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Publication date:
2016

Document Version
Publisher's PDF, also known as Version of record

Link back to DTU Orbit

Citation (APA):
Glückstad, J., & Banas, A. R. (2016). *The R&D-platform for OptoRobotix and its new tech-transfer GPC Photonics*. Paper presented at EU ITN RELEVANCE, Amsterdam, Netherlands.

The R&D-platform for OptoRobotix and its new tech-transfer GPC Photonics

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The ability to efficiently sculpt spatially coherent and quasi-coherent light has a variety of new and disruptive applications in both academic and industrial R&D. In particular, spatial beam encoding based on non-absorbing means such as phase-only modulation methods has been extensively applied in contemporary laser microscopy, for advanced optical micro-manipulation [1,2] and in fully parallel two-photon optogenetics [3]. These example applications demand light wavefronts to be sculpted in a variety of asymmetric ways [4]. One typical case from the optics lab. is the frequently occuring need for efficiently illuminating e.g. the rectangular aperture window of a high-end spatial light modulator using a circular symmetric laser beam. Another challenging need is found in optogenetics [5] where the urge is to selectively address complicated patterns of neurons even with shaped light following the particular shape of dendrites and axons. Since light sources based on lasing is typically having a circular symmetric Gaussian illumination profile for single mode operation more than 2/3 of the incident laser power might be lost when the aim is to address e.g. a rectangular aperture with a homogeneously expanded version of the orginal beam [6-8]. Moreover, the light lost in this process will inherently lead to heating of the surroundings and thereby contribute to the shortening of expected device lifespan or might even require the supply extra power for obtaining active cooling of the applied optics and photonics devices.

In GPC Photonics - now an integral part of OptoRobotix ApS - we apply the proprietary GPC (Generalized Phase Contrast) method to obtain a light-based »impedance matching« to sculpt single mode laser profiles into a variety of forms and shapes including static optical device apertures. GPC is based on a common-path light-propagation configuration [9] where phase-only input patterns are directly mapped pixel-for-pixel in a 4F-architecture by interfering phase-shifted low spatial frequencies with directly transmitted high spatial frequencies. Thereby GPC can effectively reduce and in some cases even prevent highly disturbing speckle noise and dispersion effects known from e.g. phase-only holography. Hence, GPC can be advantagously applied using multiple laser wavelengths or for spectrally broad light sources such as ultrafast pulsed lasers or contemporary supercontinuum sources [10-12]. A variety of GPC-embodiments have been successfully demonstrated in the laboratory during recent years and will now be harnessed for commercial use under the auspice of GPC Photonics and OptoRobotix [13-16].

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