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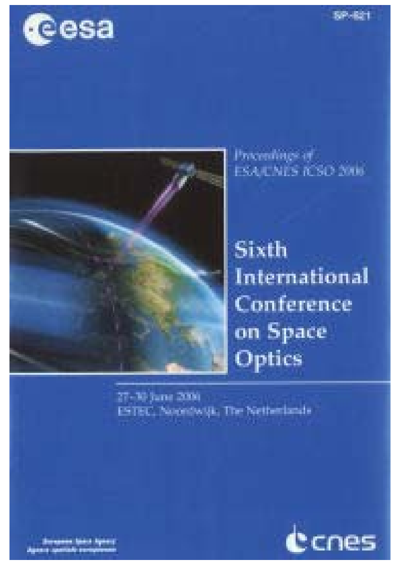

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EQUIPMENT FOR FUNCTIONAL TESTING OF THE ALADIN TXA PULSED LASER HEAD

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ABSTRACT

It is described a measurement instrument, used as Optical Ground Support Equipment, capable of performing the characterization of a pulsed laser beam. The instrument was developed for the functional testing of the EQM and FMs of the ALADIN laser transmitter (TXA). The performed measurements are: beam shaping, M^2 measurement, beam angular stability, energy and wavelength measurements, pulse duration, polarization, pulse shape and spectral characterization, optical frequency stability measurement. The measurement system can work in automatic mode performing several measurements and providing automatic report generation.

1. INTRODUCTION

The presented system is an electro-optical measurement instrument realized to carry out several measurements for the characterization of a burst operated pulsed laser beam. The instrument is capable of performing an automatic managing of the measurements, starting from the acquisition, data management, presentation, storing, test reporting and compilation of the compliance tables. The use of this instrument permits a considerable reduction of the times needed to perform such measurements and validations.

2. DESCRIPTION

The instrument is composed by two units:
1) an optical module (120 x 90 x 30 cm^3) shown in fig. 1, used to interface the laser beam under test and to couple it to the diagnostics subunits present inside the optical module;
2) an electronic control module (127 x 51.5 x 46.5 cm^3) composed by a rack, shown in fig. 2, containing most of the electro-optical instrumentation and electronic circuitry to perform the different measurements.

The instrument can work at three wavelengths: 355nm, 532nm and 1064nm (Nd-Yag). The wavelength is manually selected by means of a translation stage supporting proper holographic beam splitters. For measurements at 355nm and 1064nm the laser beam under test is divided by the holographic beam splitter into seven rays having different intensity depending to the considered diffraction order. For the 532nm wavelength only the energy measurement is foreseen.

The different rays generated by the holographic beam splitter are sent to the following diagnostics:
- a lateral effect photodiode placed in the in the focal plane of a lens to measure the angular stability;
- a high dynamic USB2 camera for the characterization of the near field profile, having a motorized polarizer for the automatic adjustment of the intensity impinging on the camera;
- a Fabry Perot interferometer (working only at 355nm) coupled to another USB2 camera for the laser pulse bandwidth measurement;
- an energy meter;
- a collecting optics system for the wavelength measurement;
- a fast photodiode for time shape and optical frequency stability characterization;
- a photodiode having a motorized polarizer for the polarization measurement;
- a USB2 camera used in conjunction with a series of mirrors and lenses mounted on a motorized translation stage, to perform the M2 measurement, a motorized rotating polarizer provides the adjustment of the intensity on the camera sensor.

The optical module contains also some fiber optical mixers used to generate the beating signals among the laser pulse, the seeder laser and a reference laser source. These signals are used for the optical frequency stability measurement.

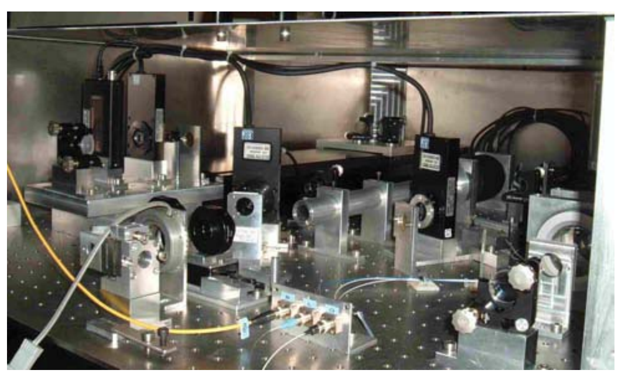

Fig. 1. Optical module.

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The acquired optical/electrical signals are sent to the electronic unit by two cables 5m long.
The electronic unit is composed by:
- a personal a computer used for data acquisition and for the instrument control;
- a 6GHz bandwidth 20Gs/s oscilloscope for high speed acquisition (to characterize the pulse temporal shape, to measure the optical frequency beating and to perform the bandwidth measurements);
- an optical energy meter;
- a wavelength meter;
- a control system for translation and rotation stages;
- a reference CW laser source at 1064nm for frequency stability measurement.

Fig. 2. Electronic control module placed inside the rack.

3. THE INSTRUMENT CONTROL PROGRAM

The instrument control is performed by the PERSONAL computer which is interfaced with all the measurement subunits. The control program operates in LabView™ environment (National Instruments).
The operations performed by the control program are:
1) Interfacing with all the instrumentation (electro-optical instrumentation, video cameras, positioning systems).
2) Preliminary calibration and/or prealignment of the single subunit instruments.
3) Measurements automation with the possibility of setting up the temporal sequence of the measurements that can be executed sequentially or in parallel.
4) Measurements initialization with the possibility of loading and modifying each measurement parameter.
5) Automatic saving of the measurement parameters and data. Data are saved in different modes from raw to partially elaborated or fully processed data. The saving directory structure is automatically managed by the control program.
6) Off-lines reprocessing of the raw data (play back).
7) Compliance check between measured results and specifications.
8) Automatic report generation with the measurement results and the pass/fail table for each test.

Part of the calculations are directly performed by the computer. Some particularly heavy mathematical analysis have been shared, both for measurement and for the reprocessing, with the computer present inside the oscilloscope.

4. ACHIEVED RESULTS

The following improvements have been obtained:
- Automated measurement procedures with reduction of the measurement time with respect to the manual procedures previously used.
- Possibility of performing parallel measurements with a further reduction of the measurement time.
- Possibility of programming set of measurements in sequence and/or in parallel.
- Raw data reprocessing (play-back option) for further successive analyses.
- Automatic report generation and creation of compliance tables.
- Availability of a single instrument (composed of an electronic rack and an optical bench) to perform the whole laser beam characterization.
- The instrument can be used by trained technical personnel instead of the expert personnel necessary for manual measurements.

5. CONCLUSIONS

The developed system is capable of performing a full characterization of a pulsed laser beam in nearly fully automatic way, thus reducing the measurements execution time with respect to the manual approach. The instrument can be programmed to perform series of measurements in sequence and/or in parallel. The data are automatically stored as raw and processed data. At the measurement end the instrument provides a report of the measurement results in PDF format.

6. ACKNOWLEDGMENTS

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