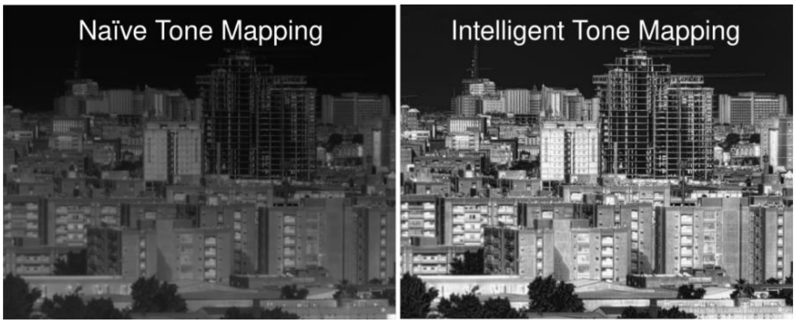
Deep Learning Based Tone Mapping for Infrared Images and Videos

Master's Thesis



Tone Mapping is a method used in the field of computational imaging to map a High-Dynamic Range (HDR) image to a limited dynamic range. A camera that is able to acquire images with a value range (=bit depth) larger than 8 bits per pixel (bpp) can lead to suboptimal images when naïvely displayed on a standard monitor limited to 8 bpp. Such naïve displaying can be the result of linear downscaling and the rich information contained within the higher bit depth can get lost. Instead, intelligent and image content sensitive mapping such as tone mapping can not only preserve all relevant information but even emphasize it. This approach is well-known for its application in computational photography, where visual-optical (VIS) HDR images and tone mapping can be used to make details of the image content visible even in case of difficult illumination conditions. Similar demands raise for visual surveillance applications, in which thermal infrared (IR) cameras are used. Although thermal IR cameras do not see reflected but emitted light, different temperature ranges within the same observed scene can lead to image regions with weak contrast. For a human operator, such regions can contain crucial information for scene understanding and need to be preserved by an appropriate tone mapping algorithm.

In this master's thesis, tone mapping for a high-quality cooled thermal IR camera shall be performed using novel deep learning techniques. One powerful reference algorithm that is not based on machine learning already exists at HENSOLDT Optronics and serves as a baseline. Existing tone mapping algorithms shall be compared and evaluated for their suitability. The best performing algorithm is identified and used to produce the desired output images. A large dataset of HDR thermal IR training images with 14 bpp already exists at HENSOLDT Optronics and is used as input. Then a Deep Convolutional Neural Network (DCNN) is trained with this dataset and learns to apply tone mapping to thermal IR images. There are two potential benefits: the image quality can be higher compared to the baseline algorithm or the processing can be faster by using the DCNN. The generalization abilities of the DCNN based tone mapping approach can be analysed via cross-validation using public thermal IR datasets that also provide images with 14 bpp.

This thesis will be jointly supervised by HENSOLDT and KIT. For more information, please contact:

Dr. Saquib Sarfraz, E-Mail saquib.sarfraz@kit.edu, Tel. +49 721 608 41694
Dr. Michael Teutsch, E-Mail michael.teutsch@hensoldt.net, Tel. +49 7364 9557 140

HENSOLDT Optronics GmbH
Carl-Zeiss-Str. 22
73447 Oberkochen
Germany

www.hensoldt.net

Computer Vision for Human-Computer Interaction
Institute for Anthropomatics and Robotics (IAR)
Head: Prof. Dr.-Ing. Rainer Stiefelhagen
Vincenz-Prießnitz-Str. 3, Geb. 07.08
76131 Karlsruhe, Germany

cvhci.anthropomatik.kit.edu