# Durer's Rhinoceros – Artists' Approaches to Reproducing Texture in Art

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## ABSTRACT

Since the introduction of computers, there has been a desire to improve the appearance of computer generated objects in virtual spaces and to be able to display the objects within complex scenes exactly as they appear in reality. This is a straightforward process for artists who through the medium of paint or silver halide are able to directly observe from nature and interpret and capture the world in a highly convincing way. However for computer generated images, the process is more complex, and could be compared to the notion of Durer's Rhinoceros – Durer created an image of a rhinoceros based on a description; he had not seen a real rhinoceros but managed to create a convincing likeness. In comparison, if data were inputted to build a rhinoceros on a computer, the accuracy of the image would also be dependent on the appropriateness of the data. Furthermore the computer has no capability to compare whether the rendering looks right or wrong – only humans can make the final subjective decision. I have used the term appropriate, because too much data could also be considered as a potential hindrance: too much information could slow down image processing, too little information could result in an incomplete image.

As humans we use highly complex terms to describe the things we see, and which are based on our background, age, education and cultural influences. My other reason for using Durer's Rhinoceros, is that the drawing was beautifully textured. Whilst it is not an accurate representation, it captures the roughness and bumpiness of the skin, the layers or folds of hide, the furriness of the ears. However, it is a difficult task to accurately convey all the essential textural elements. In order to translate between subjective and objective, to extrapolate numerical data from natural objects, and present ways that most people can understand is a challenge for many fields and industries. Mathematical models and methods have been developed, but there is an element of ambiguity, adjective and comparison.

The evolving question is, what are the elements of paintings produced by artists that capture the qualities, texture, grain, reflection, translucency and absorption of a material, that through the application of coloured brush marks, demonstrate a convincing likeness of the material qualities of wood, metal, glass and fabric? This paper aims to look at the relationship between texture, objects and artists' approaches to reproducing texture in their art.

## INTRODUCTION

The field of object perception is well documented both in the sciences and the arts [1, 2, 3, 4]. Objects, symbols of objects, even highly abstracted or badly drawn objects can be simply understood as a representation of the object. The new challenge is to render materials and objects whereby the textural attributes of the object are perceived to be convincing [5]. When looking at reproductions of photographs and artworks, the human visual system is more forgiving of halftoned images. However texture is problematic as our visual system is able to discriminate the difference between natural and patterned texture, and incorrectly rendered surfaces can hinder understanding. A natural texture appears homogeneous, but remains random - each element is similar but remains unique. However a patterned texture, although homogeneous is composed of the same repeatable and recognisable elements. Furthermore to render surfaces with no discernable pattern structure that comprises unlimited variations can result, as demonstrated by the computer-generated rendering, in exceptionally large file sizes.

Durer's rhinoceros can be compared to the current and emerging area of interest in the accurate reproduction and application of texture in additive layer manufacturing (ALM, 2.5D and 3D printing). Novel materials, decorative printing inks, textures and embellishments are now being incorporated to enhance the surface qualities of packaging and prints. Printed textures are considered acceptable where the surface is purely decorative (i.e. repeat patterns for wallpaper). However where a low relief texture is applied to photographic images, there has to be a correlation to the subject, and so far, convincing naturalistic rendering of texture has proven to be more difficult. The conflict between texture and image is more apparent where there are contrasts, edge contours, or attempts are made to distinguish relief from a flat picture plane. The appearance of false shadows and edges tends to amplify these problems. As humans we inherently know what appears to be wrong, whereas computers have no such powers of perception.

The primary question when looking at the relationship between the object and surface is: *does this surface look realistic to me?* Adelson highlights the difference between things and stuff, and to make things look more convincing, the stuff of things requires closer attention. [6] This does not necessarily mean that more information (or computer power) is required, but a better study on the relationship between the intrinsic and organic relationship of material and texture.

The complexity in the creation of a convincing textural render is essentially due to the enormous range of physical components that are required to incorporate all the nuances of a texture, such as colour, fibre, grain, reflectance, specularity, weave, hardness, softness, glossiness, fluidity; and as demonstrated in the previous list, the range of descriptive adjectives, cultural and specialist terms that extend these more subtle characteristics of a texture. Furthermore, these multi-variables of textures tend to be stored as a visual taxonomy in the human memory, whereby subtle textures and surfaces can easily be identified and differentiated by our visual memory. In a real world scenario, planed wood can quickly be distinguished from paper (grain, surface, flexibility) and animal fur from human hair (direction, colour, smoothness, curl) for example a fashion designer would quickly be able to differentiate textural variation between cotton, poly-cotton, velvet, calico, hessian, linen, silk, felt.

As humans we use highly complex terms to describe the things we see, and which are based on our background, age, education and cultural influences. In order to translate between subjective and objective, to extrapolate numerical data from natural objects, and present ways that most people can understand has been a challenge

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for many fields and industries. Mathematical models and methods have been developed, but there is an element of ambiguity, adjective and comparison.

As demonstrated in inkjet printed artworks, such as paintings and drawings, the textural and surface qualities of the inkjet prints rely on the optical mixture of colour halftoning. Digitally reproduced texture is implied through the use of dense areas of ink to suggest shadow and non-inked areas to suggest high points or highlights. Whereas, texture in analogue paintings and prints is generated through the physical relief of brush strokes, palette knives, pencils and charcoal, or printed surfaces through building and overprinting multiple layers of colour. In artistic practice, where paint is over-layered onto canvas or paper, the paint has a multi-dimensional quality, the varying translucency and opacity of the marks can be seen, as can gloss and matte differential between oil on canvas and watercolour on paper.

The difference between an artist's approach to drawing using paint on an iPad and drawing on paper can be loosely described as the difference between digital (graphical user interface, pixels, colour picker tools, vector, raster) and analogue (autographic, pigments, brushes, fluid dynamics, materials, texture). In the emerging 2.5D and 3D print market, there is now a requirement to develop methods that are a verisimilitude of real materials [7, 8] towards the reproduction of textures that have the look and feel of, for example, brushstrokes or textured surfaces. In a previous paper the author considered how by observing the brush strokes of painters, the images are generated through a repetitive over layering of paint. [9] The objective is to work towards the application of colour through surface deposition, by which an image is not transferred onto a pre-textured surface, but where texture and colour are integral to the mark, that like a brush, delineates the contours in the image. By re-addressing these historical methods and the ways images were painted, the potential implications for 21st century digital technologies could assist in the development of new rendering methods that incorporate vector and analogue approaches through the overlayering of different colour, pigments and decorative paints.

The evolving question is, what are the elements of paintings produced by artists that capture the qualities, texture, grain, reflection, translucency and absorption of a material, that through the application of coloured brush marks, demonstrate a convincing likeness of the material qualities of wood, metal, glass and fabric?

Artists have been long aware of the psychological aspects of the juxtaposition of colour in exploiting the optical qualities and arranging visual effects in artworks. The artists, such as Velázquez, Goya, Holbein, Raphael, Raimondo de Madrazo, Gainsborough, Reynolds (fig.1) demonstrated their mastery of texture by juxtaposing velvet with fur, satin alongside stiff silver embroidery. [10] (See also a selection of pictures listed according to materials at the end of the document) In order to better understand the convincingness of the visual appearance of texture, in this instance, this study has concentrated on the accurate rendering of textiles and metal, and the range of material qualities were they able to convey to the viewer through the medium of paint.

The paper considers the *photoreal* painting methods developed by artists working from the 15th to 21st centuries who were interested in creating a convincing representation of the attributes of a material. These paintings on close inspection demonstrate a gestural almost abstracted interpretation of the material and surface through colour and pigment. The paper suggests that in order to create both a convincing visual appearance, a high level of detail is not necessary, that too much information possibly hinders the appearance. It suggests that by using a more gestural approach, whereby the relationship of mark and colour, and by modulating the fluid dynamics of a mark through a textured surface, a more convincing rendering of texture can be achieved.

[1] Gombrich, E. H., "Illusion and Art", in Gregory, R., and Gombrich, E.H. (Eds.), [Illusion in Nature and Art] London, Duckworth (1973).
[2] Marr, D., [Vision - A computational Investigation into the Human Representation and Processing of Visual Information], New York, W.H Freeman (1982).
[3] Elkins, J., [The Object Stares Back], New York, Simon and Schuster (1996).
[4] Ramachandran, V. S., [The Tell-Tale Brain: Unlocking the Mystery of Human Nature: Tales of the Unexpected from Inside Your Mind], London, Windmill Books, (2012).
[5] Pappas, T. N., "The rough side of texture: texture analysis through the lens of HVEI," Proc. SPIE 8651, Human Vision and Electronic Imaging XVIII, 86510P (2013).
[6] Adelson, E. H., "On Seeing Stuff: The Perception of Materials by Humans and Machines," Proc. SPIE 4299, Human Vision and Electronic Imaging VI, 1 (2001).
[7] Koudelka, M. L., Magda, S., Belhumeur, P. N., Kriegman, D. J., "Acquisition, Compression, Synthesis of Bidirectional Texture Functions," ICCV 03 Workshop on Texture Analysis and Synthesis, (2003)
See also www.vision.ucsd.edu/kriegman-grp/papers/texture03.pdf
[8] Adelson, E. H., "On Seeing Stuff: The Perception of Materials by Humans and Machines," Proc. SPIE 4299, Human Vision and Electronic Imaging VI, 1 (2001).
[9] Parraman, C.E., "The development of vector based 2.5D print methods for a painting machine," Proc. SPIE 8652, Color Imaging XVIII: Displaying, Processing, Hardcopy, and Applications (2013)
[10] A highly useful resource of world wide art collections and archives, which includes some high resolution images of popular artworks. http://www.google.com/culturalinstitute