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Thermal Aerial Images

**With Allied Vision's heat imaging camera the Application Center for Multimodal and Airborne Sensor Technology measures surface temperature of water and shorelines.**

Stadtroda, 15.12.2015 - The Application Center for Multimodal and Airborne Sensor Technology (known in Germany as AMLS) has declared war on behalf of the German Federal Institute of Hydrology against “dead zones” in water bodies. With Allied Vision cameras on board a gyrocopter, the Center recorded water and shoreline temperatures with the goal of validating mathematical and physical models of temperature development.

Rising oxygen deficiency (hypoxia) in water bodies alarms not only fishers and environmental protection groups with regularity, but is also a topic to which research institutes have continuously dedicated themselves. The water or surface temperature of water bodies is an important parameter for determining oxygen content and, in turn, water quality.

**The Tidal Elbe Dead Zone**
In cooperation with the German Federal Institute of Hydrology in Koblenz AMLS initiated a project with the goal of performing extensive measurements from the air in critical areas. The collected data will enable further analysis and testing of mathematical models, as well as the definition of measures to prevent and improve aquatic hypoxia. In a pilot project during the summer of 2015, the first measurements were performed on the Tidal Elbe between Hamburg and Stade.

The area of the Hahnhöfer Nebenelbe and the Mühlenberger Loch in the region bordering Hamburg, Lower Saxony, and Schleswig-Holstein continues to make headlines as a “dead zone”. Particularly in the summer, aquatic hypoxia reaches critical levels that not only endanger flora and fauna but even fishermen's existence. From this region, encompassing 24 km² (approximately 9.25 square miles) of water and shoreline area, precise thermal aerial images were taken in the summer of 2015.
 **Airborne Temperature Measurement**
From the air, a field of vision opens for the viewer that is many times greater than that at ground level. The creation of aerial images is usually a costly process in which cameras are attached to airplanes or helicopters. Very recently, however, a new class of small, manned aircraft has opened up affordable alternatives. Gyrocopters use a driveless rotor to gain altitude and a machine-operated propeller for thrust. A high-resolution camera can thus capture images with great detail from a high altitude.

Researchers from AMLS, a cooperative venture of the Fraunhofer Institute for High-Frequency Physics and Radar Techniques and the Koblenz University of Applied Sciences, availed the advantages of this lightweight yet powerful aircraft and developed the compact AMLS remote sensing image capture system. It consists of an image capture unit attached to a gyrocopter that, using cameras from Allied Vision, generates aerial images. The ground temperature is captured with the aid of the Pearleye P-030 thermal imaging camera, while a reference image is delivered to cartographers by the simultaneously running Mako G-419.
 **Seamless Mosaic**
Equipped with this image capture system, the gyrocopter began its flights over the target area on a sunny morning at low tide. To reduce vibrations, the cameras were attached by using an anti-vibration device. An electromechanical stabilizer also offset movements that occurred during normal flight maneuvers.

At an altitude of 1,300 meters (4265 ft.), the aircraft flew as often as possible over the surface. With each pass, lasting approximately 45 minutes, a total of 276 photographs were taken in accordance to a specific flight plan, meaning that an image was taken approximately every ten seconds. A precise navigation system in combination with software integrated into the image capture system ensured that the route was followed accurately and that images were always recorded at the same location. The flight route, type, and quantity of images were all defined in advance. Even parameters such as image overlapping, flight altitude, resolution and image rates were predefined. In total, an image surface of 24 km² (6.5 square miles) was disassembled into small sections and captured. The images were then stored together with GPS data so that they could be reassembled afterward into a seamless image mosaic.

**Precise Data Fusion**
The Pearleye thermal imaging camera's task in all this was to create temperature recordings of all 276 image rasters at a resolution of 1.8 x 1.8 m per pixel. The Pearleye P-030 LWIR is sensitive in the long-wave spectral range from 8,000 to 14,000 nm and operates with an uncooled microbolometer sensor with 640 x 480 pixel resolution. Equipped with a temperature reference element as well as Peltier temperature stabilization, this camera reliably detects differences in temperature.

In order to be able to precisely correlate recordings and details to the exact ground locations, high-resolution images in the visible spectrum were created concurrently. The Mako G-419 Gigabit Ethernet camera that was used was equipped with a CMOSIS sensor delivering the highest image quality with resolution at 2048 × 2048 pixels and numerous image correction functions.

On the ground, the acquired images were superimposed using the GPS data with the aid of characteristic landmarks and fixed control points. “The camera team that was used, Pearleye for thermal images and Mako for high-resolution reference photos, gave us outstanding image material that enabled a very precise analysis of relationships on the ground. In particular, over the course of time the images permit conclusions on problem zones and their causes,” stated Immanuel Weber of AMLS in summary of the thermal flight mission results.

Maps with the superimposed temperature data demonstrated, for instance, clear temperature differences in the water, according to the soil condition of the tidal zones and tide levels. Significant temperature differences could also be observed between fields with varying vegetation or uses.

The flight mission's success proved the researchers correct. Using valid data collected in this manner, mathematical models could be tested, which gave scientists a basis for defining effective measures for prevention and improvement. The gyrocopter as well as the camera technology from Allied Vision will be put to use in the future not only over the hypoxic Tidal Elbe but also over other bodies of water whose oxygen levels regularly drop to critical levels.

**Profile of Allied Vision**

For over 25 years, Allied Vision has been helping people to see the bigger picture. Allied Vision supplies camera technology and image capture solutions for industrial inspection, science, medicine, traffic monitoring and many more application areas in digital imaging. With a deep understanding of customers’ needs, Allied Vision finds individual solutions for every application, a practice which has made Allied Vision one of the leading camera manufacturers worldwide in the machine vision market. The company has eight locations in Germany, Canada, the United States, Singapore and China and is represented by a network of sales partners in over 30 countries. [www.alliedvision.com](http://www.alliedvision.com)

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