



Application Note AN M85

Remote sensing systems monitor air in stadiums

During the FIFA soccer World Cup, scanning imaging infrared remote sensing systems identified and located various gases in the air over public areas.

The German ministry of the interior has established task forces for the analysis of released chemicals in the case of fires, chemical accidents, terrorist attacks, or war. In these cases, information about the released compounds is required immediately in order to take appropriate measures to protect workers, residents, emergency response personnel at the site of the release, and the environment.

The analytical task forces are equipped with mobile systems that apply analytical methods such as gas chromatography / mass spectrometry¹ (GC/MS) and ion mobility spectrometry. In addition they are equipped with sensors such as photo-ionization detectors and a hand-held system containing a combination of sensors, the portable gas detector array² (GDA 2). However, all these methods require the collection of a sample, which may be dangerous, time-consuming, and difficult, for example in case of a terrorist attack in a stadium or a crowded public place. In contrast, remote sensing by infrared spectrometry allows identification of hazardous clouds from long distances. The analytical task forces, based in four German cities, were equipped

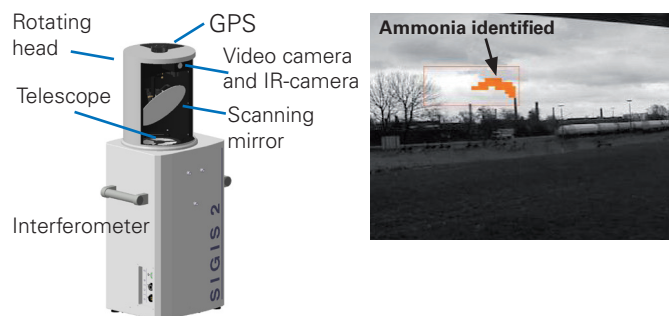


Figure 1. Left: SIGIS 2 combines an infrared spectrometer and a scanning system. Right: The image of a cloud of ammonia emitted by a stack appears in the video display.

with scanning infrared gas imaging systems (SIGIS^{3, 4}). During the FIFA soccer World Cup, these systems were used for surveillance of stadiums and public viewing areas, where large crowds watched the games.

SIGIS 2

SIGIS 2 is a scanning imaging remote sensing system based on the combination of an infrared spectrometer with a single detector element and a scanning system (see Figure 1). In order to align the field of view and to scan the field of regard, the system is equipped with a rotating head containing an azimuth-elevation scanning mirror. The measurement scene

is recorded by a video camera and displayed on a PC. To visualize gas clouds, the rotating head is kept at a fixed position and the scanning mirror is sequentially set to all positions within the field of regard. The operator may define this field of regard interactively using the displayed video image and the mouse. Each spectrum is analyzed by an automatic identification and quantification algorithm and the results are visualized in the video, overlaid by false-color images. This direct display of the cloud in the video allows simple assessment of the position and the size of the cloud, as you can see in Figure 1.

Measurements during the World Cup

During the World Cup, five SIGIS 2 systems were deployed. In addition to the four systems used by the task forces, one system was operated by the team of Hamburg University of Technology.

The surveillance of the Olympic stadium in Berlin was performed from one of the towers of the stadium (see Figure 2). During various games, ammonia was identified. There are several possible sources of ammonia in the stadium. One is the football field, because fertilizers may contain ammonia. It could also have evaporated from cleaning agents that are used to clean the stadium. In addition to ammonia, ethanol was identified in the stadium during the World Cup. Ethanol evaporates from alcoholic beverages and is exhaled by the spectators, who consume alcoholic beverages before or during the game.



Figure 2. Monitoring of the air in the Olympic stadium in Berlin using SIGIS 2.

In Stuttgart, SIGIS was used to monitor the public viewing area in the center of the city. Ethanol was identified in multiple directions (see Figure 3). As in the stadium, alcoholic beverages consumed by the spectators are the source of ethanol.

In Hamburg, sulfur hexafluoride and ammonia were identified and located in and near the public viewing area, which is illustrated in Figure 4. In addition, methanol was identified near an incineration plant.

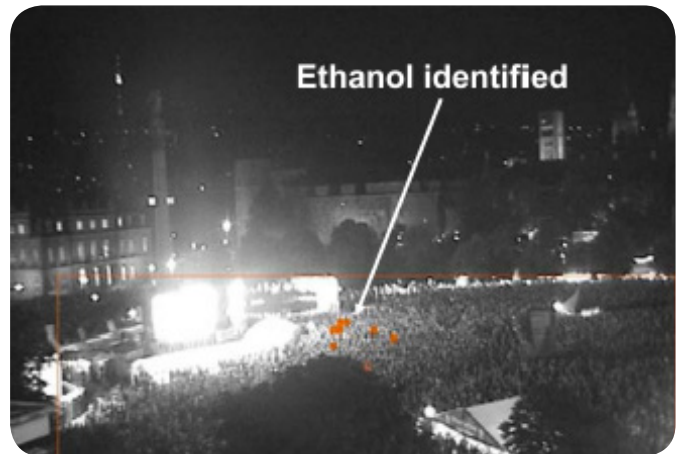


Figure 3. The locations in which ethanol was identified in this public viewing area are indicated by the overlay of red squares.



Figure 4. Surveillance of the public viewing area in Hamburg using SIGIS 2.

Conclusions

Five SIGIS 2 systems were employed for surveillance of public areas during the FIFA World Cup. Although no intentional or accidental releases of hazardous gases occurred in the stadiums and in the public viewing areas, the systems proved their effectiveness by identifying and locating various gases in the air.

Acknowledgments

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