# Linearmotor as a key-component in the microscopy

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## Abstract

In MICROSCOPICS, structures must be imaged with sub-µm and be imaged with crystal clarity. To ensure that this succeeds, the motor as a drive component within the positioning system for the microscope stage, the motor makes an essential contribution. The challenge in microscopy is the rapid collection of the smallest structures in combination with high precision and efficiency. At the same time, the cost side should not be disregarded. A fast and reliable acquisition of the sample material to be examined can sometimes save human lives. For ITK Dr. Kassen GmbH, this represents a motivation to direct technical know-how in the appropriate direction and to develop positioning systems that support traditional microscope technology in analysis. This involves a wide variety of applications for microscopy - from life sciences to the the semiconductor industry to materials diagnostics. One field of application within microscopy is 'live cell imaging'. Here, it is particularly important to generate many sharp images in the shortest time of the sample to be examined. In practice, this means that, for example, with a 40x lens used, ten positions per second can be recorded (image 2). An essential component within the microscope application is the microscope stage. The living cells to be studied are only available in limited numbers and their lifespan is limited. It is therefore crucial to quantify the processes within the cell as quickly as possible. Two decisive factors should be mentioned here: The Traveling speed and the precise reaching of the target position. The Screening of the sample material to be examined must be fast and precise. Many thousands of such images are then stitched together via software. The stitching together of these enormous amounts of data is faster the more precisely each individual image within the overall picture has been captured. This means that the less overlapping of the individual images, the less the evaluation software has to calculate to correct the offset. Thus time it takes to generate a sharp image. Users confirm that precise and fast positioning at the beginning of the process chain offers significant advantages in image acquisition. Here, the synchronization between image acquisition and the motion sequences of the microscope stage is crucial for the result.

**Every sub-micrometer counts**

However, a system consisting of individual components is only as good as the weakest link in the chain. In order to meet the requirements of the market high-performance drives are needed. Commercially available motors have physical limits - these are overcome with the in-house developed and manufactured linear motors. The drive concept with the individually linear motors results in numerous advantages for the end user. The low overall height of the linear motors is also reflected in the dimensions of the microscope stage. With a height of only 30 mm, the microscope stage high degree of freedom with regard to the installation space. The larger the space between the objective and the microscope stage, the lower the risk that the objectives can be damaged when inserting the specimen material.

If you would like to have interesting areas within a sample at certain time intervals the exact location has to be approached again and again. The corresponding coordinates of the point to be approached are already stored in the software and are known. In these mark-and-find experiments, each sub-micrometer counts. The important parameter is the repeatability. It tells you how precise a certain position can be achieved. This is where the drive concept with linear motors in combination with the absolute measuring system within the microscope stage shows its strengths. Positions can be reached with a precision of less than 0.25 µm. In the sample material to be examined, the user decides the speed at which speed can be reached precisely. In experiments to study growth processes, holding a position, often for a period of 24 hours, is necessary. Live cells are examined at an ambient temperature above 37 °C in an incubator. Special requirements are placed on the microscope stage. Different materials have different coefficients of thermal expansion. Knowledge of the material properties as a function of temperature is enormously important when dealing with expansions in the µm range. Even the slightest deformations due to thermal expansion of the materials used within the microscope stage have an influence of the result. Where confocal microscopy is used, very high demands are placed on accuracy and positional fidelity. To meet these requirements, special high-tech materials are used for the microscope stage. ***The result:*** Hardly measurable drifts of the position and thus only corrections in the evaluation of the images - the computing time required for the correction is thus is considerably reduced. This reduces the costs significantly.

Thunder Imager 3-D-Cell Culture with Quantum microscope stage from ITK Dr. Kassen GmbH