Table of Contents

This is the API of the **Narrow Field Infrared Adaptive Optics System** (TMT.INS.AO.NFIRAOS).

The Narrow Field Infrared Adaptive Optics System (NFIRAOS) is the first light Adaptive Optics (AO) Systems for TMT. It is located on the TMT Nasmyth Platform and relays light from the telescope to 3 science instruments after sensing and correcting for wavefront aberrations introduced by atmospheric turbulence and the observatory itself.

It is a Laser Guide Star (LGS) Multi Conjugate AO (MCAO) System, which includes two deformable mirrors, one tip/tilt stage, six LGS wavefront sensors, one high-order NGS wavefront sensor for operation without LGS, one truth wavefront sensor, an acquisition camera, and all associated opto-mechanical devices, electronics and computing systems. The NFIRAOS computing sub-systems include:

- The NFIRAOS Real Time Controller (NFIRAOS RTC), which processes the outputs of the wavefront sensors to compute the commands for the deformable mirrors and the tip/tilt stage;
- The NFIRAOS Component Controller (NFIRAOS CC), which controls all the slow mechanisms located within NFIRAOS and consists of several assemblies and Hardware Control Daemons (HCDs) including but not limited to the global assembly, the LGS trombone focus assembly, the time generator assembly;
- The NFIRAOS Truth Wavefront Sensor and Acquisition Camera Controller (NFIRAOS TWAQC Controller), which reads and processes the outputs of the TWFS, acquisition camera or high-resolution wavefront sensor system (part of NFIRAOS test equipment).

Trombone Assembly (trom)

Subsystem	Name	Prefix	Type	WBS ID
NFIRAOS	lgsTrombone	nfiraos.ncc.trombone	Assembly	TMT.INST.AO.NFIRAOS

The prototype Trombone Assembly

Items published by lgsTrombone

Telemetry Published by lgsTrombone

lgsTrombone publishes telemetry: state

LGS trombone assembly state

Archive
no

Attributes for state

Name	Description	Type
cmd	LGS trombone assembly command state	enum: (uninitialized, ready, busy, continuous, error)
move	LGS trombone assembly movement state	enum: (unindexed, indexing, indexed, moving)
sodiumLayer	flag indicating if the initial sodium layer estimate has been set	boolean
nss	flag indicating if NSS mode is enabled	boolean

---

lgsTrombone publishes telemetry: sodiumLayer

Estimate of the current sodium layer elevation and range distance. The sodium layer estimate is only valid when state.sodiumLayer flag is true. If state.sodiumLayer is false then both elevation and range distance will be zero.

Max Rate	Archive	Archive Rate
3.33 Hz	yes	3.33 Hz

Attributes for sodiumLayer

Name	Description	Type	Units
elevation	sodium layer elevation estimation.	double (0 ≤ x)	km
rangeDistance	sodium layer range distance estimation. This value is equivalent elevation to if NSS mode is enabled (i.e. zenith angle is 0).	double (0 ≤ x)	km

---

lgsTrombone publishes telemetry: engr

engineering data for LGS trombone assembly

Max Rate	Archive
3.33 Hz	no

Attributes for engr

Name	Description	Type	Units
focus	Current focus error from the NRTC.	double	micrometers of RMS wavefront error
position	Current position of the LGS trombone stage.	double	mm
angle	Current zenith angle used to calculate range distance. This value is 0 if NSS mode is enabled.	double	degrees

---

Alarms Published by lgsTrombone

lgsTrombone publishes Alarm: limit

The LGS trombone stage has reached a limit

Severity	Archive
major	yes

Commands for lgsTrombone

LGS Trombone Assembly commands.

Command Configurations Received by lgsTrombone

lgsTrombone receives configuration: init

Request Command.

Prepares the assembly for operation and read configuration files. The configuration name must be specified if a configuration version is specified. This command will also the sodium layer estimate, and the clear NSS flag. This command will internally trigger a stop if required.

If the configuration name is not specified, then a default configuration name and version is used. If the configuration version is not specified, then the default version is used for the specified configuration name.

Precondition:

- none

Execution:

- state.cmd = busy
- state.move = unindexed | indexed

At Completion:

- state.cmd = ready
- state.sodiumLayer = false
- status.nss = false

Arguments for init

Name	Description	Type	Required
configuration name	Name of the configuration file to get from the TMT Configuration Service	string	no
configuration version	Version of the configuration file to get from the TMT Configuration Service	string	no

lgsTrombone receives configuration: datum

Submit Command.

Datum the LGS trombone stage, clear sodium layer estimate, and the clear NSS flag. This command will internally trigger a stop if required.

Precondition:

- state.cmd != uninitialized

Execution:

- state.cmd = busy
- state.move = indexing

At Completion:

- state.cmd = ready
- state.move = indexed
- state.sodiumLayer = false
- status.nss = false

lgsTrombone receives configuration: stop

Request Command.

Cancel the current submit type command and stop the LGS trombone state stages.

Precondition:

- state.cmd != uninitialized

Execution:

- state.cmd = busy

At Completion:

- state.cmd = ready
- state.move = unindexed | indexed

lgsTrombone receives configuration: move

Submit Command.

Engineering command that moves the LGS trombone stage to the specified position.

Precondition:

- state.cmd != uninitialized
- state.move = indexed | moving

Execution:

- state.cmd = busy
- state.move = moving
- state.sodiumLayer = false

At Completion:

- state.cmd = ready
- state.move = indexed

Arguments for move

Name	Description	Type	Units	Required
position	target LGS trombone stage position.	double	mm	no

lgsTrombone receives configuration: position

Submit Command.

Engineering command that moves the LGS trombone stage to the specified range distance.

Precondition:

- state.cmd != uninitialized
- state.move = indexed | moving

Execution:

- state.cmd = busy
- state.move = moving
- state.sodiumLayer = false

At Completion:

- state.cmd = ready
- state.move = indexed

Arguments for position

Name	Description	Type	Units	Required
rangeDistance	target range distance.	double (0 ≤ x)	km	no

lgsTrombone receives configuration: setElevation

Submit Command.

Set the initial sodium layer elevation value, and move the LGS trombone to the corresponding position by executing the move command.

Precondition:

- state.cmd != uninitialized
- state.move = indexed | moving

Execution:

- state.cmd = busy
- state.move = moving
- state.sodiumLayer = false

At Completion:

- state.cmd = ready
- state.move = indexed
- state.sodiumLayer = true

Arguments for setElevation

Name	Description	Type	Units	Required
elevation	initial sodium layer elevation estimate	double	km	no
angle	initial zenith angle used to calculate range distance	double	degrees	no

lgsTrombone receives configuration: setAngle

Submit Command.

Engineering command that sets the zenith angle used to position the trombone. In normal operation the zenith angle supplied by the TCS and is tracked while the follow mode is enabled.

Precondition:

- state.cmd != uninitialized
- state.move = indexed | moving
- state.sodiumLayer = true

Execution:

- state.cmd = busy
- state.move = moving

At Completion:

- state.cmd = ready
- state.move = indexed

Arguments for setAngle

Name	Description	Type	Units	Required
angle	zenith angle used to calculate range distance	double	degrees	no

lgsTrombone receives configuration: follow

Request Command.

Enable the LGS trombone follow mode. When the follow mode is enabled, the LGS trombone will track the focus errors from the NRTC, zenith angle from the TCS, and update the sodium layer elevation and range distance estimations. If NSS mode is enable, then the LGS trombone will not follow the zenith angle stream from the TCS and the internal set the zenith angle to zero.

Precondition:

- state.cmd != uninitialized
- state.move = indexed | moving
- state.sodiumLayer = true

Execution:

- none

At Completion:

- state.cmd = continuous
- state.move = indexed | moving
- status.nss = < input nss value >

Arguments for follow

Name	Description	Type	Required
nss	enable NSS mode to operate with NSS LGS Assembly	boolean	no