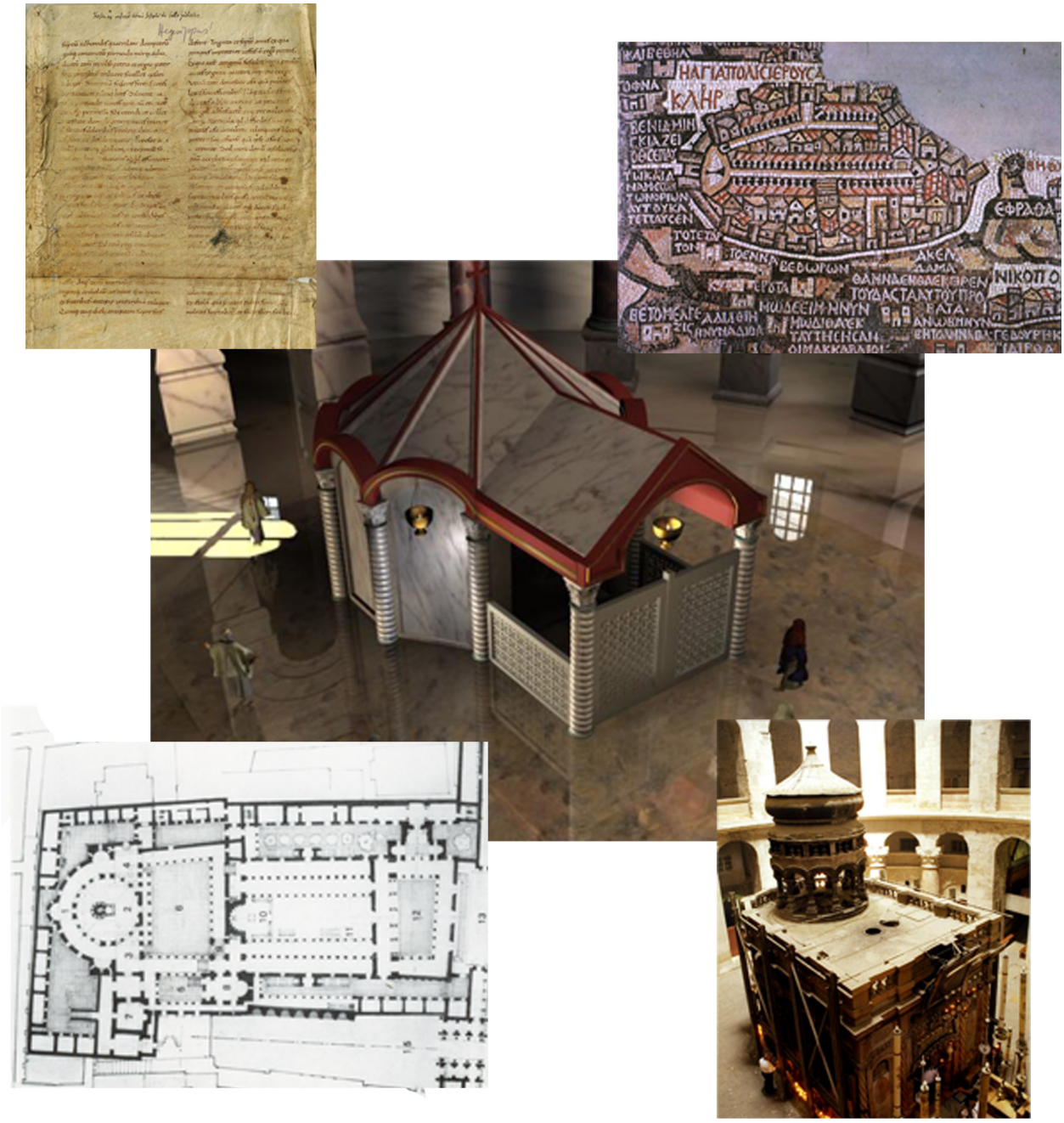

Figure 2

Armed with a basic concept of the environment they will recreate, a scholar can next decide on the preferred format for the project's presentation. Here two major considerations apply: first, whether the output will be still renders or moving animations of the 3D environment; and second, whether these renderings will be passive or interactive. Passive stills are the obvious choice for print media and web galleries, and most closely resemble traditional illustrations or photographs. But stills may also be used for interactive presentations, such as the rendering of 360° panoramas which a user can pan across and zoom, or in series of stills that are arranged to provide step-by-step click-through

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tours of a space. Passive animations will be the primary format for documentary film or broadcast television, and may also appear as online streaming videos, or as clips on educational CD-ROMs. The most challenging and complex projects are those using interactive animations, which render an entire environment in real-time that users may manipulate. These are most closely analogous to video games or online environments like Second Life, and are the only projects that require 3D software after creation for their presentation.

The purpose, research plan, and format of a virtual reconstruction all affect the level of visual detail depicted in the project. High-detail projects display greater levels of realism, but demand longer production times, higher costs, more computing power, and more intense research. Conversely, lower-detail scenes are more efficient, more customizable, less expensive, and more easily integrated into different media for presentations. Creators may also choose higher detail for only certain, specific aspects of their environment, emphasizing architectural form, surface texture, lighting, or even a scene's virtual inhabitants over the remaining elements. The range of possible levels of detail is endless, from spaces represented only by simple, unadorned geometric objects like cylinders and boxes, to hyper-realistic recreations of marble sculptures, employing advanced shader computations to simulate the play of light in the partially translucent stone. Balancing the level of detail against the resources and time available is perhaps the most important element in defining the scope of the final project.

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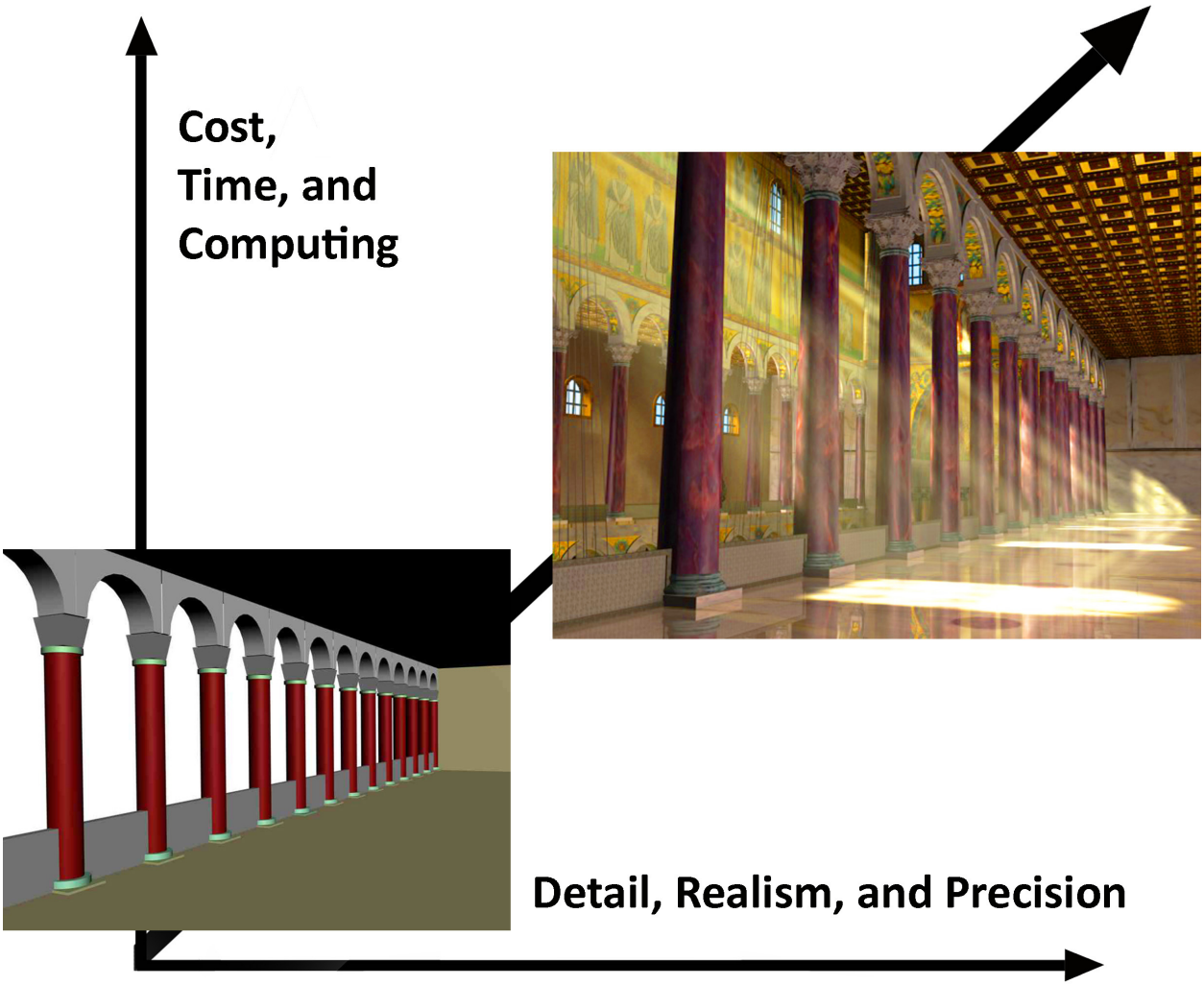

Figure 3

This leads to three strategies creators might employ in attempting a simple, intermediate, or advanced level historical reconstruction. A simple project would likely be the work of a single scholar, working with free software such as Google Sketchup or Blender. Such reconstructions would usually be limited to stills or very simple animations, and employ relatively low detail in order to be rendered on the scholar's home or office computer. An intermediate project would require a scholar with significant skill in 3D modeling and animation, who might work with a small team. This group would use more advanced software suites such as Maya or 3D Studio Max, and could attempt photorealistic stills or more complex animation clips. Depending on the level of detail, they might work on consumer PCs or on more sophisticated professional graphics workstations. Finally, an advanced project that attempted broadcast-quality animations or interactive game environments would likely require a broad collaboration between scholars and professional graphics designers and programmers. Advanced projects may also be too massive to render on an individual computer and will require the construction or rental of a powerful linked network called a render farm.

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3D modeling and animation technology provides scholars with unprecedented opportunities to communicate visually with wide audiences. Careful planning and consideration of the issues involved in a reconstruction will help designers balance their ambitions with their resources to create the most effective project. With nearly limitless possible variations, the 3D technology can allow virtual reconstructions to serve nearly any need to visually represent the past.

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