

TIME-RESOLVED LIDAR FLUOROSENSOR FOR SEA POLLUTION DETECTION *

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As it has been demonstrated in another paper of this conference and earlier (1) by the researchers of JRC-Ispra, a contemporary time and spectral analysis of oil fluorescence is useful for the detection and the characterization of oil spills on the sea surface.

Nevertheless the fluorosensor lidars, which have been realized up to now, have only partial capability to perform this double analysis.

The main difficulties are the high resolution required (of the order of 1 nanosecond) and the complexity of the detection system for the recording of a two-dimensional matrix of data for each laser pulse.

CISE laboratories have been asked by JRC to design and construct an airborne system whose major specifications are:

- time range : 30 - 75 ns
- time resolution : 1 ns
- spectral range : 350 - 700 nm
- spectral resolution : 10 nm

In order to fulfill these requirements a short pulse UV laser source and a streak camera based detector have been designed (2).

Streak cameras are currently used for the analysis of fast optical phenomena, with resolution up to 1 ps; however, their two-dimensional pattern has been fully utilized in a few spectroscopic applications. In these cases the streak cathode is coupled to the output of a polychromator, so that one streak axis becomes the spectral axis, orthogonal to the time axis.

The laser source consists of a Nd-YAG laser, able to produce about 300 mJ at 1060 nm, in 3 ns, with 10 Hz repetition rate, in a single oscillator configuration. The emission at the third harmonic at 355 nm is expected to be about 50 mJ, in 2 ns.

The return signal consists of the water surface and bulk water direct backscattering, of the water Raman signal (at 400 nm) and of the fluorescence signal of oils and of suspended organic materials.

The signal is collected by a 30 cm telescope and sent, through a fiber optic, into a polychromator. The output light of the polychromator is a light strip whose width is equal to the telescope spot size and whose length depends on the polychromator dispersion and on the chosen spectral range.

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The strip must have the same dimensions as the streak camera cathode. The streak camera time and spectral resolutions are mainly dependent on the ratio between the cathode size and the telescope spot size, which must be as small as possible. The telescope spot size can be reduced by reducing the laser spot size on the sea, which, in turn, can be reduced by using a small laser beam divergence (of the order of 0.1 mrad). The streak camera signal is then intensified and digitized by using a CCD read-out system. The digitized signal is sent into a computer as a matrix of about 40 spectral channels by 90 time channels and stored on Winchester disks for subsequent analysis.

The system should be ready for the first flight in summer 1987.

REFERENCES

- (1) P. Camagni et al. "Remote Fingerprinting of Oil Pollution by Means of Time Resolved Fluorosensing", 1984 World Conference on Remote Sensing, Bayreuth 8-11 October, 1984.
- (2) A. Ferrario, P. Pizzolati, E. Zanzottera "Feasibility Study for an airborne lidar fluorosensor", Final Report CISE 2563, March 1985.