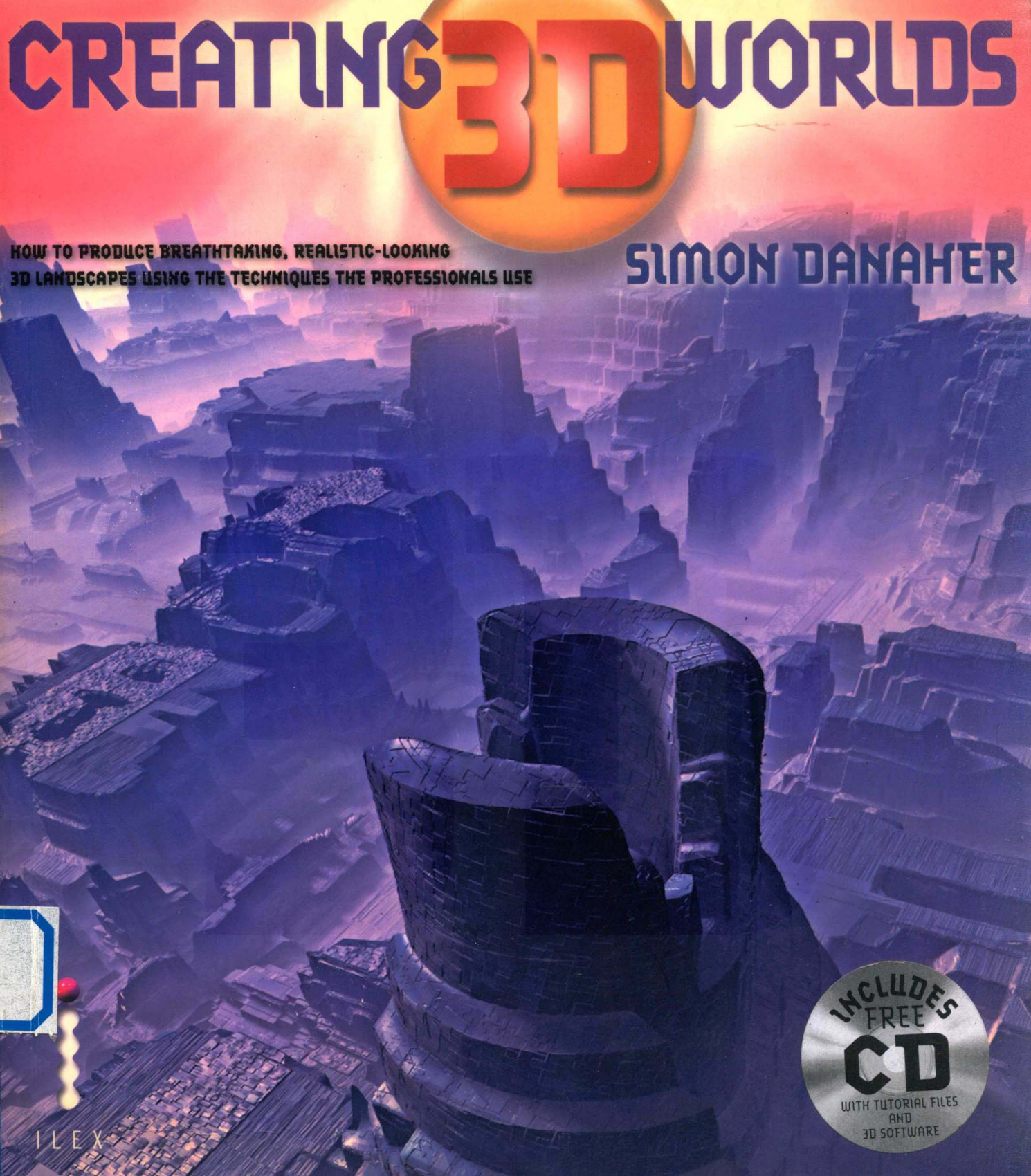
CREATING 3D WORLDS

HOW TO PRODUCE BREATHTAKING, REALISTIC-LOOKING 3D LANDSCAPES USING THE TECHNIQUES THE PROFESSIONALS USE

SIMON DANAHER



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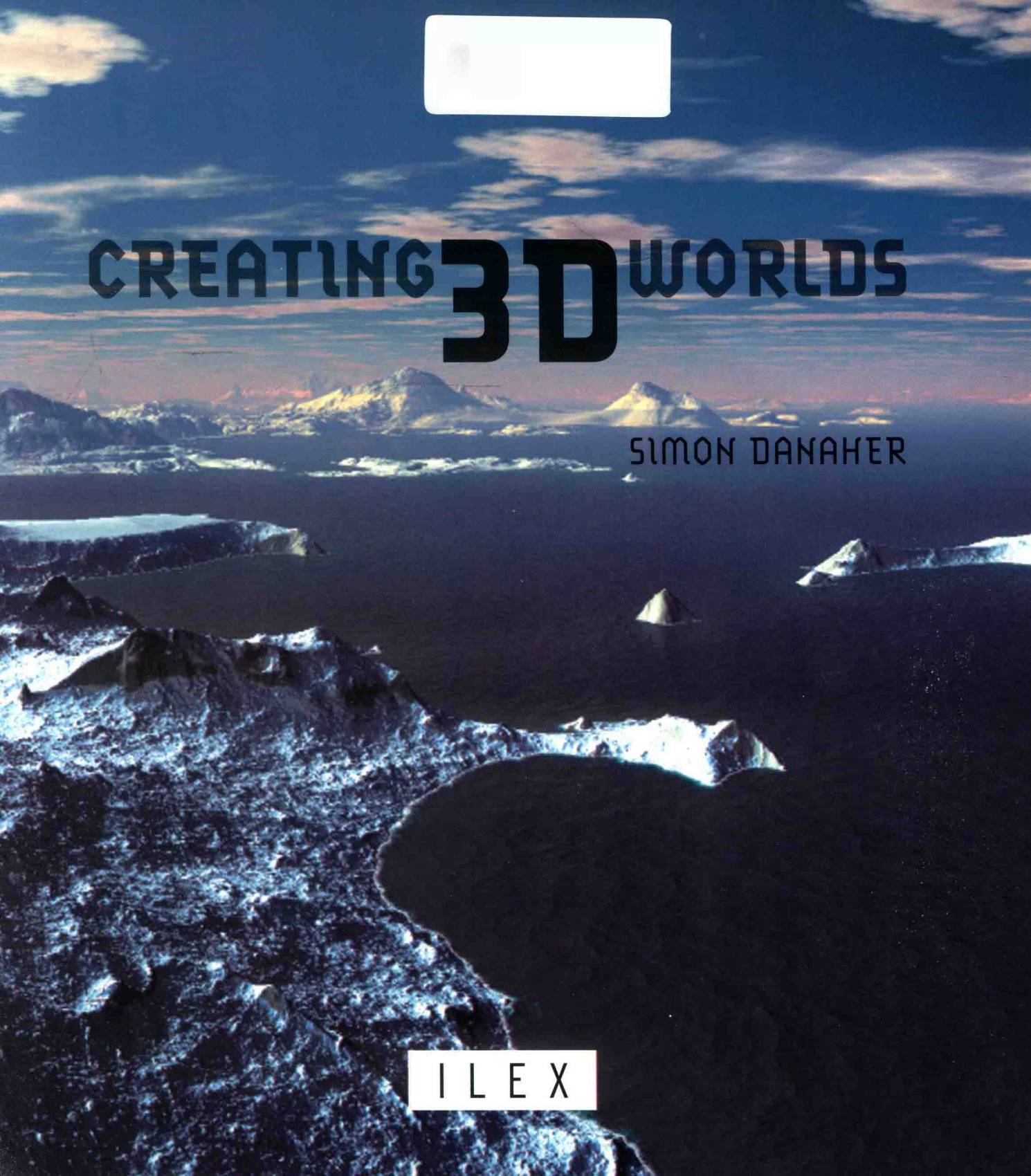
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6 Populating Landscapes

7 Lighting

8 Working between 3D applications

9 Interactive Authoring

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Minimum System Requirements for software on CD:

Mac OSX 10.3 or Windows 2000/XP
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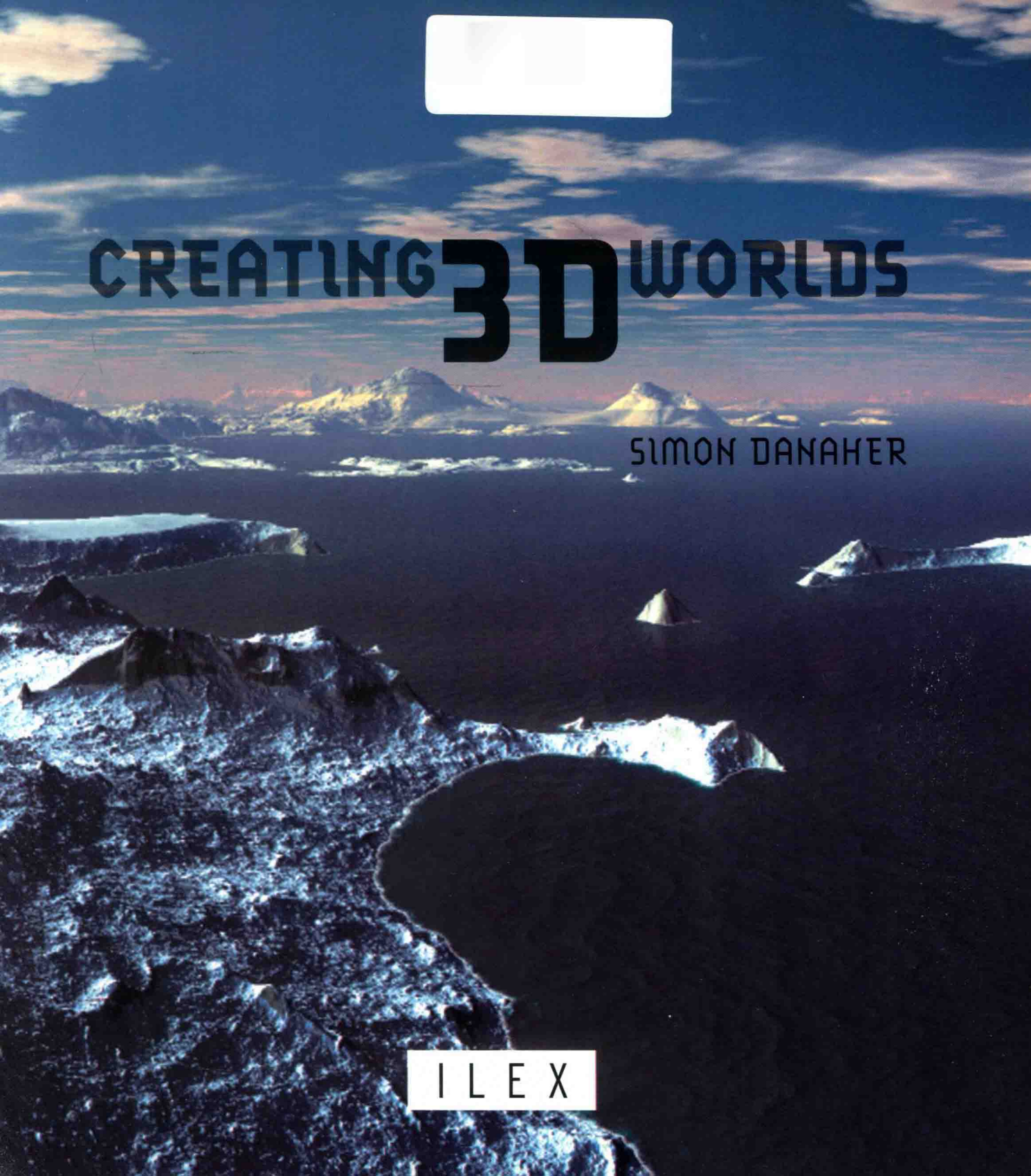
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Introduction

Digital 3D graphics have allowed professional artists and hobbyists to create incredible images and animations, and one area of this emerging field of digital expertise is the creation of virtual worlds and environments.

Over the years this has become a very well-defined sector of the 3D digital market and, as a result, there are numerous 3D applications whose sole purpose is to produce 3D imagery of invented (and actual) worlds and places. That said, it's also possible, and in many ways desirable from a professional perspective, to create exterior 3D scenes in a general purpose 3D program such as 3ds max, Lightwave, Cinema 4D, or Maya. This book is dedicated to the techniques and art of creating digital environments in either kind of package, and will examine the different aspects of simulating realistic worlds and landscapes using 3D graphics.

ABOVE AND LEFT *In traditional media, such as photography or watercolor painting, exterior environments have always been a fascinating and endlessly interpretable subject for artists, and in 3D digital media the tradition continues—the difference being that here, artists are creating environments rather than just capturing them.*

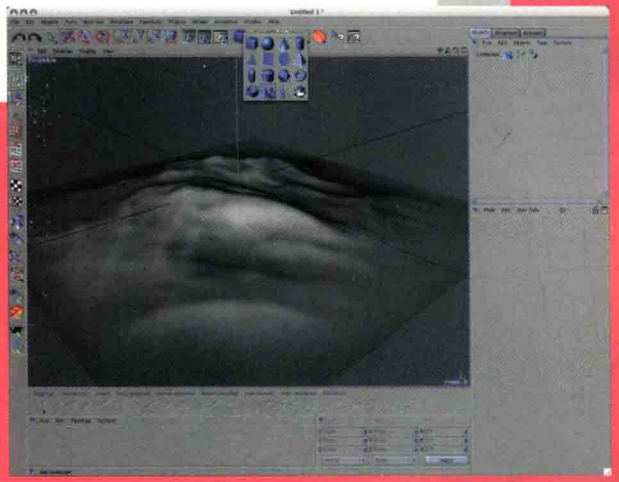
OPPOSITE TOP AND RIGHT *An extreme close-up of the ground at the scale of insects is as valid a subject for examination as a large-scale space scene showing most of a planet, but they will require very different approaches technically. Mostly, though, the "environments" covered here will be at the scale of human beings with feet planted firmly on the ground.*

When we talk about "3D worlds" or "virtual environments" we're talking specifically about exterior scenes, such as landscapes, seascapes, and skyscapes, and how to create them in 3D. But environments can also be at vastly different scales.

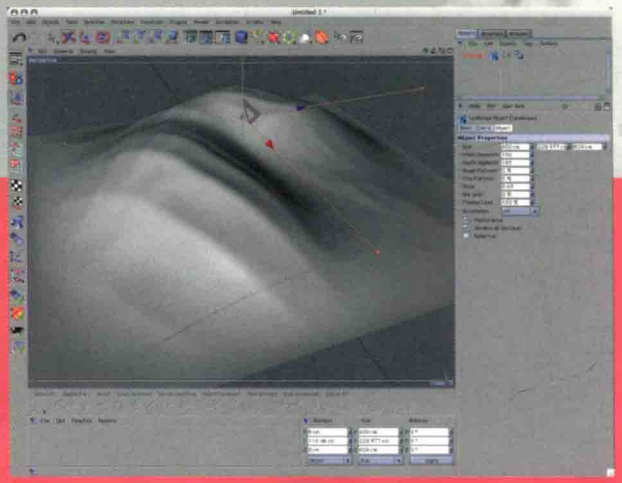
However, in 3D graphics there are two dominant styles of image: photorealistic and hyperrealistic, both of which we'll look at here. In a photorealistic image the 3D artist will attempt to recreate as faithfully as possible all the natural phenomena associated with exterior scenery and light. With a hyperrealistic image, faithfulness and accuracy need not be a concern. Photorealism can require a battle against the sterility inherent in 3D graphics, while hyperrealistic imagery tends to embrace the character of digital media.

Limitations of "ordinary" 3D programs

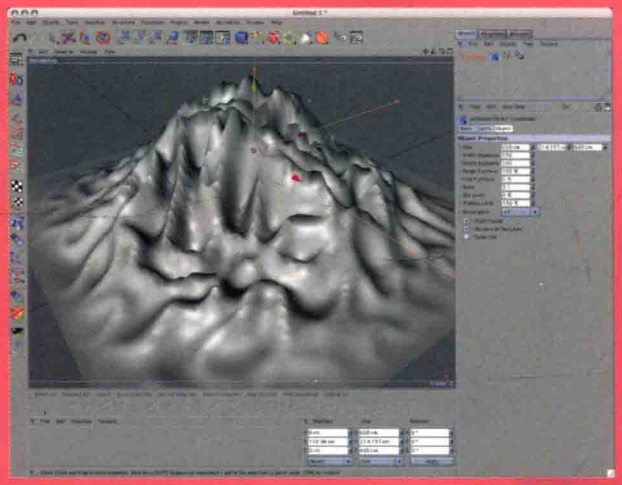
Almost any 3D program (except those that are extremely basic) can be used to create a 3D landscape scene. There are three main elements to consider when undertaking such a task: how to create the ground, how to create the sky and atmosphere, and how to light the scene convincingly.



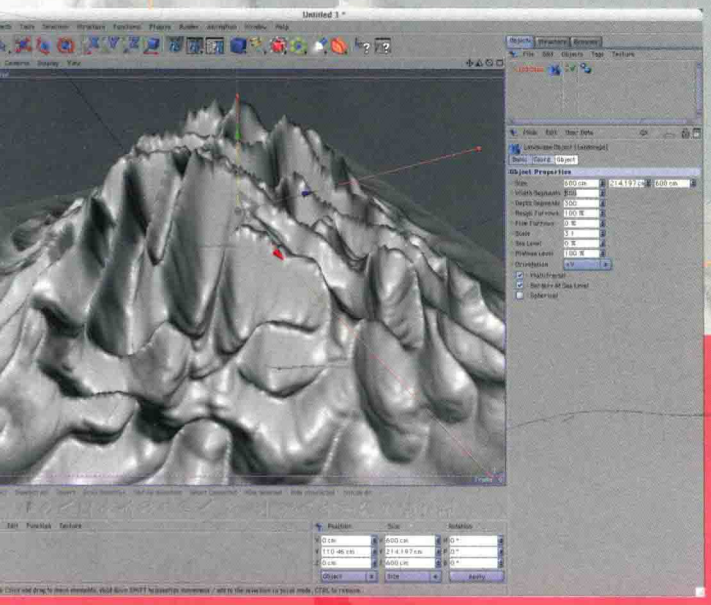
1 Most professional 3D programs have ways to generate landscapes despite not being specifically designed to tackle such a problem. Here in Cinema 4D, for example, there is a Landscape primitive object that can simply be inserted into the scene.



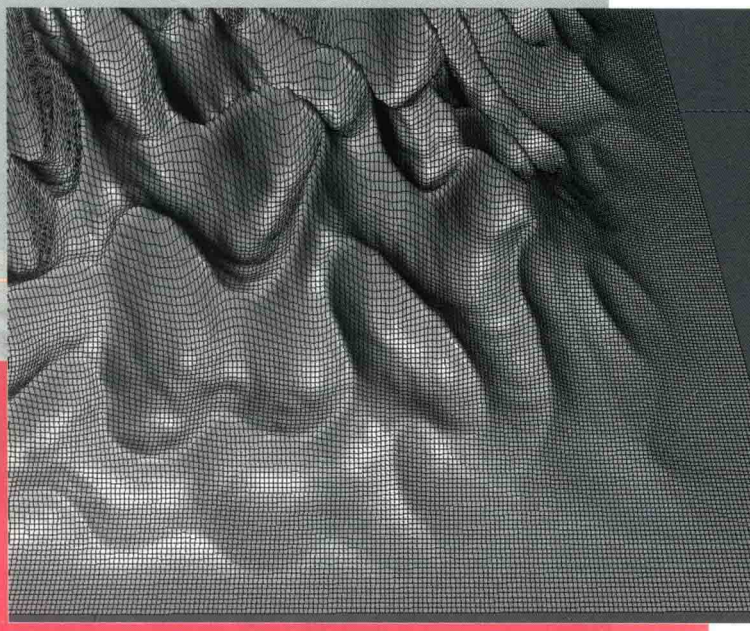
2 Because the object is procedural, you can edit its parameters to change the default mountain into something smoother, such as a gentle rolling hillside.



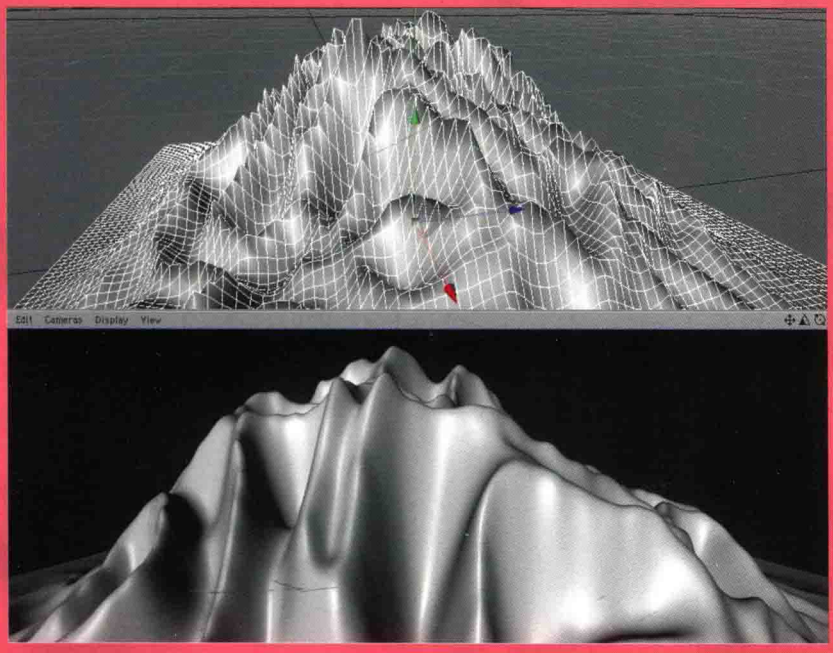
3 By dialing in some higher settings for the fractal pattern that is generating the mountain, you can create a much rougher, craggier look for your mountain. However, when you do this, you notice a limitation of the primitive, and that's its regular polygonal subdivision. Where the frequency and height of the crags is greatest, you can clearly see the polygons that make up the primitive's surface.



4 You can increase the resolution of the primitive to alleviate the effect of the polygonal artifacts. Here we increased the X and Y subdivision of the primitive from 100 to 300, but the polygons at the peaks are still very much in evidence.



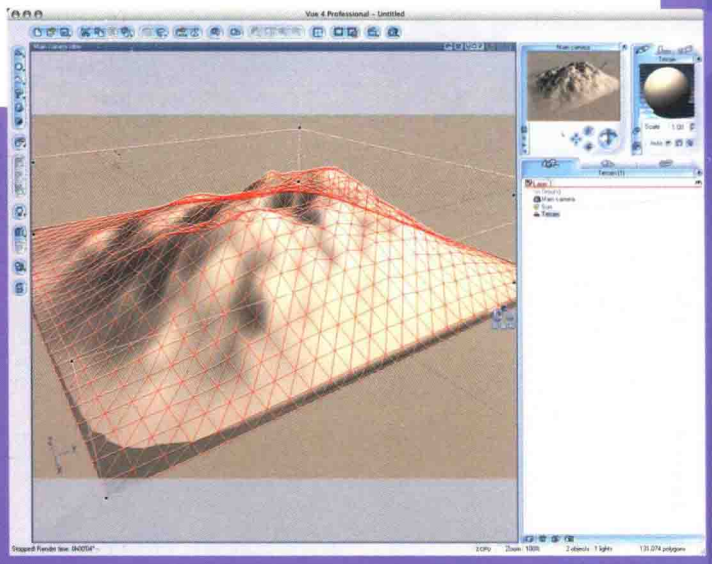
5 Conversely, where a very high density is not required (i.e. on smoother areas toward the edges of the model), the extra polygons are wasted. At 90,000 polygons for this single landscape, it's clear that this is not a very efficient way to work. More polygons makes for slower display and slower rendering.



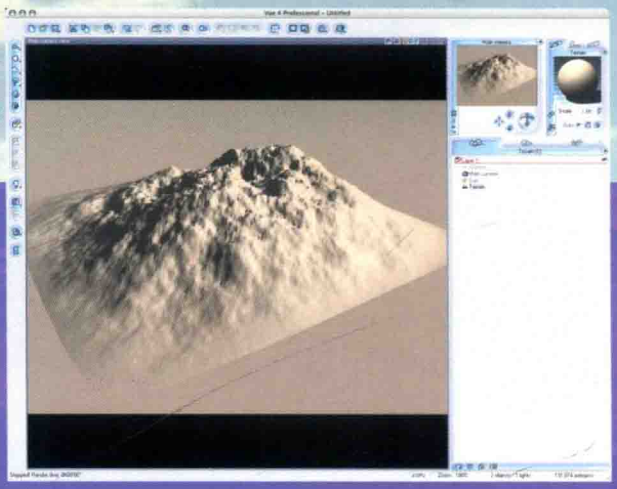
6 Instead of using raw polygon density, we can work around the limitation of the primitive by turning it into a Subdivision Surface object (called HyperNURBS in Cinema 4D). This smooths out the jagged edges when rendered, eliminating the appearance of polygon artifacts. It also keeps the polygon density down to a manageable level when working interactively with the scene. The down side is that you end up with a rather soft and "melted" looking mountain, but texturing can help to counteract that.

Types of 3D landscape application

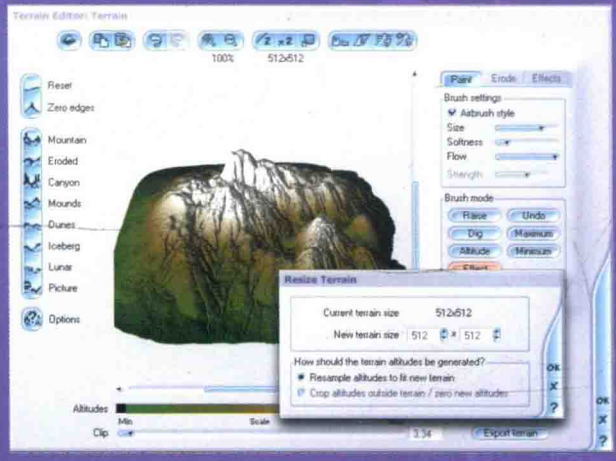
As we've seen, when using an "ordinary" 3D program, it is perfectly possible to create 3D landscapes, but you tend to have to work harder to overcome the fact that the program is not optimized for that task. There are, of course, a number of programs designed specifically for creating 3D worlds and environments, but these have their own set of compromises that arise from the very fact that they make creating this kind of 3D image easier to produce.



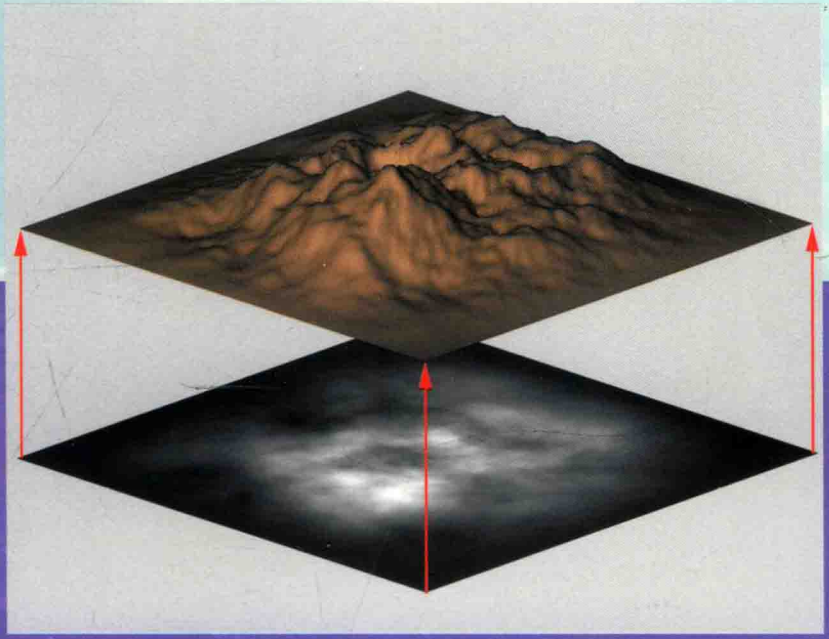
1 One of the most successful 3D landscape applications currently available is Vue. This program is designed with a workflow and toolset specifically for the job of creating landscape scenes. Taking the mountain example once more, we can immediately see a different approach. Landscape objects can be added to the scene, but they seem very low in resolution.



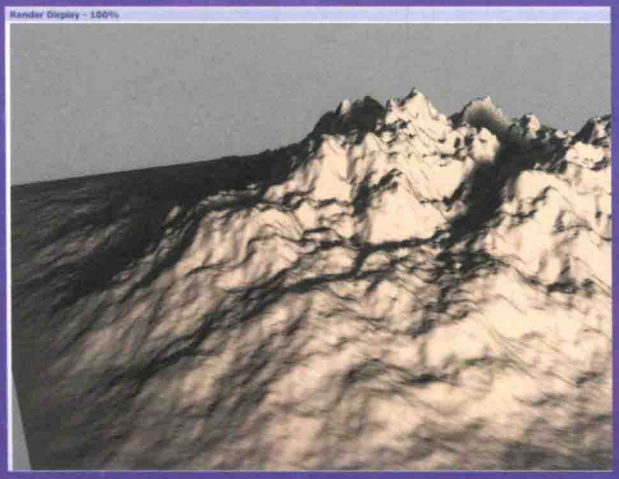
2 Yet when rendered, the resolution is automatically increased to a level suitable for a final quality image. The landscape object is procedural, but separate resolutions are generated for display and rendering automatically, so you don't have to worry about overloading your scene with polygons as you are creating it.



3 That said, there is usually an upper limit to the resolution of a terrain that you define in a system such as Vue because the mountain is generated from a grayscale "height map" of specific pixel dimensions. If you find you need a higher resolution you can increase the map resolution as needed. The program simply resizes the height map. This process is called displacement or height mapping and forms the basis of much landscape work.

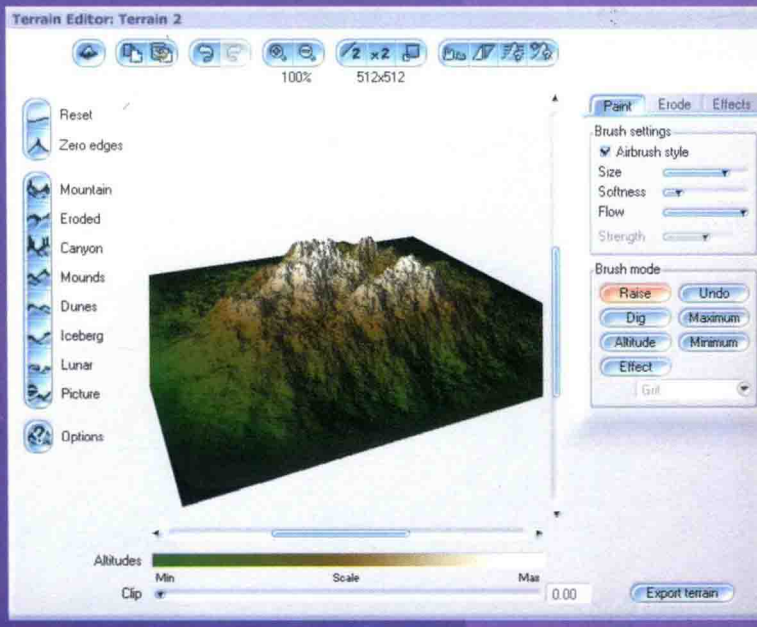


4 Here's what's going on internally in a landscape program using displacement maps: a map is generated at a specific resolution, say 256 x 256 pixels square with a fractal pattern. For every pixel, a polygon is created and moved vertically based on the brightness of the pixel. Where there are shades of gray in the map, mountain peaks are generated, but there is zero polygon movement at black pixels.



5 So although there appears to be an "increase" in resolution when you render the terrain, it's actually just being rendered at the maximum resolution that is allowed by the height map. To increase the resolution of the terrain when rendered, you need to increase the map size and regenerate the fractal pattern.

Here's another terrain, this time with a 512 x 512 pixel height map. The mountain has finer details because of the greater height map resolution.



Types of 3D landscape application

6 Even though this is a limitation of this kind of terrain generation scheme, it does offer digital artists some degree of control over how to distribute the complexity in their scenes—low resolution terrains can be used in the distance, while higher resolution terrains can be used closer to the camera.

There are other programs that take over the control of resolution decisions; one such application is MojoWorld. In this program, the landscape of an entire planet is generated on the fly procedurally when the camera view changes, and the resolution is set depending on the distance from the camera.

7 Zooming up close to the distant mountains in the previous image reveals complexity and detail that was not generated in the distant view. This approach saves much unnecessary computation, speeds scene interaction, and in animations relieves the artist from having to plan camera paths explicitly and know where to place high-resolution scenery. The problem with this approach is that it also shifts a large portion of the creativity from the artist onto the computer.