Everything in view - Field volume as a new quality criterion in stereomicroscopy

Leica
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Stereomicroscopes are often required in production areas such as electronics and medical products (hearing aids, cardiac pacemakers) manufacturing, as the spatial impression is essential for manufacturing and repairing workpieces.

For decades, ingenious optics designers and engineers have taken up the challenge of pushing stereomicroscopy to the limits of what is optically possible. In doing so, they are always constrained by the interrelation between resolution, magnification and depth of field: the higher the resolution and magnification of a microscope are, the lower the depth of field will be. However, a reduced depth of field makes assembly and manufacturing tasks more difficult.

With the FusionOptics™ developed for the Leica M205 high-performance stereomicroscope in 2007, Leica Microsystems was able to go one step beyond the previous limits of classic stereomicroscopy and increase resolution and depth of field equally.

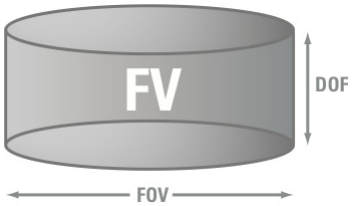
For the first time, this technical approach of FusionOptics™ has now been able to be used for a routine stereomicroscope. Where the high-performance stereomicroscope featured increased resolution, the Leica A60 features a depth of field that is doubledby the FusionOptics™ principle.

Greatest field volume for maximum productivity

The field volume is the volume displayed by a stereomicroscope in sharp focus. The field volume is calculated from the area of the field of view multiplied by the depth of field.

The formula for field volume is as follows:

$$FV = \left(\frac{FOV}{2}\right)^2 \times DOF \times \pi$$



FV = Field Volume, FOV = Field of View, DOF = Depth of Field

With the values for the field of view and depth of field, the Leica A60 attains a fieldvolume of 22.6 cm^3. Thus it is several times higher than comparable instruments. While resolution and magnification are important metrics for high-end stereomicroscopes, the field volume is the chief indicator for a routine stereomicroscope. All parts of a specimen that are within this volume are displayed in completely sharp focus. In practice, this means less need to refocus and move the specimen. The workflow is made shorter and easier, the risk of errors is decreased and the ability to concentrate is maintained for a longer period. All of these factors taken together result in a substantial increase in productivity.

Leica A60: The stereomicroscope that sees more

For assembly and repair tasks, in addition to the depth of field, the size of the field of view - the area visible through the microscope - is a central feature of a stereomicroscope. This feature has likewise been taken into account when developing the new Leica A60 stereomicroscope. The magnification range of 5 – 30× has been selected such that with 46 mm, it has the largest field of view of its class at the starting magnification. Moreover, the Leica A60 provides a depth of field of 13.6 mm at the lowest zoom level with the FusionOptics™ used. This allows even tall components to be brought into sharp focus, where previously the user had to refocus.

The secret of FusionOptics™

FusionOptics™ makes use of an organ that is exceptional in many respects: the human brain. In addition to thinking and controlling the human body and providing an immense data memory, it plays a role in many areas of life without our being aware of it. We take in our environment with two optical sensors, the human eyes. The brain processes the two image channels to create three-dimensional images, allowing us to also classify objects in terms of depth of space. It is only because of this that we can evaluate and manipulate the smallest spatial structures. However, the brain accomplishes even more astounding feats. Vision problems in one eye, which are very common, are compensated for without any problems.

FusionOptics™, developed in conjunction with the Institute for Neuroinformatics at the Swiss Federal Institute of Technology (ETH Zurich) and the University of Zurich under the leadership of Dr. Kiper, makes full use of this effect. The right image channel is responsible for resolution, while the left channel provides the large depth of field. The brain takes the best information from both of these sources. This optical approach brings with it two great advantages. The optical resolution is identical to that of existing concepts, while the depth perception is approx. 100% better than in the classic approach – at every magnification setting!