LATRA

LRF boresight station

Fig. 1. Photo of LATRA test station

1 Basic information

In order to enable proper work of laser range finder not only transmitter and receiver must be fully operational but also these two main modules and optional aiming channel must be properly aligned. This means that LRF can be considered as properly aligned when two conditions are fulfilled:

1. Optical axis of transmitter is parallel to optical axis (line of sight) of the internal/external aiming channel,
2. Optical axis of receiver is parallel to optical axis of transmitter.

If condition no.1 is not fulfilled then LRF will miss target during real shooting. It should be noticed that this condition is valid also for LRF modules without internal aiming channel but optimized to be attached to an external aiming device (reference mechanical axis that is parallel to transmitter axis). If condition no.2 is not fulfilled the operational range will be lower or LRF will not work at all.

LATRA is a modular station to support boresight of all types of LRFs (monopulse/ multipulse, different wavelengths) at different application levels (R&D, manufacturing line, final quality check, maintenance, repairing workshop). The station is optimized to enable high speed, accurate, user friendly boresight of laser range finders.

2 Stations for boresight of LRFs

Inframet offers a series of stations that can be used for boresight of LRFs: LTE, LTF, LBOR, LJT120 and LATRA. However, there are reasons why in some applications the LATRA station can be the best choice.

LTE is a quasi universal station optimized for expanded testing (measurement of a long series of parameters) and checking of boresight of LRFs. The boresight checking is done by simulating field tests when LRF is to shoot to a reference target. If LRF is badly aligned then its performance parameters like transmitter energy/power, receiver sensitivity or Extinction Range are poor. User of LTE station can also optimize boresight of tested LRF by shooting this LRF at a set of different angular positions of its modules (receiver, transmitter, aiming device) in order to find positions when the performance parameters are the best. However this method of boresight optimization is time consuming as sometimes several dozens of shots are needed to find optimal angular regulations of LRF modules because the station does not indicate direction where is optimal angular position of LRF modules.

LTF station has the same limitations because it uses the same method of boresight optimization of LRFs.

LBOR is a customized station for checking aligning of transmitter of tested LRFs to a reference external aiming system. It cannot be used to check boresight of transmitter to receiver of tested LRFs.

LJT120 offers visual method to align precisely transmitter, receiver and aiming channel. In detail, it generates three overlapped images: 1) laser spot emitted by the transmitter, 2) cross reticle of the aiming device, 3) detector of the receiver. One shot from tested LRF is enough to do proper boresight. Therefore LJT120 is a perfect solution for boresight of LRFs. However, high price due to use of SWIR camera is a big disadvantage of this station.

LATRA is a specialized boresight station that requires a short series of shots to (typically below 10) to optimize aligning of LRF modules. It needs longer time to do boresight optimization of tested LRFs comparing to LJT120 station. However, time to do boresight optimization of tested LRFs using LATRA is several times lower comparing to time needed using LTE/LTF stations because after each shot the LATRA station indicates direction of further regulation of angular position of LRF modules. At the same time cost of LATRA station is much lower comparing to LJT120 or LTE stations.

3 What LRFs can be tested?

LATRA is an universal station that can be used to boresight (align) of virtually all LRFs offered on the market:

- both monopulse LRFs (single high power shot to get distance measurement) and multi pulse (a series of low power pulses to get distance measurement) LRFs
- LRFs operating at all typical wavelengths (910nm, 980nm, 1064nm, 1530nm, 1550nm, 1570nm)
- LRFs with different solutions to assure aiming (internal aiming channel at visible band, internal pointer, mechanical adapter that indicates reference mechanical axis, external attachable aiming device: VIS-NIR camera, SWIR camera, or thermal imager)
- optimized for testing typical dual channel LRFs (separate transmitter and receiver blocks) but optionally coaxial LRFs can also be tested.

It is however expected that optics of receiver/transmitter of LRF and aiming device at least partially overlap circle 120mm (option 150mm) diameter.

4 How it works?

LATRA works on two modes:

A) transmitter boresight mode,
B) receiver boresight mode.

The aim of transmitter boresight mode is to align optical axis of the transmitter to line of sight of aiming channel or inverse. Basically the aim is to achieve situation when aiming mark of the aiming channel indicate center of laser beam emitted by transmitter that irradiates a far away target. It should be noted that this aim is valid for any design of aiming channel: internal aiming channel at visible band, internal pointer, mechanical adapter that indicates reference mechanical axis, or external attachable aiming device (VIS-NIR camera, SWIR camera, or thermal imager).

The aim of the receiver boresight mode is align optical axis of the receiver to achieve situation when center of laser spot irradiated by the transmitter on a far away target is located in center of field of view of the receiver. In other works, the receiver must see target irradiated by transmitter in its field of view.

Work of LATRA in mode A is based on a concept to create image of laser beam at far away plane that could be visible for aiming channel of tested LRF. In detail, LATRA in mode A works according to eight step procedure:

1. regulation of angular position of LRF to achieve situation when aiming mark of the aiming channel indicates aiming target simulated by LATRA,
2. inserting of laser sensing card,
3. shooting of tested LRF,
4. creation of laser spot at collimator focal plane that simulates plane of far away target,
5. conversion of SWIR image of the laser spot to visible band or to thermal band,
6. projection of converted image of the laser spot into direction of aiming channel of tested LRF,
7. calculation of angle between center of laser spot and aiming mark,
8. correction of angular position of tested LRF (if the angle is too high).

Work of LATRA in mode B is based on a concept of a system capable to show direction for regulation of angular position of receiver of LRF needed to achieve perfect aligning. In detail, LATRA in mode B works according to six step procedure:

1. regulation of angular position of LRF to achieve situation when aiming mark of the aiming channel indicates aiming target simulated by LATRA,
2. shooting of tested LRF,
3. tested LRF indicates measured distance to simulated target,
4. LATRA indicates direction for regulation of angular position of receiver of LRF needed to achieve perfect aligning
5. steps 2-3 are repeated until near perfect position is found.
6. Optional calculation of the angle between center of FOV of the receiver and and aiming mark of the aiming channel.

5 How is built?

LATRA is a modular station built using series of blocks: CDT12100HR off-axis reflective collimator (option CDT15120 collimator), SOA set of optical attenuators, LSC set of laser sensing cards, CAP card pocket, MTI multi-target illuminator, LPS set of laser pulse sources, OTR optical trigger, RAC reference aiming camera, ROD reference optical detector, XNAS-B angular stage, HEC camera, LATRA Control program, BOR computer program.

6 Technical specification

Tab. 1 Technical parameters of LATRA test station

Parameter	Value
Types of tested LRFs	• Monopulse or multipulse, • coaxial, dual or three channels LRFs, • internal or external aiming channel
Wavelengths of tested LRFs	905/910nm, 1064nm, 1540nm, 1550nm, 1570nm (other wavelengths possible)
Maximal aperture of optics of transmitter/receiver of tested LRF	Tx and Rx of LRF shall be overlap in 50% of front aperture of collimator
Maximal distance between transmitter/receiver of tested LRF and aiming channel	Tx and Rx of LRF shall be overlap in 50% of front aperture of collimator
Active area of target	10 mrad (option – 12 mrad)
PC	Typical modern laptop, windows 10 system
PC communication	USB 2.0
Working temperature	+5°C to 35°C
Storage temperature	–5°C to 50°C
Humidity	Up to 95% (non condensing)

Tab. 2 Test capabilities of LATRA test station

Parameter	Measurement range	Measurement resolution	Measurement uncertainty
Alignment error between transmitter of LRF and internal optical sight used as an aiming device	22 mrad	0.04 mrad	0.1 mrad
Alignment error between transmitter of tested LRF and external thermal imager	22 mrad	IFOV of thermal imager	0.1 mrad
Alignment error between transmitter of tested LRF and external VIS-NIR camera	22 mrad	IFOV of VIS-NIR camera	0.1 mrad
Alignment error between transmitter and receiver of tested LRF	11 mrad	0.05 mrad	0.1 mrad
Field of view of the receiver	6 mrad	0.05 mrad	0.1 mrad or 0.1 FOV
Divergence angle of transmitter LRFs	22 mrad	0.1 mrad	Depends on sensing card

7 Why LATRA station?

Boresight (aligning) of modules of LRF is typically the most time consuming period of manufacturing or repairing of LRFs. LATRA is a user friendly, reliable station that enable fast measurement of aligning errors and finding near perfect boresight of virtually all LRFs offered on international market. It is a very useful tool for both production line or for workshops repairing of LRFs.

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