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Merate, 08.10.2013

Oggetto: Acquisto di interferometro per misure di fronte d'onda nel contesto del Progetto T-REX

Caro Giovanni,

In relazione all'allestimento dei laboratori di metrologia ottica avanzata finanziato con fondi premili di denominazione "T-REX", riteniamo opportuno l'acquisto di un interferometro avanzato per la misura interferometrica di ottiche avanzate.

Di seguito ti elenco le caratteristiche imprescindibile che l'apparato da acquistare dovrà avere per soddisfare le esigenze risultanti da una indagine interna all'Osservatorio presso i potenziali utilizzatori. Esse sono riportate in lingua inglese per loro inserimento nelle procedure di approvvigionamento.

Optical characteristics:

Laser:

The system shall operate with a laser of wavelength 632.8nm and a coherence length greater than 100m. The laser system shall have a separated power-on button with respect to the acquisition head (CCD and other electronics): this is to maintain the system fully operational even with the laser source off, for instance for testing purposes and safety.

Test beam:

The instrument will measure optics in a wide range of f-numbers, thus it will require additional optics. In particular, the testing configuration will require a converging f/2.5, 100 mm aperture beam. The appropriate optics shall be provided to satisfy this condition.

The instrument shall have pupil magnification capabilities: goal 4x optical zoom, target 4x hybrid zoom (at least 2x optical).

The pupil focusing shall be motorized and remotely controlled.

Fringe contrast and spatial resolution:

Fringe contrast shall be adjustable in order to test optics with reflectivity ranging from 1 to 100%.
The system shall provide an interferogram true spatial resolution of at least 1k x 1k points and a fringe resolution of at least 250 fringes of equivalent tilt.

Performances:

The uncalibrated wavefront shall be better than λ/10 PtV. The calibration of the instrument shall be possible with referenced methods. The calibration shall be independent of the optics under test. After the calibration, the wavefront accuracy shall be less than λ/100 PtV. The wavefront repeatability shall be better than λ/300 PtV. Characterization method of the reference wavefront shall be agreed between customer and provider.

Electronics:

The recording speed shall be higher than 25 full frames per second (storage to disk only, no additional processing), the minimum exposure time shall be lower than 35 microsec. The external temperature of the instrument shall be ±1.5° w.r.t. ambient temperature (TBC). The digitization of the camera shall be at least 10-bit.

Raw images acquisition and post-processing

Acquisition:

The system must provide images acquisition and storage on HD at high frequency, i.e. up to the frame grabber recording speed. Provided that full phase reconstruction is time consuming, raw images only are saved on HD, with no or very little post-processing: we will refer to such preliminary status of the images as RAW.

The acquisition mechanism must be stable to guarantee that a large number of frames (up to 4000) can be grabbed and stored correctly on HD. A RAM disk can be used as an intermediate storage for the images.

Processing:

RAW files can be processed separately from the sampling time to produce the relative phasemaps. The resulting phasemaps are saved with commonly adopted standards (.FITS, .H5…).

Processing configuration:

The configuration needed for the image processing must be saved on a configuration file. Such configuration file can be saved/stored upon request; the information content of the RAW images must not be affected by the configuration files (i.e.: a RAW image can be processed several times varying the configuration files according to need, as the content of the RAW file is the most general in terms of configuration).

The configuration must include (e.g.): mask, modulation threshold, wedge, resolution/binning, trimming/filling.

Processing sampling:

In order to speed up the post-processing routine, phasemaps can be produced at reduced resolution. This operation should not be a final image binning.

Remote processing:

The processing routines must be executable from a separated workstation (equipped with the interferometer SW and license). Such second workstation is not necessarily equipped with a frame grabber or HW interface to the interferometer and is used for post-processing only.

Scripting:

The relevant SW commands that can be executed graphically from the GUI should be executable via command line.

Scripts:

A full list of the implemented commands must be provided, including a general description about building upper level scripts starting from the low level commands. Generic system commands for files management (e.g. copy, move, listing) should be callable.

Some simple high level scripts should be also provided as templates for the preparation of custom configuration/acquisition/processing routines.

The scripts provided should include at least(example given):

- A command to grab n raw frames and store them in the disk
- A command to post-process the a list or a folder of raw frames
- A command to enable/disable the synchronization trigger
- A command to set the image resolution
- A command to load a given configuration file
- A command to set the acquisition delay
- Other commands.

Console:

The SW must be equipped with a scripting console for launching configuration/acquisition/processing scripts. Such console could also be a third party console, interfaced with the interferometer software.

Quality check of the sampling:

The sampling script should return a log of the relevant sampling statistics and informations. For instance:

- Image sequence number;
- Capturing time (referred to the first image)
- Mean acquisition frame rate
- Flag: CCD/frame grabber error
- Flag: write to disk error

Remote operations:

The system must be controllable from a separated PC via remote scripting. For instance, with a server-client mechanism (i.e. no VNC access to the GUI). All the scripting commands should be accessible remotely, in particular:

- Load the system configuration
- Enable and select the trigger line
- Grab N raw images
- Post-process images
- Other commands.

Synchronization trigger:

Enabling/disabling of the external trigger:

The external trigger line shall be enabled and disabled via a script. If more than a trigger line is provided, the desired channel could be selected as the call parameter.
Examples:

```
ExtTrigger_enabled();
ExtTrigger_disabled();
ExtTrigger_enabled(Line1);
ExtTrigger_enabled(Line2);
```

Frame grabber synchronization:

The trigger mechanism must be such that a single image is captured when a single pulse is received (this, to specify that it is excluded the mechanism by which a burst of images is captured at the internal frequency when the first trigger pulse is received).

The number of collected images must be equal to that specified in the command; if the trigger signal is stopped before the collection of the number of images requested, the acquisition is automatically stopped after a timeout with no error.

Trigger acceptable frequencies:

- Start of Trigger timeout:

When the external trigger port is enabled, the system waits for the trigger signal during a start-of-trigger timeout. The timeout shall be in the range 5s to 10s. If no signal is received the system returns an error.

- Slowest frequency

The slowest accepted frequency is given by the definition of the start of trigger timeout. When no trigger signal is received within the timeout, an error is returned.

- Fastest frequency

The fastest triggering frequency is given by the frame grabber frame rate f. When a faster trigger signal is received, an image is acquired when a pulse is received after a time t=1/f after the last captured image.

- Frame-to-frame timeout, or frequency jitter

The synchronization mechanism must be not affected by the frequency stability, i.e., no stable or unique frequency must be expected (example: 100 images are requested; the first 50 are triggered with a 20Hz

signal, then a 300ms delay is commanded by suspending the trigger signal, then the last 50 images are triggered with a 15 Hz signal)

Trigger delay:

The triggering mechanism can be configured with a delay t between the detection of a trigger edge and the collection of an image. Such delay should be selectable in the range 0ms<t<1/2f (alternatively: 0ms< t<8ms). The delay resolution must be comparable to the CCD exposure time (tens of microseconds). The delay must be selectable with a scripting command, in the form: SetTriggerDelay(xx).

Environment:

Thermal:

The interferometer shall be able to operate properly in normal environmental conditions, i.e., a temperature from 15 to 30°C and a relative humidity from 5 to 95% (non condensing). It shall also have to cope with a maximum thermal gradients of 4°C/hour.

Mechanical:

The interferometer shall cope with an equivalent static load of 2.5g in any direction (TBC).

Technical support and debugging:

The provider shall include in the offer a plan of remote assistance for technical support (software) and debugging to be agreed by the customer. Minimum requirement is 30 equivalent working days.

In conseguenza di quanto sopra descritto ti pregherei di avviare le procedure necessarie per la acquisizione.

Un caro saluto,

(DR. Filippo Maria Zerbi)