

Optical microsystems for advanced imaging in biomedicine

In medical diagnosis, digital imaging is an essential technique in every day practice. The realization of innovative optical system designs by means of combination of optical M(O)EMS components like Spatial Light Modulators and micro scanning mirrors with passive optical elements will lead to new systems for biomedicine and, hence, will enable new applications.

Optical microsystems cover a broad variety of applications in biomedicine. For optical investigations into embryonal development of organisms for instance, continuous and long-term microscopy is required. However, the inevitable illumination of the cells damages the species. In order to overcome this negative effect called phototoxicity, a selective illumination of the region of interest with spatial-angular control of light is required. Solutions for such a structured illumination make use of optimized spatial light modulators, realized as monolithically integrated micro mirror arrays by Fraunhofer IPMS. Each one of the up to several million mirrors on one chip can be individually tilted around the central axis in an analog fashion. A dedicated optical setup comprising two of those MOEMS components enables control in space and angle of incident light.

Another example is in-situ detection of malign cells during tumor resection. The surgeon needs the information if the margins are free of remaining tumor cells, which is often still determined by rapid incision and visual analysis by pathologists. A novel compact confocal laser scanning fluorescence microscope based on MEMS scanning mirrors with integrated image analysis is a means to significantly reduce the time for the surgeon and the patient.

Dr. Michael Scholles is the head of the Fraunhofer Project Hub "Microelectronic and Optical Systems for Biomedicine" (MEOS), in Erfurt, Germany. He has almost 30 years of experience in R&D for electronic and photonic systems. Previously, he was responsible for business development and strategy and had other management positions at the Fraunhofer Institute for Photonic Microsystems IPMS Dresden, which is one of the three Fraunhofer Institutes that operate the Project Hub MEOS. He has a diploma and a doctoral degree in electrical engineering, both from Gerhard Mercator University of Duisburg in Germany.