Multicolored is my new favorite color

Revolutionarily easy color set up by *Color FEX*®

"Multicolored is my favorite color" – Walter Gropius, one of the most famous advocates of architecture and design, once admitted. In image processing, this is far more meaningful than any simple parameter. When thinking of colors the first picture that comes to mind might be children sorting "red", "green", or "blue" colored pencils. Similarly, Baumer's new vision sensor, *VeriSens*® Color, is capable of sorting objects by color.

Seeing colors is a perception – a sense only enabled by special anatomical building blocks. Daylight provides our brain with additional information on hue and saturation. For color mapping by color models, human eyesight and perception were "standardized" in test groups and statistics. Different color models have been created, for example the so called HSV-model – mapping hue, saturation and value (in relation to brightness). The well-known RGB color model is different, but none can do without a third dimension.

Bad news

This is bad news when it comes to sorting by color in industrial image processing – especially since clear limits are essential. Known vision sensor parameters are number of surfaces, edges, distance – always in the form of a numerical value with related minimum and maximum limit. Applying the above to the necessary third dimension makes the problem clear: Color mapping calls for three independent adjusting parameters (hue, saturation, brightness). Including associated tolerances results in six parameters per color, i.e., each with a minimum and maximum limit in the three dimensions of the color space. When it comes to color distinction, things become even more complex. Besides observing the numerous limits in relation to each other there must be no overlap in the color

Baumer's VeriSens® XC series vision sensor with Color FEX®.

space. This is further complicated in view of the shades created by illumination in the image processing task.
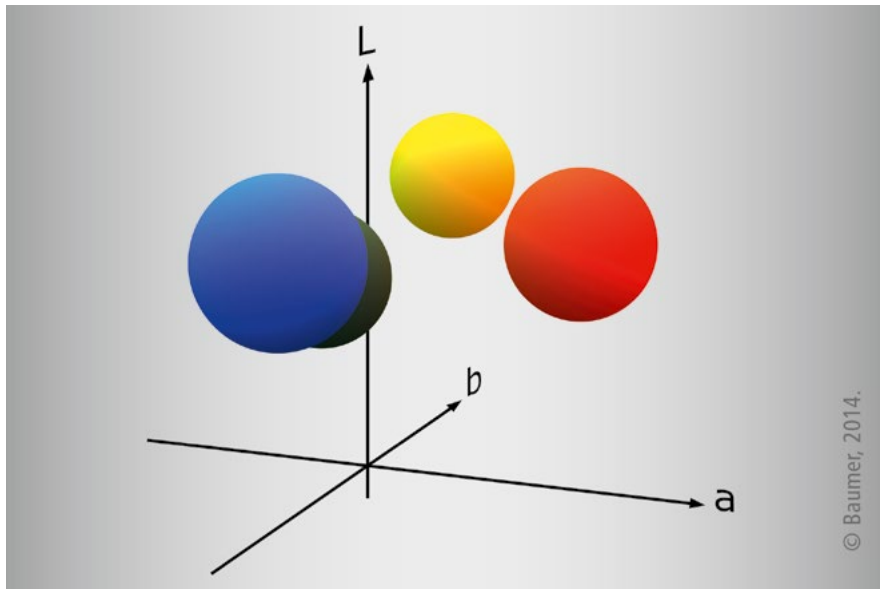
Inspired by color pencils

A child would sort pencils by their red, green or blue color without thinking in three-dimensional vectors. That's exactly the point where Baumer *VeriSens*® vision sensors with *Color FEX*® come in. One of the crucial objectives in development was making color set up extremely easy to all users – ideally allowing the process to be completed intuitively without instruction. A final example of a typical vision sensor application is color identification in the proper order. When recognizing color codes or verifying the correct arrangement of color LEDs or colored products, one speaks merely of red, green or blue objects without using colorimetry – close to the vision sensor's root intention in application practice. This brings up the question: How does one move from complex 3D color models to simplicity in color inspection?

Color FEX® in *VeriSens*® vision sensors can be thought of as an intelligent set-up wizard. After teaching the object colors, the sensor defines the related color space in the form of 3D spheres. The core represents the color while the tolerances are mapped in the radius. Visualized in 3D, the spheres are verified upon collisions among each other. The core color is assigned a name by the system, which means a yellow area is also yellow by name.
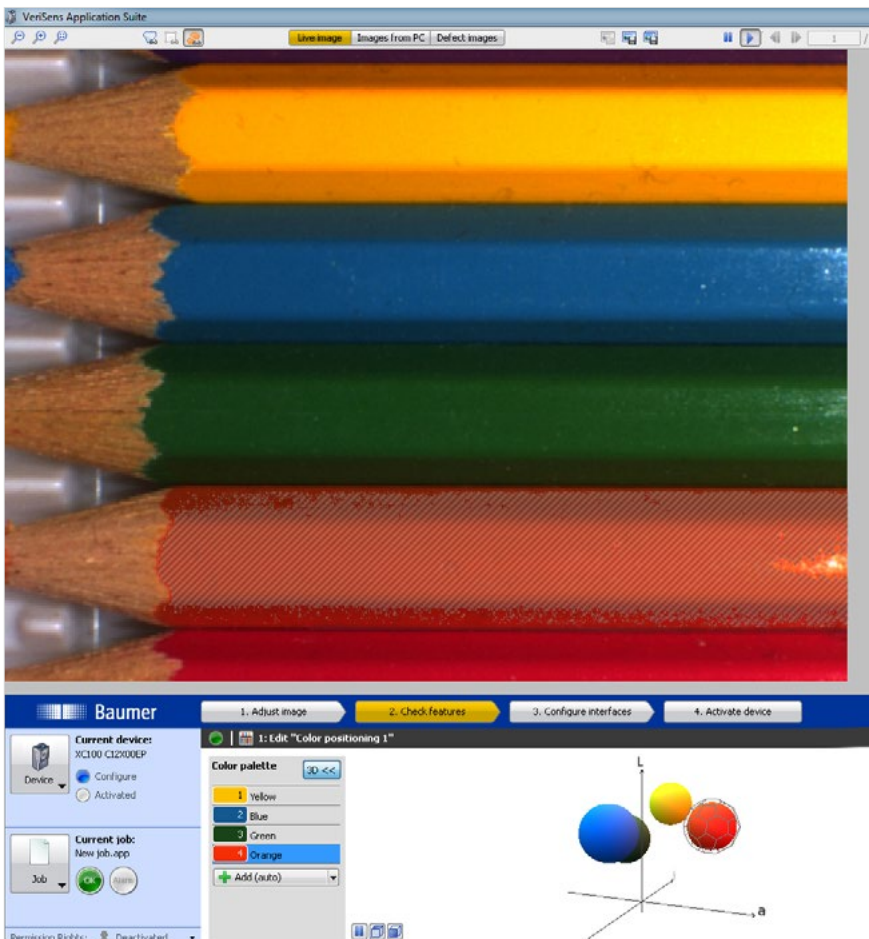
No Experts required

This is a true benefit to the user with limited experience: When seeking to make sure the object is blue or green or the red LED is to the right of the green one – and not vice-versa due to an error in component placement. The user takes center stage, accompanied simply by "the color". A color sphere mapping the variable tolerances in its size is sufficient for dependable color inspection: No collisions in the "universe of spheres" ensure reliable color differentiation. The spheres can be seen by

the user during color inspection setup to ensure the bright orange is not the yellow of the neighbor object. The only question remains: Must the user know about color science and color models? The answer is a clear *no*. VeriSens® with 3D color sphere graphics requires no expert knowledge on color models. The universe of color spheres explains itself. Successful usability tests performed by Baumer proved also non-experts capable of reliable color param-eterization within a few minutes. Finally, sorting color pencils has become child's play for adults.

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The „universe of spheres" in color mapping.

Verification of correct pencil arrangement: after color teaching in VeriSens® Application Suite, the four colors are visualized as spheres. No collision with each other will ensure reliable color inspection.

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