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Smart imaging devices for bioimaging (SidBio)

Project idea:

Modern imaging sensors, such as SCAMOS cameras and SPAD-arrays, deliver unprecedented data rates. This opens new opportunities for the bioimaging field, but also poses challenges on image processing and quantification as well as data handling such as storage, sharing, streaming and visualization. This project aims to (i) implement on-chip spatio-temporal resolved imaging patterns in collaboration with camera manufactures, (ii) to establish a real-time data processing pipeline for bio-imaging data and (iii) develop real-time algorithms for lossless as well as “information less” compression and hereby reduce the amount of data to be stored over years significantly. In particular in the field of fluorescent 3D high-speed imaging with light-sheet microscopes, where single experiments can yield tens of terabytes of data per day, a tight integration of imaging sensors and processing is needed. In addition to FPGA- and GPU-based image processing of the camera data streams, the increase on-chip logic can be used to implement novel imaging modalities (see comments below).

Direct applications and Industrial end users:

We expect direct application in the field of fluorescent microscopy and adjacent applications such as drug discovery (high throughput and high content screening), flow cytometry or electron microscopy which will foster research across all scales in the life sciences from cell biological to the organismal scales and in the end translational medicine.

EMBL is at the forefront of research conducted in the areas described above and its recent Spin-off Luxendo explores the use of the above-mentioned technologies in light sheet microscopy.

Areas of technology spillover:

Similar concepts, algorithms as well as complete submodules are needed in applications where data handling is currently limiting general use. Such application include 3D cartography of buildings, cities and landscapes, 3D vision in robotics as well as automotive industry (driver assistance), medical data processing for CT and MRI images.

Comments:

Our collaboration with Hamamatsu Photonics Germany and Japan has lead to a sensor modification, which enables confocal line detection on latest SCAMOS sensor without any addition optical components[for details see Medeiros et al, 2015 and Patent pending]. Although this work marks only the first steps, it has triggered similar approaches other camera manufactures (Andor Technologies and PCO GmbH Germany).

Reference:

Medeiros G, Norlin N, Günther S, Albert M, Panavaite L, Fiuza UM, Peri F, Hiiragi T, Krzic U, Hufnagel L. (2015)

Confocal multiview light-sheet microscopy.

Nat Commun 6 doi: 10.1038/ncomms9881

Summary

3D bioimaging, smart sensors, large data handling, real-time image processing.

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