

Science and Filmmaking

Academics are now working more with filmmakers who are impressed by the results of their research in computer generated imagery (CGI).

Every year the film academy in the USA celebrates the outstanding achievements of the year in a ceremony known as the Oscars. In 2004 a notable event took place: the academic world met the cinematographic world when researchers from Stanford University in the USA were awarded an Oscar. These researchers, led by Steve Marschner, were from the field of Computer Graphics at Stanford. They were part of a growing cohort of computer scientists that has become fundamental to moviemaking. Films have demonstrated that CGI can be used to alter an actor's appearance - making them seem younger, older, more fragile, or more powerful - while still looking surprisingly real. However, this effect only works well if the modified actors are not shown in extreme close-up shots. This is because replicating the detailed textures of skin and fabric is difficult, and the illusion becomes less convincing at close range. Marschner and his team made major progress in accurately and realistically reproducing both skin and cloth. They identified that one of the key problems in making believable computer-generated characters is that CGI often treats skin as opaque and flat (two-dimensional), whereas real skin is translucent and has depth (three-dimensional), meaning it lets some light pass through.

The group won an Oscar for successfully creating a CGI system that mimics translucency when light enters the skin, scatters underneath, and then exits again. This process, known as subsurface scattering, is based on mathematical concepts that date back decades to their use in astrophysics. Since human skin naturally possesses translucency, it had to be artificially simulated to capture the soft, realistic quality of actual skin. Earlier CGI systems that assumed skin was fully opaque resulted in characters looking artificial and plastic-like. The breakthrough was so important for giving life to digital characters that, within two years of their research being published, every major visual effects company had adopted it in their rendering software.

Even after receiving their award, the researchers remained determined to perfect their work, believing that the fine details of light reflection still were not reproduced convincingly. They examined closely how skin and fabrics reflect light in different ways depending on their physical structure - the precise arrangement of fibers in cloth and the network of fibers in skin. To investigate this, Marschner's team used computerized tomography, a medical imaging technique most familiar for viewing internal organs. Like traditional X-rays, it uses radiation, but instead of producing a single photographic exposure, it combines images

taken from multiple angles in a computer, allowing it to capture subtle details invisible in conventional radiographs.

This advanced imaging provided a highly detailed, three-dimensional map of the microstructure of various materials. By analyzing these maps, the researchers could develop new algorithms that accurately simulate how light interacts with the complex geometry of skin pores and fabric weaves. Their subsequent work focused on replicating the phenomenon of specular reflection, where light glints off individual fibers or skin oils, and diffuse reflection, where light is scattered evenly from a rough surface. This dual approach was crucial for overcoming the final hurdle of achieving photorealism in extreme close-ups, ensuring that a digital character's skin would show pores and fine wrinkles just like real human skin, and that cloth would exhibit the intricate play of light across its woven threads.

Questions 27-31

Do the following statements agree with the information given in Reading Passage 3?

TRUE if the statement agrees with the information

FALSE if the statement contradicts the information

NOT GIVEN if there is no information on this

27 The Oscar awarded in 2004 was the first one ever given for an achievement in CGI.

- ☐ TRUE
- ☐ FALSE
- ☐ NOT GIVEN

28 CGI is most effective for altering an actor's appearance in wide shots rather than close-ups.

- ☐ TRUE
- ☐ FALSE
- ☐ NOT GIVEN

29 Marschner's team was the first group to identify that human skin is translucent.

- ☐ TRUE
- ☐ FALSE
- ☐ NOT GIVEN

30 The mathematical principles behind subsurface scattering were originally developed for filmmaking.

- ☐ TRUE
- ☐ FALSE
- ☐ NOT GIVEN

31 All major visual effects companies started using the new subsurface scattering technique before the research was officially published.

- ☐ TRUE
- ☐ FALSE
- ☐ NOT GIVEN

Questions 32-36

Complete the summary below.

Choose **NO MORE THAN TWO WORDS** from the passage for each answer.

After winning the Oscar, the researchers wanted to improve how light **32** is shown. They studied how the physical composition of skin and cloth affects this. To do this, they employed **33**, a method from medical science. This technique uses **34** to create composite images from various angles, revealing minute details. The data from this process was used to create a detailed **35** of material structures. The team then created **36** to simulate the interaction of light with these tiny structures.

Questions 37-40

Answer the questions below.

Choose **NO MORE THAN TWO WORDS** from the passage for each answer.

- What did early CGI systems incorrectly assume about human skin?
 37
- What scientific field provided the original mathematical concepts for simulating skin translucency?
 38
- What specific visual problem did the researchers address after winning the Oscar to achieve realism in close-ups?
 39
- Which two types of reflection did the researchers' later work focus on replicating?
 40 and diffuse reflection.