



Abstracts

Oswaldo Da Pos, and Liliana Albertazzi, *Colour Determinants of Surface Stratification*

If a coloured surface is overlapping and partially occluding another differently coloured surface, the visual margin separating the two belongs to the former and is the contour which closes it. The surface in the back does not appear closed by that margin, but is perceived amodally continuing behind the former surface. If on the contrary the two surfaces are perceived lying in the same plane, the margin, i.e. where the two abut, assumes a double function and on the one side is the contour closing one surface, and on the other side, at the same time, is the contour of the other. Therefore the stratification of the two surfaces goes in parallel with the function of the dividing border. It is well known that stratification depends on luminance contrast, and the higher the contrast the farther the two surfaces are seen one as respect to the other [1,2,3]. Nevertheless it is also well known that some colours usually are perceived nearer and other farther from the observer [4]. The problem then is what are the colour conditions for perceiving coloured surfaces in the same fronto-parallel plane. We conducted four experiments in which participants had the traditional task of adjusting the colours to make perceptively coplanar the correspondent surfaces. In experiment one and two there were two regions one with fixed colours and the other with the adjustable ones; in experiment three and four there were five regions, again one with a fixed colour and the other had to be adjusted. Our findings suggest that colour determinants of surface stratification cannot be reduced to simple luminance contrast but this must be weighted as a function of the natural lightness of hues, with a consequent influence on colour harmony.

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Kengo Kuma, *Surface, Screen and Structure*

We want to create a façade that feels like animal skin.

The skin of living things has thickness. The thickness balances environmental differences between the inside and the outside of the body. And this thickness is gained from accumulated layers. In my view, façade of architecture can be thick with the existence of layers, therefore must be much thicker and more stratified. Accumulated layers show that the exterior changes gradually towards the interior – outdoor to indoor. By being layered, the skin could become a structure to support architecture. The skin of sea cucumber is a great reference for this. Their bone is not located at the center of the body. It is broken into pieces and tucked into the skin. In my design also, bone is often scattered into the skin and the two elements are indistinguishable. As the result, such skin with thickness becomes soft and warm. Stroking it is so relaxing – like when you caress your sweetheart.

Gabor Domokos, *Natural Numbers, Natural Shapes*

The first step towards understanding natural shapes might be their systematic description. Instead of creating a hierarchical list of names in the spirit of Linné, we try to classify shapes based on naturally assigned integers, carrying information on the number, type and interrelation of static equilibrium points [1,2]. In mechanical language, these are points where the body is at rest on a horizontal surface, in mathematical language these are the singularities of the gradient flow associated with the surface.

While at first sight this appears to be a rather meager source of information compared to the abundance of three-dimensional shapes, we found that often meaningful information is condensed here.

One advantage of this classification is that we count (instead of measure) and thus do not add observer-related noise to the obtained data. Counting equilibria results in several, distinct integers describing different geometrical aspects of the

investigated shape. One can distinguish between stable and unstable equilibria, also, the graph (called the Morse-Smale graph) carrying the topological information about their arrangement [9] can be uniquely identified by an integer. Beyond physically existing equilibria we can also count imaginary ones, corresponding to arbitrarily fine, equidistant polyhedral approximations [8], providing information about curvatures.

When looking at various shapes in Nature, ranging from coastal pebbles [3],[7] to asteroids [6], from extant [4] to long-extinct turtles [5], the integers extracted by the described means appear to carry information relevant to natural history. One could also imagine the long evolution of these shapes (whether biological or mechanical) as a coding sequence. Whether or not equilibria are the 'true code', we do not know, however, these simple numbers certainly help to better understand evolutionary history [10]. We are also confronted by some puzzles: shapes corresponding to some special integer combinations appear to be missing from Nature.

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Jan Koenderink, *Skin Deep Only*

The concept of a “surface” is a rather problematic one. It has evolved since ancient times, and keeps evolving today, in such widely different fields as – among more – geometry, physics, the phenomenology of visual awareness, and the visual arts. It is perhaps remarkable that even stuffs of great biological importance are usually hidden from sight by some skin, crust, or shell, with a very different look from that of the desirable material inside. Just think of peaches, nuts, eggs, cows, and so forth. This is not only true for nutrients, which are animal or vegetable, but also of inorganic materials. Pieces of metal are covered with oxide layers, and even stones have a crust due to weathering. Human artifacts are commonly treated so as to give them a desirable “finish”. Examples are painting, varnishing, application of cosmetics, or the French polishing of woods. Often such skins are automatically produced by the manufacturing process. For instance, the ancient Greek way of cutting marble involved a pointed tool, applied at right angles to crush the stone. This produces a surface with a decidedly different “look” from the surfaces one produces by taking off chips with the modern flat chisels. In wood sculptures the choice of surface attitude within the block is decisive for the visual appearance, due to the strong anisotropic scattering of light by the wood grain. Our experience of surfaces is mainly of a haptic and visual nature. Thus we frequently describe the looks of a surface in terms of haptic experiences, even when we're unable to touch it. Such transmodal awareness is developed to an extraordinary extent in painting, and drawing, where the skins of things are replaced with daubs of paint, or patterns of marks.

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Laurence Maloney, *Perception of Surface Color and Illumination in Three-Dimensional Virtual Scenes*

In everyday scenes, the intensity and chromaticity of the light absorbed by a matte surface depends on its location and orientation. I will first describe recent experiments intended to investigate surface color perception in 3D rendered scenes [1,2]. We found that the visual system partially compensates for changes in illumination due to changes in location and orientation of test surfaces. In carrying out these experimental tasks, observers effectively represent the spatial distribution, chromaticities and relative intensities of light sources in the scene. The bidirectional reflectance distribution function of a Lambertian surface acts as a low-pass filter on directional variation in the light field [3,4]. Consequently, the visual system needs to discount only the low-pass component corresponding to the first nine terms of a spherical harmonics expansion to accurately estimate surface color. We test experimentally whether the visual system discounts directional variation up to this physical limit and find that it does [4]. I'll describe additional experiments where we assess how the visual system estimates the distribution of light in scenes (the light field) and how it used this information in estimating surface colors [6,7].

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Daniel Osorio, *Cuttlefish Camouflage: Seeing and Making Surfaces*

Cephalopod molluscs - octopus, cuttlefish and squid - may be the nearest we will get to intelligent life from another world. They have solved problems of perception and action from a different evolutionary starting point. How for example are limb movements organised without joints [1]? Equally remarkable is the ability to control the skin's physical texture and coloration pattern. Cephalopod skin can have over 100 chromatophores per mm [2], each containing pigment (of varying colour) that can be opened by a muscle, which is directly innervated from the brain. How is such a powerful system organised to produce moving and static patterns for camouflage and display? Camouflage is mainly under visual control: the animal's appearance depends on what it sees. The chromatophores are activated in groups known as behavioural components, which produce local visual features such as a white square on the back and dark lines across the head, or visual textures. The European cuttlefish has about 40 components, which are expressed flexibly to produce thousands of camouflage patterns. The ability of non-human animals to discriminate surfaces and recognise objects is normally tested by binary choice experiments. Cuttlefish can potentially produce thousands of patterns, which requires commensurate visual processing giving unique insight into their perception. We study how these animals use 2- and 3-dimensional image parameters and visual features to select their coloration [2,3]. Our evidence suggests that they have effective mechanisms for identifying objects by edge detection and other mechanisms of figure-ground segregation familiar in humans, and are also sensitive to depth and shadowing. How the cephalopod brain integrates diversity of visual information about surfaces and objects and co-ordinates the expression of its coloration patterns, and how they work as camouflage are open questions.

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