VISUALIZINGUNCERTAINTY
INVIRTUALRECONSTRU CTIONS

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Thevirtualreconstructionoflostbuildingsasmeansofrecreatinglostculturalheritagehasbecomea stronglygrowingfieldofapplicationforcomputergraphics[1].Researchresultsofhistoriansand archeologistsareusedbycomputerscientiststocreatecomputermodelsasbaseforvisualizations.Typically, off-the-shelfsoftwareisemployedthatallowsgeneratingimageswiththequalityofphotographs(see,for example,Figure1).

Figure1:Aphotorealisticimageofthe virtualreconstructionoftheareaaround theKaiserpfalzofMagde burg,rendered withastandard3Drenderingtool (originalimageincolor).

Althoughthismethodcanbeusedto illustratetoanaudiencehowcertainbuildingsmayhavelookedlike,thispracticeissubjecttoanumberof fundamentalproblems.Fornon -experts,itisstrikinghowcarefullyspecialistsareinchoosingthewordsto describetheirexcavationfindingsori nterpretations.Oftenverbalizationslike"Thesefindingssuggestthat thiscouldhavebeena[...]"areused.Butthesecautiousstatements —conveyinguncertaintiesoreven

speculations—are represented as proven facts in computer models that are used to create visual materials. The wary character of the verbal message is lost. A photorealistic image always bears the danger of being taken for reality and making a viewer believe too strongly in that specific visualization. The images settle in the viewer's mind, pretending a certainty that does not exist to this extent.

A new field in computer graphics, the so-called "non-photorealistic rendering," offers promising alternatives that aim at avoiding those unintentional visual fixations [2]. Non-photorealistic visualizations (like the one shown in Figure 2) provide scientists with methods to handle uncertain knowledge in computer models. Here, attributes describing reasons or alternatives can be stored along with the usual geometric data. From this data, visualizations can be generated that are honest with respect to the degree of certainty, the reasons, and the alternatives.

Figure 2: A sketch-like rendition of the reconstructed building. Here, the same 3D model as in the previous image is used, but the "sketchy" character of the line drawing proposes a preliminary design state. This type of image does not pretend that the expert knows exactly how the building has looked like in the 10 th century.

Especially in the discussion process between experts it becomes obvious that a photorealistic graphic with too much detail distracts from answering fundamental questions, since first of all in a reconstruction the building's overall structure has to be determined. Furthermore, the combination of different techniques enables the generation of novel visualizations of 3D models.
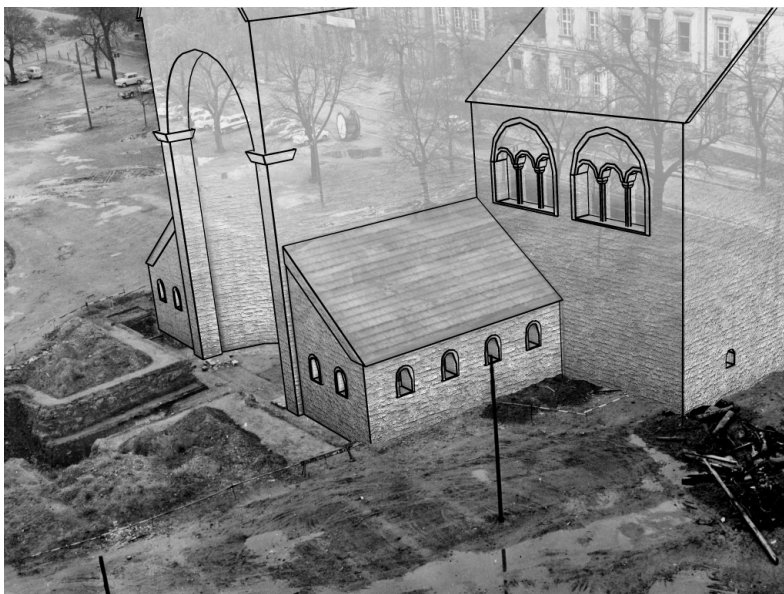

Figure 3: The visualization of the reconstruction over its foundation walls gives an impression of the former position and appearance of the building.

InFigure3,several techniqueswereappliedtoillustratethefactthattheuncertaintyofareconstruction increaseswithgrowingdistancefromtheground:thefurtherawaywegetfromtheexcavationbasis,the moreinsecureisthereconstruction.Inordertovisualizethis increasinguncertainty,afadingphotorealistic image(depictingtheassumedappearanceofthebuilding)andalinedrawing(maintainingtheoverallshape) werecombinedinthispicturetovisualizethebuildinginquestionaboveitsexcavatedfoundation walls. Basedonaphotographyoftheexcavationsite,thecamerapositionsoftherenderedimageswereadjustedto matchtheoriginalpositionofthephotographer.Eventually,thesethreewerecombinedtovisualizethe reconstructioninitsoriginallocat ion.WiththeaidofA NCIENTVIS(seeFigure4),asystemwhichis proposedin[3],wecanrenderimageswithlessdetail,usingtechniquesforemphasizinganddeemphasizing, andwecanreuseanddevelopthe3Dmodel,thusundergoingaconstantrefinement.

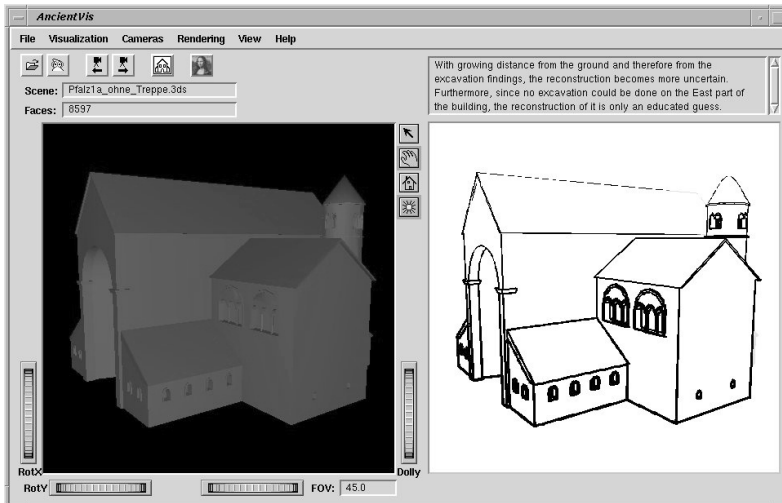Figure:4:Ascreenshotoftheproto - typicalsystem ANCIENTVIS,which allowstogeneratesketch -like renditionsofarbitrary3Dmodels. Itis possibletospecifycertainillustrative featuressuchasfadinglinestylesthat indicateuncertainty.

Thesetechniquesemergedfromtheworkonthevirtualreconstructionofthe"KaiserpfalzzuMagdeburg",a collaborationbetweenthe *InstitutfürSimulationundGraphik* andthe *KulturhistorischesMuseum Magdeburg*.Thereconstructionwillbepresentedasp artoftheexhibition"OttoderGroße,Magdeburgund Europa"intheyear2001inthemuseum.Severaldifferentvisualizationtechniquesthatweredeveloped throughoutthereconstructionprocesswillbeappliedinthisexhibition.

Weconcludethatamuch richerselectionofvisualizationandinteractiontechniquesisultimatelyneededfor providingviewersa"fair"pictureofavirtualreconstructionandthedifficultprocessofarrivingatit.

References

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