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SMART MEDIA

REAL-TIME ULTRA HD VIDEO ENHANCEMENT

A decade and a half ago we were lucky if our camera had a 2-megapixel resolution. Now, some photo cameras boost a resolution of up to 25 megapixels. The reason is the enormous progress in CMOS imaging sensors. Unfortunately, lenses have not evolved at the same speed. As resolution improved, lens imperfections became more visible, causing blurred edges. As part of the Horizon 2020 project EXIST, researchers from imec – University of Ghent developed a computational solution for real-time video enhancement, which is flexible, universal and scalable.

HIGH-QUALITY VIDEO WITHOUT INVESTING IN A HIGH-QUALITY LENS

In a nutshell, the problem is that color components are not always reaching the correct pixel location, due to chromatic aberration. Different colors of light have different wavelengths and are therefore sometimes refracted differently when passing through the lens. The result is visible in the image as colored fringes along boundaries of dark and light colors.

As pixel size becomes smaller, these aberrations become more pronounced. In addition, most cameras today use a single imaging sensor overlaid with a color filter array, which further increases the visibility of these artefacts. Technically, upgrading the hardware – with better lens design – could fix the problem. But these high-quality lenses are very expensive and bulky and don't fit more compact applications, such as

smartphone cameras.

Researchers from IPI (Image Processing and Interpretation), an imec research group at the University of Ghent, have developed a computational imaging-based method, which simultaneously performs noise reduction, chromatic aberration correction and demosaicking.

The most important advantage of our method is that video enhancement is performed in real time, instead of offline via specialized editing software (like many existing lens distortion algorithms). There is also no need to select affected areas, because the correction process is fully automatic.

Our algorithm is programmed on GPU with Quasar (also developed by IPI) and not implemented in FPGA like current solutions for broadcast cameras. As a consequence, our

alternative is much more flexible without any trade-off in performance: it can easily be transferred to new PC hardware and is compatible with different types of lenses because the parameters of the algorithm can be adapted on-the-fly. And by simply upgrading the GPU and other PC hardware, the same algorithm can be used to process much higher resolutions and frame rates.

Key features:

- **Flexible:** can adapt to any type of camera, lens, mosaicking pattern, frame rate or resolution
- **Scalable:** higher resolutions and frame rates can be handled by using faster GPU and other PC hardware.
- **High performance,** similar to hardware solutions (FPGA) but more flexible
- **High frame rate:** 30 frames per second for 4K Ultra HD video

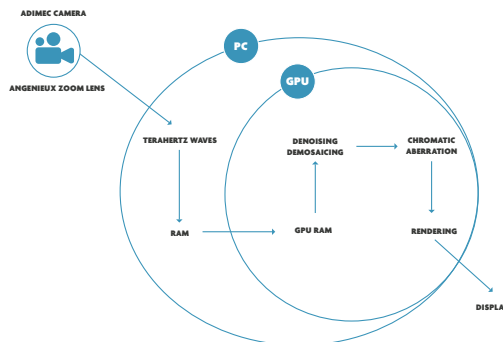
FROM SURVEILLANCE CAMERAS TO SMARTPHONES

This research is part of the EU-funded project EXIST. The aim of this Horizon 2020 project is to research next-generation technologies for CMOS image sensors that have applications in many different fields, ranging from entertainment to medical imaging and security cameras.

This algorithm for video enhancement neatly fits into this project thanks to its versatility. Because it can easily adapt to different lens types, imagers, new processing hardware, etc., it offers perspectives for many different applications. Not only could it be used to enhance video quality from broadcast cameras, but it could also be used for surveillance cameras (as distortions might blur details that are important from a security point of view, e.g. a car's license plate) or become integrated in smartphones, microscopes, telescopes, etc.

LOOKING FOR: INDUSTRY PARTNERS

We have a working demonstrator that proves the potential of our algorithm. Currently, we are looking for partners from the industry – e.g. camera manufacturers, developers of photo editing software or operating systems, etc. – who are interested in licensing our technology.



Our video enhancement solution is programmed on GPU and can process Ultra HD video in real time (up to 30 fps).



Image from a surveillance camera at sea. Chromatic aberration causes colored fringes around the edges of the boat's sail.

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