

VIDEO AND IMAGE ENHANCEMENT



Input image (courtesy of Ampleye)



Output image after LACE processing

TNO innovation
for life

Images obtained from cameras (daylight, infrared and image intensifier) over longer distances or under poor visibility conditions, for example caused by inclement weather or nightfall, are often not suited for investigation and observation. Using standard camera settings like contrast, brightness, shutter time and diaphragm, only a marginal improvement of those images can be obtained. To obtain a significant image quality improvement TNO has developed an image enhancement suite which consists of real-time Local Adaptive Contrast Enhancement, Turbulence Compensation, Dynamic Super Resolution, and Image Stabilization.

LOCAL ADAPTIVE CONTRAST ENHANCEMENT (LACE)

In many situations, the light conditions in which cameras have to operate cannot be controlled. This often results in images with disappointing quality. Some parts of the image may be too dark to see any details, while other parts may be too bright. Furthermore, some parts may have too little contrast. Adjusting the contrast or brightness manually will result in improvements in one part of the image but will inevitably degrade other parts.

LACE is a digital signal processing technique that performs contrast and brightness adjustment for each pixel individually. It is based on the contrast and brightness properties in the neighboring pixels (hence "Local Adaptive"). Because LACE operates in real-time, it handles scene changes immediately. Thus, after switching on a light, or pointing the camera to a completely different scene, the new optimal contrast and brightness settings for each pixel will be applied without noticeable delay.

TURBULENCE COMPENSATION

The effects of turbulence on an image are known to everyone. For example when looking ahead toward the horizon when driving down the road on a summer day. The turbulence in the atmosphere can distort the images introducing rapidly changing shape distortions, position shifts and changes of intensity, which all occur simultaneously at various degrees, making it hard to see details and to identify object at long range. The Turbulence Compensation technique partly removes the effects of turbulence in a video which results in more stable and sharper images.



Turbulence Compensation



Input UAV-mounted camera



Output after processing with Image Stabilization, DSR and LACE

DYNAMIC SUPER RESOLUTION (DSR)

The Dynamic Super Resolution technique enhances images by increasing the spatial resolution of the images while simultaneously improving the signal to noise ratio. This technique makes it possible to enhance the resolution up to a factor of four.

IMAGE STABILIZATION

Although some cameras are mounted on rigid platforms most of them are on moving platforms or inside handheld devices. The Image Stabilization technique eliminates the motion in the video without any camera stabilization devices. This allows the observation process to be less tiring.

APPLICATION AREAS

Possible application areas of our image enhancement suite include surveillance, industrial inspection, medical imaging, monitoring, traffic monitoring, and reconnaissance. Our real-time algorithms can be applied on daylight, infrared and image intensifier cameras.

The picture shows TNO's image enhancement suite, which was successfully used at Camp Holland in Afghanistan.



HOW WE CAN COOPERATE

We offer you access to a group of world-class professionals that can help from idea generation to implementation and testing. We do this by consultancy, contract research, licensing, development of algorithms, and support with software and hardware implementations. TNO offers several interesting co-financing possibilities for companies, for example so called Technology Clusters (20% self-funding), co-financing proof of principle (10%), proof of concept (25%), and development of a demonstrator (50%). Furthermore, we are a recognized partner in several European and worldwide research programs.

INTELLIGENT IMAGING GROUP

TNO's Intelligent Imaging group works together with partners on technological breakthroughs leading to major innovations in high-priority societal and economic themes. More than 45 professionals work in the Intelligent Imaging research group, which is engaged in image processing, image enhancement, image analysis, visual pattern recognition, and artificial intelligence. We develop applications in the areas of Defence, Safety & Security (video surveillance systems, multi-camera tracking and re-identification software, behavior recognition software, smart cameras), Transportation (traffic management systems, cooperative traffic control, pedestrian and moving object detection), Health care (remote patient monitoring, unattended autonomous surveillance, image-guided interventions), as well as highly complex measurement and control systems. In addition, the research group is also engaged in a wide variety of projects involving complex image processing and computer vision in both 2D and 3D. In these projects, we apply our unparalleled expertise in the area of sensors and sensor systems to develop smart real-time algorithms. We work together with companies to develop complete systems and to implement software on computer platforms (PC, DSP and FPGA).

TNO.NL

TNO is an independent research and technology organization whose expertise and research make an important contribution to the competitiveness of companies and organizations, to the economy and to the quality of society as a whole.

TNO's unique position is attributable to its versatility and capacity to integrate this knowledge. TNO employs about 4.000 professionals and concentrates on seven themes, each of which has a prominent place in the national and international innovation agenda: industrial innovation; defense, safety and security; energy; mobility; healthy living; built environment and information society.

For more information and contact details please visit our website at:
TNO.nl/IntelligentImaging