



ATMOSPHERIC TURBULENCE COMPENSATION

2020b
1/4

For the most demanding applications, ALPAO can provide a state-of-the-art **Real Time Computer (ALPAO RTC)**, a CPU linux based Real Time Computer (RTC) running up to 5kHz with a pure delay lower than 150 μ s.



Key features

SPEED

Up to 5kHz

LOW LATENCY AND JITTER

Pure delay
as low as 150 μ s

FLEXIBILITY

User-friendly and flexible
RTC control node

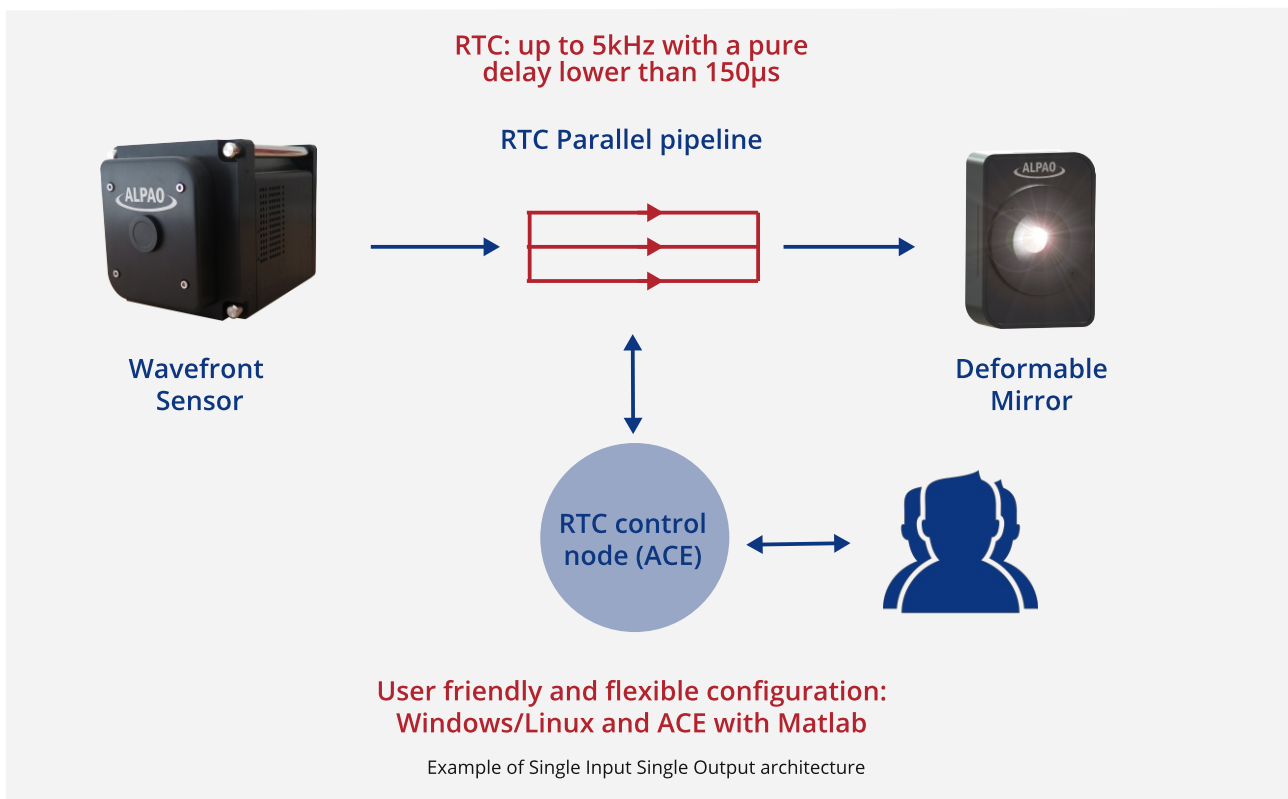
ALPAO RTC UNIQUE ARCHITECTURE

The **RTC** pipeline is specially optimized for high speed AO loop. To obtain such performances, it is hardware dependent and closed source.

The **RTC** control node is based on the **ACE** toolbox, already powering more than 100 adaptive optics systems worldwide. The **ACE** layer is based on the standard Matlab® environment, which allows high flexibility.

The following functionalities are provided in **ACE**:

- Step-by-step operation of the **RTC** pipeline
- Non-intrusive monitoring of all data streams
- Configuration of each worker process such as integration time, CCD gain, CCD readout mode, CCD dark and flat images for gain/offset compensation, threshold level, target centroids, partial command matrix, integrator gain, and deformable mirror offsets.
- Script-based generation of all calibration data such as reference centroids, influence matrix, dark and flat images.



RTC is provided with the specific hardware already plugged in the bay (1000 x 600 x 1160mm, ~150kg, up to 4kW via a standard socket), which includes:

- The supervisor for the control node (19" x 1U x 400mm).
- The Linux multi CPU server for the fast pipeline (19" x 2U x ~900mm).

RTC OPTIONS

ALPAO RTC can be easily customized to fit your application:

- Different architectures: Single Input Single Output, Single Input Multiple Output and Multi Input Multi Output.
- Enhanced telemetry capability: large capacity storage device.
- Faster command matrix update: if your command matrix need to be refreshed at a rate above 1Hz.
- 8 channel control card: +/-10 V control on 14 bit allowing for example separate tit-tilt mirror control.
- Hardware integration, specific algorithm integration, pyramidal WFS...

More options available: contact us.

KIT PERFORMANCES

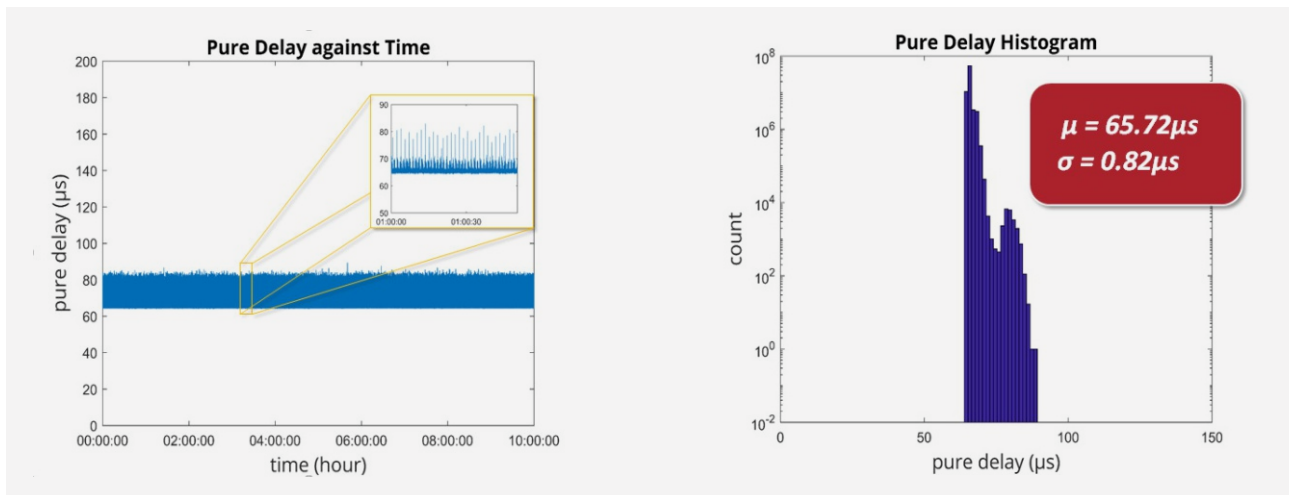
Choose the correct **ALPAO kit** depending on your application:

- the shape of your aberrations drives the number of actuators,
- the temporal fluctuations of your aberrations and the number of photons available drive the WFS and RTC choice.

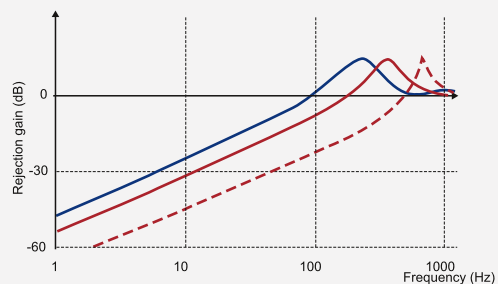
WFS sub-aperture ROI		8x8	10x10	15x15	16x16	19x19	23x23	31x31
<i>Compatible DM (Fried geometry)</i>		DM69	DM97	DM192	DM241	DM292	DM468	DM820
SH-CMOS <i>fast</i>	Frame rate RTC/Total latency Rejection bandwidth	5000Hz 27/82µs 350Hz	5000Hz 27/91µs 335Hz	5000Hz 30/132µs 280Hz	5000Hz 32/140µs 270Hz	5000Hz 33/172µs 240Hz	5000Hz 41/227µs 200Hz	3000Hz 61/343µs 130Hz
SH-EMCCD	Frame rate RTC/Total latency Rejection bandwidth	1830Hz 27/590µs 85Hz	1004Hz 27/1040µs 50Hz	1004Hz 30/1049µs 50Hz	1004Hz 32/1058µs 50Hz	n/a	n/a	n/a
SH-EMCCD <i>fast</i>	Frame rate RTC/Total latency Rejection bandwidth	2067Hz 27/527µs 95Hz	2067Hz 27/528µs 95Hz	2067Hz 30/537µs 95Hz	2067Hz 32/545µs 95Hz	2067Hz 33/553µs 95Hz	2067Hz 41/580µs 90Hz	n/a
SH-InGaAs	Frame rate RTC/Total latency Rejection bandwidth	3000Hz 27/377µs 135Hz	2200Hz 27/499µs 100Hz	1200Hz 30/887µs 60Hz	1100Hz 32/971µs 50Hz	900Hz 33/1180µs 40Hz	600Hz 41/1763µs 30Hz	n/a
SH-InGaAs <i>fast</i>	Frame rate RTC/Total latency Rejection bandwidth	5000Hz 27/244µs 215Hz	5000Hz 27/244µs 215Hz	5000Hz 30/253µs 210Hz	4760Hz 32/272µs 195Hz	3830Hz 33/330µs 160Hz	3020Hz 41/428µs 125Hz	n/a

TIMING PERFORMANCES

Lost frame and jitter could have a large impact on the overall loop performances and stability. In the following example, there was zero lost frame over 10 hours while working at 2 kHz. Pure delay was very stable as shown on the following histogram.



ALPAO high speed kit (DM97-15, SH-CMOS-fast and ALPAO RTC) featuring a rejection bandwidth of 230 Hz.



Bode diagram example using a **SH-EMCCD-fast** (in blue), **SH-InGaAs** (in red) and **SH-CMOS-fast** (in dash red) with ALPAO RTC and a DM292.

Ask for advanced simulations!

STATE-OF-THE-ART SYSTEM FOR LGS ATMOSPHERIC COMPENSATION

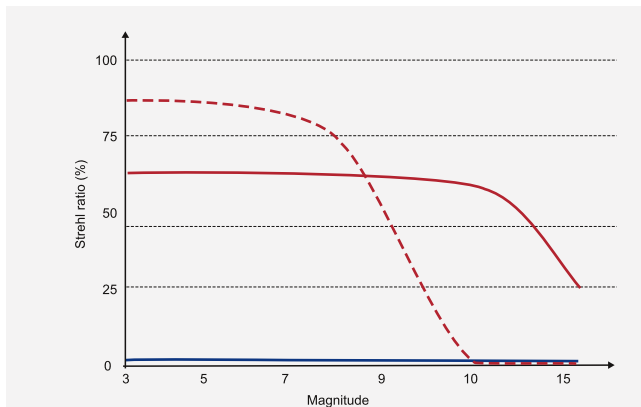
ALPAO can provide state-of-the-art AO systems for atmospheric turbulence compensation. Natural Guide Star (NGS) or Laser Guide Star (LGS) configuration can be provided.

Such systems typically include:

- ALPAO DM
- ALPAO *fast* WFS
- ALPAO RTC
- a calibration unit
- a Tip-Tilt Mirror (TTM)
- an object Tip-Tilt sensor
- a Focus Stage Control (FCS) for the LGS
- a LGS-TT
- a science camera or instrument
- a storage device

Typical applications are:

- Astronomy
- Debris and satellite imaging
- Free Space Optical (FSO) communication
- Laser precompensation of atmospheric aberrations



Example of Strehl ratio without AO (in blue), with LGS (in red) and with NGS (in dash red)

With $D/r_0 = 8$ and a **DM292, ACE *fast*, SH-EMCCD-fast-292**

ORDER TODAY



Need more information?

Contact us for one-to-one guidance and technical support.

- ▶ www.alpao.com
- ▶ contact@alpao.fr
- ▶ +33 476 890 965