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**Disposition of Sensors and Actuators**

**in Type-A Vibration Isolation System**

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**1. Disposition of Sensors and Actuators**

**1.1 Overview**



Fig.1: Sensor and actuator list

**1.2. Coordinate Definition**

* X: Transversal axis
* Y: Vertical axis
* Z: Longitudinal (beam) axis
* Pitch: Rotation around X-axis
* Yaw: Rotation around Y-axis
* Roll: Rotation around Z-axis

**1.3. Details**

**[1] Top Stage (F0) Horizontal Sensors and Actuators**



Fig.2: Disposition of horizontal sensors and actuators at F0

Geophones sense inertial motion of F0 (xF0, zF0, yawF0).

LVDTs sense relative motion between ground and F0 (xF0-xg, zF0-zg, yawF0-yawg).

Coil magnet actuators can drive 3 DoFs motion of F0 (xF0, zF0, yawF0)

**[2] GAS Filters (F0~F4, PF) Sensors and Actuators**



Fig.3: Sensor and actuator in a GAS filter

LVDTs in GAS filters sense vertical relative motion between the GAS filter and the stage below.

(yF1-yF0 (=yg), yF2-yF1, yF3-yF2, yF4-yF3, yPF-yF4, yIM-yPF)

Coil magnet actuators can drive the relative motion mentioned above.

**[3] Sensors and Actuators on IM, TM**



Fig.3: Sensors and actuators on IM and TM

IM has 6 relative displacement sensors and actuators (like OSEM), which can sense or drive 6 DoFs relative motion between IM and IRM. (xIM-xIR, yIM-yIR, zIM-zIR, pitchIM-pitchIR, yawIM-yawIR, rollIM-rollRM).

TM has 4 coil magnet actuators which can induce the relative motion between TM and RM (zTM-zRM, pitchTM-pitchRM, yawTM-yawRM). An optical lever can sense TM angular motion about 2 DoFs (pitchTM, yawTM).

**2. Noise Model**

**2.1. Sensor Noise**



Fig.4: Sensors noise model



Fig.5: Sensors noise model (optical lever)

**Geophone noise**: calculated from electronics noise of the pre-amplifier designed at NIKHEF
([JGW-D1201466-v1](http://gwdoc.icrr.u-tokyo.ac.jp/cgi-bin/private/DocDB/ShowDocument?docid=1466))

**LVDT noise**: current achieved sensitivity in pre-isolator prototype test at Kashiwa. Sensitivity is now limited by ADC noise.

**OSEM noise**: current achieved noise in payload prototype test at NAOJ with a simple driver circuit.

**Optical lever noise:** noise estimated from driver electronics noise assuming high reflection on the mirror (0.5) and 4 m round trip length

**2.2. Actuator Noise**

TBD. Requirement is calculated in ([JGW-T1402160-v1](http://gwdoc.icrr.u-tokyo.ac.jp/cgi-bin/private/DocDB/ShowDocument?docid=2160)).