Turbine exhausts monitoring by Fourier-transform infrared emission spectroscopy

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Introduction

Up to the 1960's, visual and noise effects were considered the principal agents of environmental pollution produced by large jet civil aircraft. Later investigations focused on the interest in the contribution of air pollutants from airports to the global environment. More recent research has shown that the main impact of aircraft emissions is at altitudes between 8-12 km (where the NOx emissions are at maximum) increasing the ozone concentration by 3-10%, and above 13 km to the middle stratosphere where the NOx emitted by supersonic aircraft6 can deplete the existing ozone. In the last few years, studies using FTIR emission spectroscopy measuring aircraft engines in test beds and in in-service aircrafts at airports have shown that this technique offers important advantages over gas sampling based methods currently approved by the International Civil Aviation Organization.

Measurement instrument

The SIGIS is comprised of a Fourier Transform Infrared (FTIR) spectrometer, a telescope (1), an azimuth-elevation-scanning mirror actuated by stepper motors (2), an IR camera (3) and a data processing and control system with digital signal processors for the spectrometer and the video device (4) (see figure 1).

The interferometer (Bruker, OPAG 22) has an operating range between 680 and 6000 cm\(^{-1}\) (MCT detector) and a maximum spectral resolution of 0.2 cm\(^{-1}\). A full description of the SIGIS system which is schematically shown in Figure 1, is given elsewhere (References 7 and 8).

Numerical Procedure

To interpret passive FTIR spectroscopy the transfer of radiation through the exhaust and the atmosphere must be calculated on a line-by-line basis, software MAPS (Multicomponent Air Pollution Software) developed at the institute (Haus, R., Schäfer, K., Bautzer, W., Heland, J. Mosebach, H., Bittner, H., Eisenmann, T.) Mobile FTIS-Monitoring of Air Pollution. Applied Optics 33, 24 (1994), 5682-5689.

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