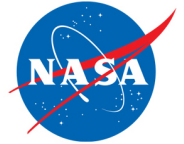




National Aeronautics and  
Space Administration



## TECHNOLOGY SOLUTION

### Information Technology and Software

# Computational Visual Servo

## Automatic measurement and control for smart image enhancement

NASA's Langley Research Center researchers have developed an automatic measurement and control method for smart image enhancement. Pilots, doctors, and photographers will benefit from this innovation that offers a new approach to image processing. Initial advantages will be seen in improved medical imaging and nighttime photography. Standard image enhancement software is unable to improve poor quality conditions such as low light, poor clarity, and fog-like conditions. The technology consists of a set of comprehensive methods that perform well across a wide range of conditions encountered in arbitrary images. Conditions include large variations in lighting, scene characteristics, and atmospheric (or underwater) turbidity variations. NASA is seeking market insights on commercialization of this new technology, and welcomes interest from potential producers, users, and licensees.

### BENEFITS

- Systematic improvements in contrast, light, and sharpness
- Compatible with varied imaging technology
- Correction for both overexposure and underexposure
- Dusk and fog image resolution

### APPLICATIONS

The technology has several potential applications:

- Photography - expanded enhancement capabilities
- Aviation - improved pilot visibility
- Automobile - improved driver visibility
- Video - Real-time digital enhancement
- Medical imaging - X-rays, computed tomography (CT), and magnetic resonance imaging (MRI)
- Surveillance - thermal and night vision
- Military - enhanced pilot vision and targeting



## THE TECHNOLOGY

The innovation improves upon the performance of passive automatic enhancement of digital images. Specifically, the image enhancement process is improved in terms of resulting contrast, lightness, and sharpness over the prior art of automatic processing methods. The innovation brings the technique of active measurement and control to bear upon the basic problem of enhancing the digital image by defining absolute measures of visual contrast, lightness, and sharpness. This is accomplished by automatically applying the type and degree of enhancement needed based on automated image analysis.

The foundation of the processing scheme is the flow of digital images through a feedback loop whose stages include visual measurement computation and servo-controlled enhancement effect. The cycle is repeated until the servo achieves acceptable scores for the visual measures or reaches a decision that it has enhanced as much as is possible or advantageous. The servo-control will bypass images that it determines need no enhancement.

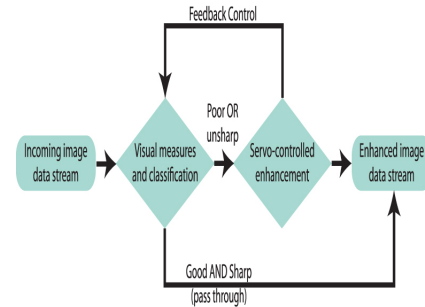
The system determines experimentally how much absolute degrees of sharpening can be applied before encountering detrimental sharpening artifacts. The latter decisions are stop decisions that are controlled by further contrast or light enhancement, producing unacceptable levels of saturation, signal clipping, and sharpness.

The invention was developed to provide completely new capabilities for exceeding pilot visual performance by clarifying turbid, low-light level, and extremely hazy images automatically for pilot view on heads-up or heads-down display during critical flight maneuvers.



Aerial photo before enhancement

Aerial photo after enhancement



Automated image enhancement servo flow chart

<http://dragon.larc.nasa.gov/retinex/servo/>

## PUBLICATIONS

Patent No: 8,111,943

## More Information

National Aeronautics and Space Administration

**Agency Licensing Concierge**

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