FUTURE OF ENDOSCOPY

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Is there any future for endoscopy in environmental visualization? We all are astounded by the rapid development of computer graphics and its' various applications in environmental visualization. The issue is, can computer graphics live up to all expectations in realtime visualization and can present endoscopy technology be developed to meet the challenge? What are the possibilities to combine the two technics?

The above in mind we started a project at the Faculty of Architecture in the Helsinki University of Technology. First we took a critical look at the current state of computer graphics concerning realtime environmental visualization. Second we studied the current use of endoscopes in association with The Department of Architecture in the University of Tampere and formed a concept for a "second generation" endoscope.

The spreadsheet in the following page is an abbreviation of our studies. As you may notice the endoscopes currently in use couldn't get some of the +-answers I have marked down here. The endoscope techology referred here is from the coming endoscope of the Helsinki University of Technology.

ENDO vs CAD

	+	−	
Modelling			
• skills needed	+	−	Everybody is not a master of making fysical models, but anybody can make some kind of model. For CAD modelling you always need a lot knowhow and special skills. And I don't mean the learning of all the commands but the difficulty to adapt to a the programs way of thinking.
• equipment needed	+	−	In CAD for twenty students you need twenty computers and software lisences!
• accuracy	−	+	CAD wins here but who really needs all that accuracy at early design stage. CAD models need to be over–accurate to work that they easily become sterile looking.
Stageing			
• adding people	−	−	Both way people look dead, you can not animate humans in real time animation.
• adding trees etc.	+	−	Same, in CAD too many polygons.
• using backgrounds	+	+	Works well is camera doesn't move.
• using materials	+	+	"ENDO; hard to make, but easy to use" "CAD; flexible, but limitations to vast use and usually quite hard to define."
Lighting			
• all kinds of lights	+	−	Inter object illumination is hard to simulate in real time. Radiosity algorithms are the only possibility, but they need a lot of computing power and time beforehand.
• number of lights	+	−	Only limited by the amount of RAM in your system is an often heard slogan in "CAD–world. That is like a car dealer would try to sell you a car saying: ""This car can" "take you anywere, you just have to build the road."" You never have enough RAM."
• animating lights	+	+	With ENDO generally one can not move lights, but who needs that anyway?
• sun simulation	+	+	Can be done in both.
Animating			
• moving real time	+	−	CAD has limitations.
• moving smoothly	+	+	This is more the question of interface for both.
• restriction of moves	−	−	"ENDO; problem for having (not going through doorways)" "CAD; problem for not having (going through everything)"
• repeteability	+	+	Possible for ENDO also.
Interface			
• using mouse for real time mov.	−	−	They both need something else.
• using "data helmet"	+	+	Both can.
• using 3D sound effects	+	+	Both can.
Picture Quality			
• high resolution stills	+	+	Both can.
• VHS –quality	+	+	CAD hardly.
• S–VHS –quality and beyond	+	−	real time HDTV picture quality is only for Endoscopy.
• stereo display	+	+	"ENDO; tecnically demanding" "CAD; easier, but you have to double your investments to retain quality."
Making Changes			
• model changes while shooting	+	−	In CAD you usually can't make changes while visualizing.
• editing existing route	+	+	Can be done in ENDO also.
Distribution			
• distributing in digital form	−	−	For ex. Apple Quicktime. Problem is real time picture quality.
• distributing in video	+	−	CAD needs to be converted to analog video first.
Cost and Maintenance			
• cost for real time quality	+	+	You need something like a Silicon Graphics Reality Engine.
• cost for maintenance	−	−	Unix– world maintenance costs!
• cost versus speed	+	−	"Are you in a hurry, or should we do this with a computer?"
Feel for Architecture			
• feel for space	+	−	In Endoscopy you are dealing with tangible objects. In CAD you are using
• feel for materials	+	+	mathematical representations of objects, points, lines and polygons. This
• feel for reality	+	−	still makes a difference, I think!
Final score	26	15	Endo is still a clear winner in real time visualization!

THE FUTURE ENDOSCOPE OF HELSINKI UNIVERSITY OF TECHNOLOGY

The basic idea is to use a computer where it is best – that is in motion control – and video technology in graphics. All interfaces are connected to the host PC (33 MHz 486DX) that in turn is connected to the indexer card (AT 6400 by Digiplan) for running the stepmotors. All six degrees of freedom can be simulated. Movements and route can be saved as a file and then be repeated as such or edited before rerun. All axes can be edited separately and the speed of movement can be changed at any point of the route.

The problem of running into ground or models is solved with a new concept – Safe Area Model. The SAM-file is produced by laser scanning the model before driving in it (DME 2000 -laser by Sick Electronics). The SAM-file allows us also to follow to contour of the ground smoothly.
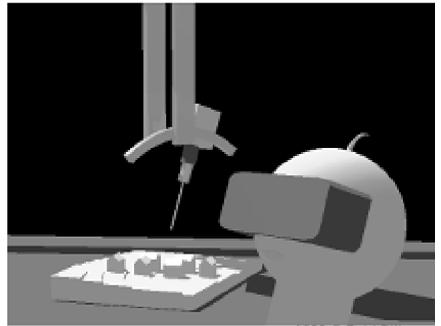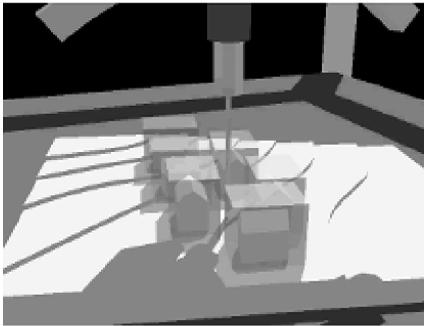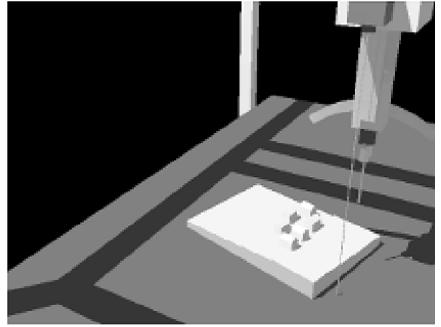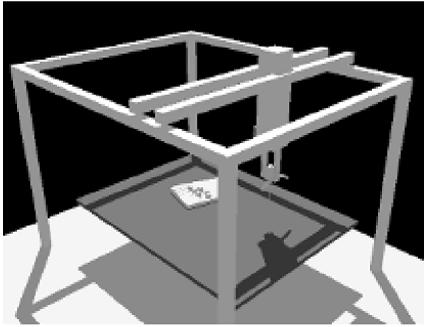
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Virtual reality interface is a very suitable interface for a endoscope that is computer controlled. The speed of graphics is no problem with endoscope video. Our "data helmet" allows a user to walk around models while having a total control over the view by just head movements. Driving, biking and other activities can also be simulated by using the helmet.

Realistic daylighting is very important for high quality simulations. Besides providing overall ambient lighting (2 x Balzac 1 kW cold spots) we can simulate sunlighting with a computer controlled movable artificial sun (4 kW Arriflex spot).

The endoscope of the Helsinki University of Technology will be completed by the end of year 1994 – we hope!