ATMOSPHERIC TURBULENCE COMPENSATION

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 RTC latency typical 80µs.

Key features

SPEED

Up to 5kHz

LOW LATENCY AND JITTER

RTC latency
Typical 80µs

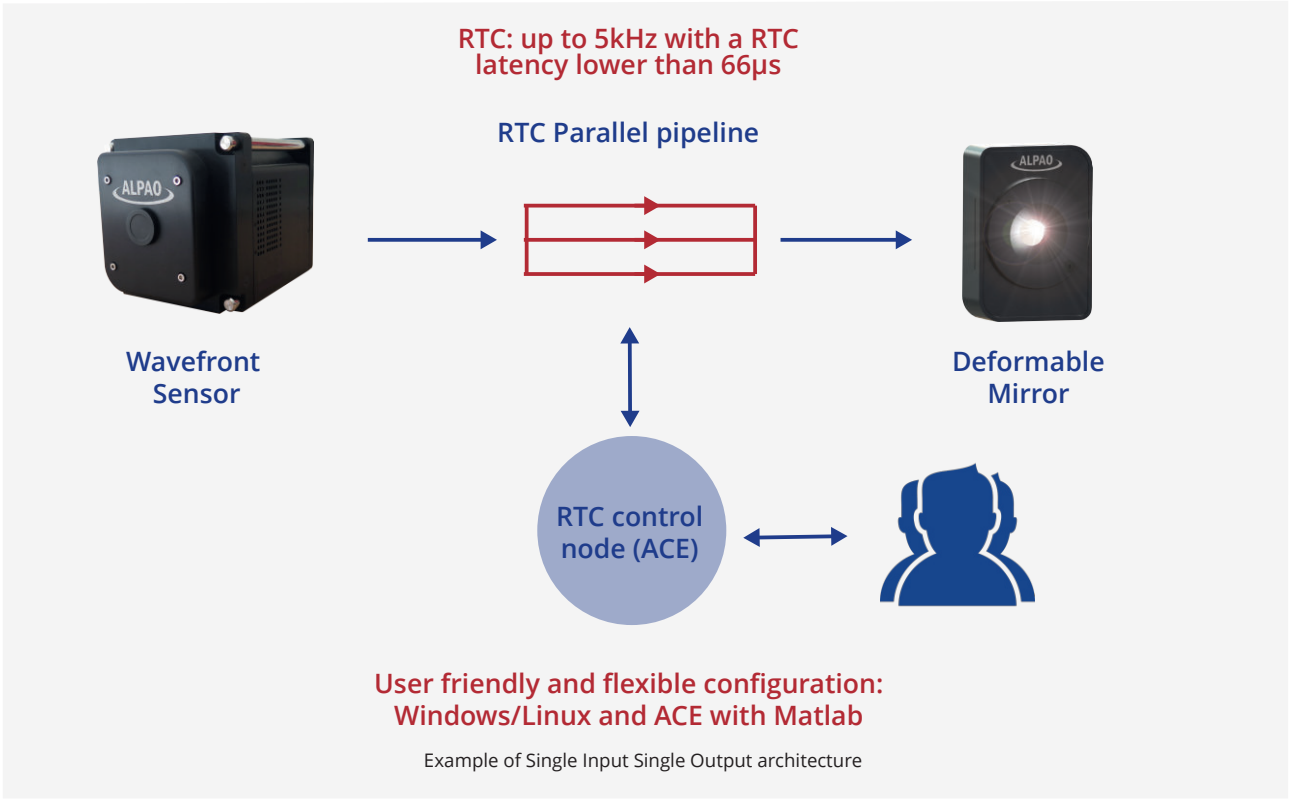
FLEXIBILITY

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 steams
- 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.



Example of Single Input Single Output architecture

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.

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KIT PERFORMANCES

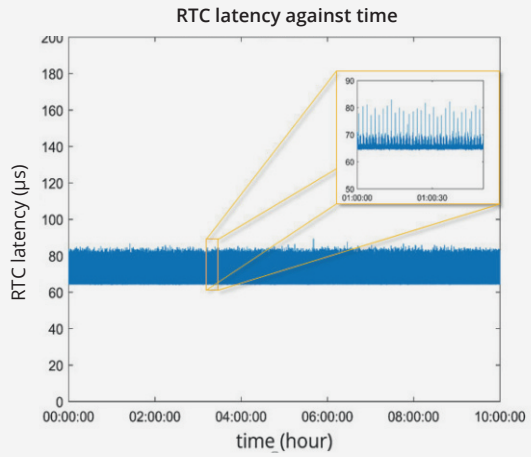
Choose the correct **ALPAO kit** depending on your application:
- the shape of your aberrations drives the number of actuators,
- the temporal fluctuations of your aberrations and the number of photons available drive the WFS and RTC choice.

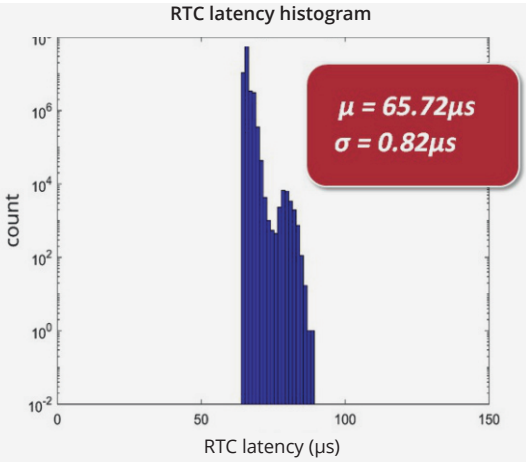
WFS sub-aperture ROI	8x8	10x10	15x15	16x16	19x19	23x23	31x31
Compatible DM (Fried geometry)	DM69	DM97	DM192	DM241	DM292	DM468	DM820
SH-CMOS fast	Frame rate RTC delay AO loop delay	5000Hz 21µs 77µs	5000Hz 21µs 86µs	5000Hz 24µs 127µs	5000Hz 24µs 133µs	5000Hz 27µs 167µs	5000Hz 66µs 253µs	5000Hz 53µs 336µs
SH-EMCCD	Frame rate RTC delay AO loop delay	1838Hz 21µs 585µs	1004Hz 21µs 1034µs	1004Hz 24µs 1044µs	1004Hz 24µs 1051µs	n/a	n/a	n/a
SH-EMCCD fast	Frame rate RTC delay AO loop delay	2067Hz 21µs 565µs	2067Hz 21µs 565µs	2067Hz 24µs 575µs	2067Hz 24µs 582µs	2067Hz 27µs 591µs	2067Hz 66µs 649µs	n/a
SH-InGaAs fast	Frame rate RTC delay AO loop delay	5000Hz 21µs 139µs	5000Hz 21µs 188µs	4760Hz 24µs 254µs	4760Hz 24µs 260µs	3650Hz 27µs 333µs	2900Hz 66µs 461µs	1970Hz 53µs 641µs

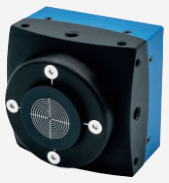
The rejection band, which is the maximum frequency of the perturbation that can be attenuated by the system, is defined for each configuration on request.

TIMING PERFORMANCES

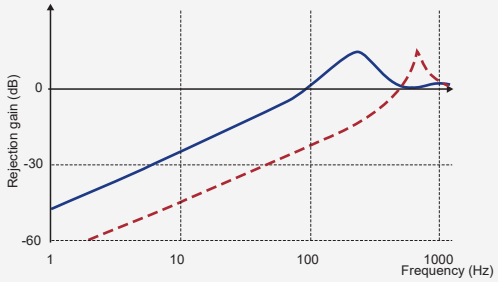
Lost frame and jitter could have a large impact on the overall loop performances and stability. In the following example, there was zero lost frame over 10 hours while working at 2 kHz. RTC latency was very stable as shown on the following histogramm.







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



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

Ask for advanced simulations!

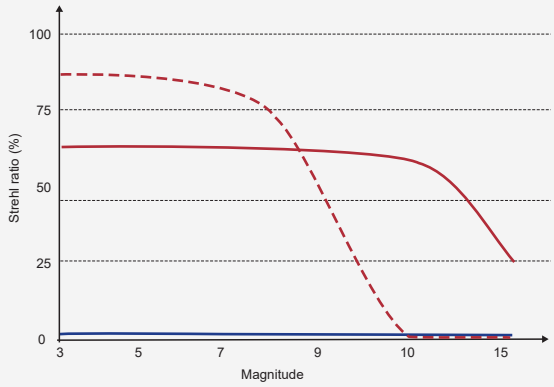
ATMOSPHERIC TURBULENCE COMPENSATION

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/r0 = 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**
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