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JOT Journal for Surface Finishing

Powder Coating
How safe are standardised test methods in practice?

New Automotive Colour Trends
Cool in blue – automotive colours of the future

Continuously Improving Measuring System
Pinpoint temperature control in painting lines

Automobil-Lackierung
Hightech für makellose Oberflächen

Describing Visual Perception Instrumentally

Existing measuring methods for visual impression characterisation are highly complex and mainly reserved for experts. In order to achieve fast and simple statements about the visual quality of a surface, a measuring instrument depicting human perception was developed.

The appearance quality of painted surfaces is of high importance for coaters and especially automotive manufacturers, since the first visual impression of the surface finish often has a considerable impact on the customer's final buying decision. The quality of painted surfaces should therefore be perceived as visually appealing. In addition to the tone of colour, this is also influenced by the surface texture.

Conventional measuring instruments rely on users who can interpret the sometimes highly complex values from several measuring instruments as real visual appearance quality. This can lead to unclear communication about surface conditions, e. g. between the manufacturer and the suppliers of add-on components. Problems with the correlation between measured values and visual perception can lead to a finish which doesn't meet the manufacturer's expectations, although all conventionally measured parameters are within their tolerances.

The new measuring instrument imitates the human eye and captures images on different focal planes. On this basis, and with the aid of algorithms, the properties are calculated.

Measuring System Imitates the Human Eye

In order to optimise painting processes, the German car manufacturer Volkswagen AG initiated a comprehensive project a few years ago, which also dealt with the examination and improvement of basic processes involved in measuring surface quality. The project resulted in the development of a completely new instrument technology by Rhopoint Instruments Ltd., a company which specialises in qualitative evaluation of the appearance quality of surfaces. An important part of the project was the intensive investigation of human perception, which was carried out at the German car manufacturer Audi AG. The joint development of definitions and calculation models was required for a comprehensive description of the viewer's visual experience.

The human eye views surfaces by passing through two different focussings: Short distance focussing for the evaluation of surface structures and defects as well as focussing on reflections and flow outs of a surface at a so-called „showroom" distance, i.e. a distance of about 1.5 meters, which is the general distance of a viewer for visual inspection.

Contrast is linked to the tone of colour of a surface; white and metallic surfaces have a low contrast, while jet black surfaces have a high contrast of 100%.
Example: On the left is a reflection on a white surface with a contrast of 40%, and on the right is a reflection on a black surface with a contrast of 100%.

Sharpness quantifies the level of detail of pictures reflected from a surface; 100 % account for a maximum of detailed reflection. Example: On the left is a blurred view, and on the right is a sharp view.

In the process, the viewer's brain passes through various evaluations, forming the basis of his reaction: "Is this product looking good?" or "Do adjacent parts have a harmonic and uniform appearance?" – these are processes ultimately affecting the buying decision.
The new measuring instrument (Rhopoint TAMS) simulates these processes by imitating the human eye's functions and depicting the mechanisms in the brain by means of a double focus imaging technology as well as image reproduction and data processing systems. The measuring system captures the images on different focal planes and calculates the properties with the aid of algorithms.
Based on these insights, it is possible to specifically capture the impression of the visual appearance. Easily comprehensible mesurands were selected, which allow clear communication between all responsible internal and external members of the motor vehicle supply chain.

Four Parameters to Describe the Visual Experience

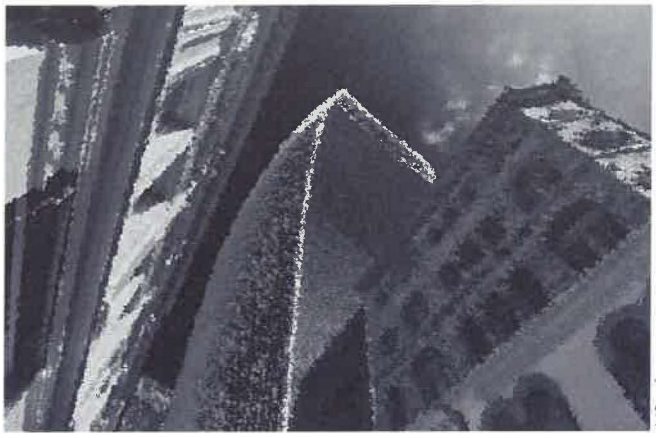
For the comprehensive description of the visual experience, the measuring instrument utilises four parameters: Contrast, image sharpness, waviness and dominant structure size (dimension).

Harmony and Quality Number is Crucial

Whilst these parameters can be used alone for evaluation, a significant advantage of the instrument is that these parameters can be combined to form two novel values: The quality and harmony number.

- The quality number (Q) is a single value combining the entire appearance quality of a surface, where 100% stands for an absolutely smooth surface with a perfect visual impression.
- The harmony number (H) was developed for the acceptance rating of two adjacent parts. A value > 1.0 indicates that the visual quality of the adjacent parts is considered bothersome by the observer.

Both values are crucial in order to receive a go/no-go evaluation for a final quality check in the production line or to establish action limits.



Waviness is a measure derived from human perception for the visual impression caused by surface waviness, when the viewer is at showroom distance (1.5m). Viewers prefer surfaces that appear smooth, e.g. with a low waviness value.

Example: On the left is a smooth surface, and on the right is a wavy surface.

Dimension describes the dominant structure size at showroom distance. The dominant structure size is an important factor to determine the harmony of two adjacent parts. A distinction is drawn between small-scale structure dominance (left) and large-scale structure dominance (right). Example: On the left is a small-scale structure dominance, and on the right is a large-scale structure dominance.

Based on optical measuring technology, the new system offers an essential advancement for measuring automotive and premium high gloss coatings, as it quantifies the visual experience and facilitates interpretation and transmission of the results. The technology provides a comprehensive view of different surfaces; from steel serving as vehicle to different intermediate layers, such as CDC, filler or finishing paint. Hence, the measuring instrument assists in surface finish optimisation and provides new quality criteria, which are not subjectively influenced by a purely visual evaluation.

The underlying technology makes further customised evaluation methods conceivable in the future. Here, Industry 4.0 will play an important role.

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