

JGW-T1402170-v1

Jan.30, 2014

**Disposition of Sensors and Actuators
in Type-A Vibration Isolation System**

Takanori Sekiguchi

1. Disposition of Sensors and Actuators

1.1 Overview

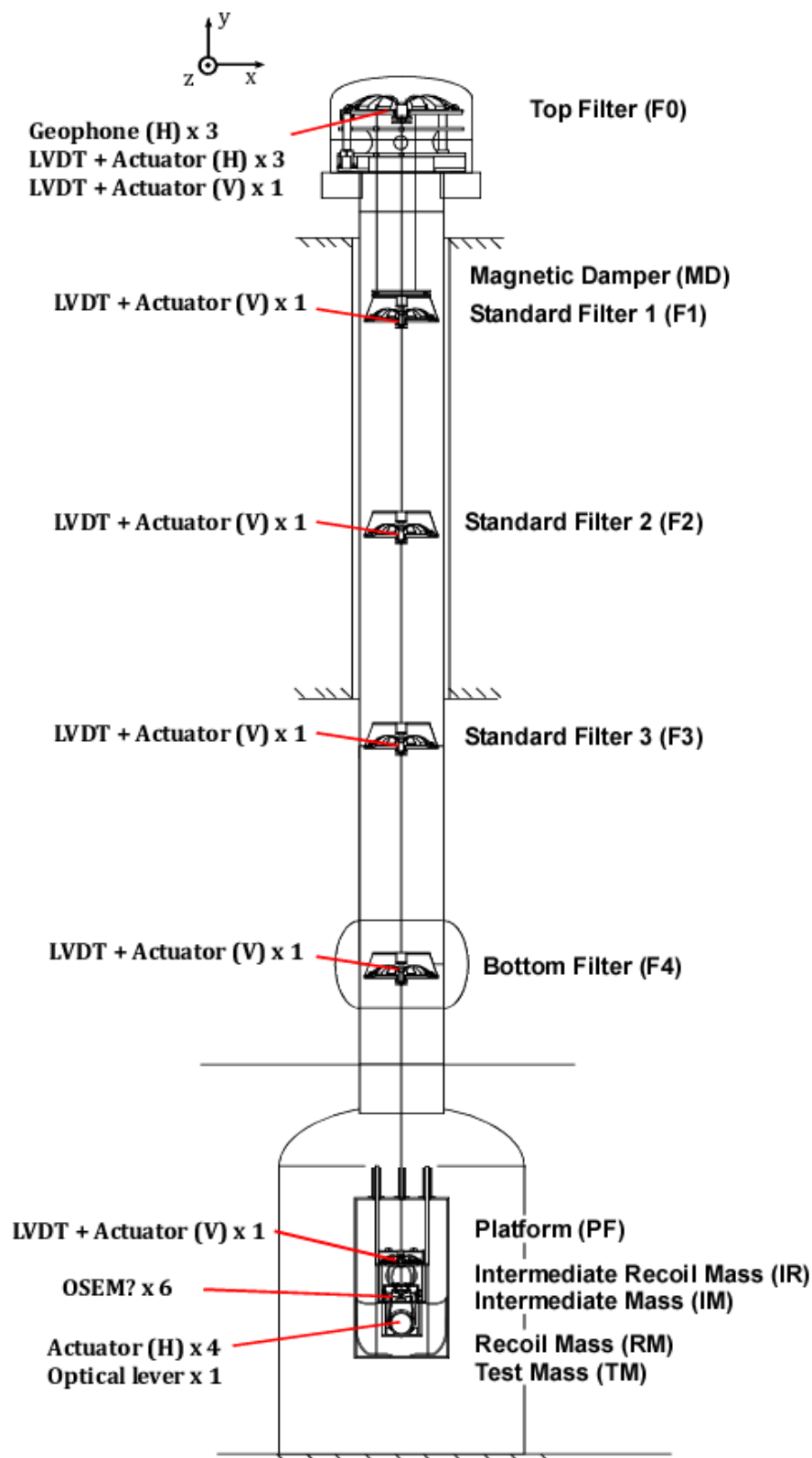


Fig.1: Sensor and actuator list

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

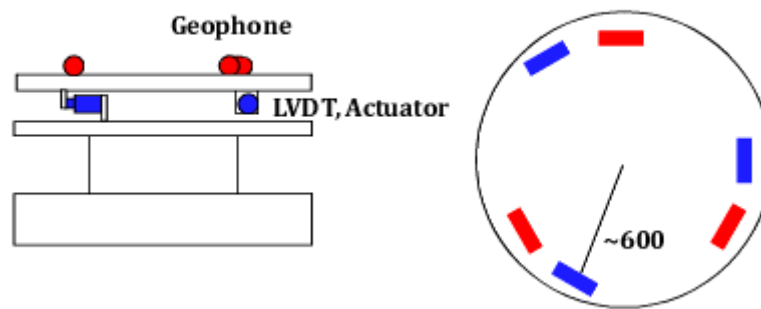


Fig.2: Disposition of horizontal sensors and actuators at F0

Geophones sense inertial motion of F0 (x_{F0} , z_{F0} , yaw_{F0}).

LVDTs sense relative motion between ground and F0 ($x_{F0}-x_g$, $z_{F0}-z_g$, $yaw_{F0}-yaw_g$).

Coil magnet actuators can drive 3 DoFs motion of F0 (x_{F0} , z_{F0} , yaw_{F0})

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

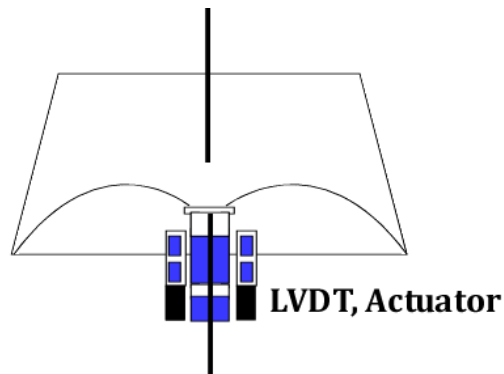


Fig.3: Sensor and actuator in a GAS filter

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

($y_{F1}-y_{F0}$ ($=y_g$), $y_{F2}-y_{F1}$, $y_{F3}-y_{F2}$, $y_{F4}-y_{F3}$, $y_{PF}-y_{F4}$, $y_{IM}-y_{PF}$)

Coil magnet actuators can drive the relative motion mentioned above.

[3] Sensors and Actuators on IM, TM

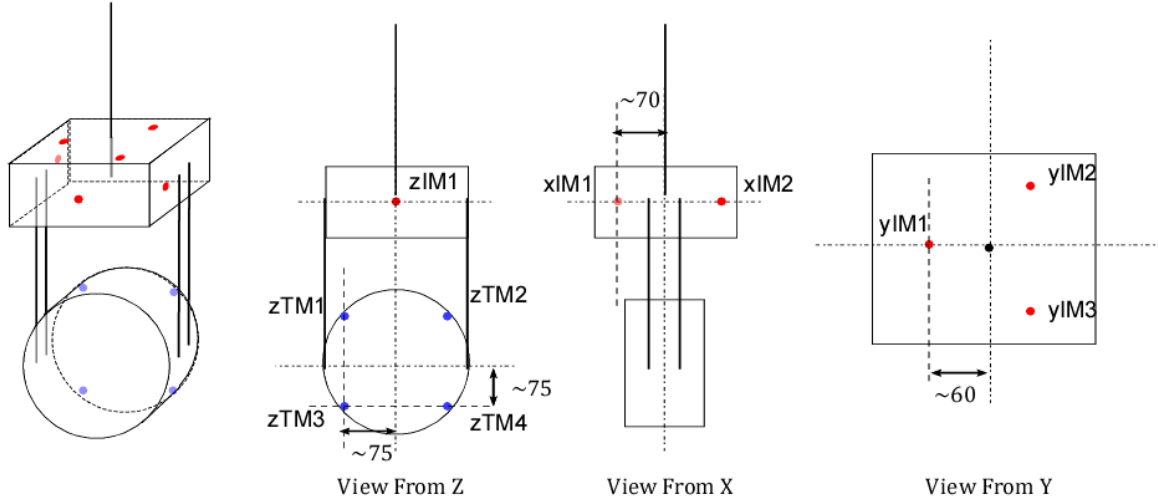


Fig.3: Sensors and actuators on IM and TM

IM has 6 relative displacement sensors and actuators (like OSEM), which can sense or drive 6 DoFs relative motion between IM and IRM. ($x_{IM}-x_{IR}$, $y_{IM}-y_{IR}$, $z_{IM}-z_{IR}$, $\text{pitch}_{IM}-\text{pitch}_{IR}$, $\text{yaw}_{IM}-\text{yaw}_{IR}$, $\text{roll}_{IM}-\text{roll}_{IR}$).

TM has 4 coil magnet actuators which can induce the relative motion between TM and RM ($z_{TM}-z_{RM}$, $\text{pitch}_{TM}-\text{pitch}_{RM}$, $\text{yaw}_{TM}-\text{yaw}_{RM}$). An optical lever can sense TM angular motion about 2 DoFs (pitch_{TM} , yaw_{TM}).

2. Noise Model

2.1. Sensor Noise

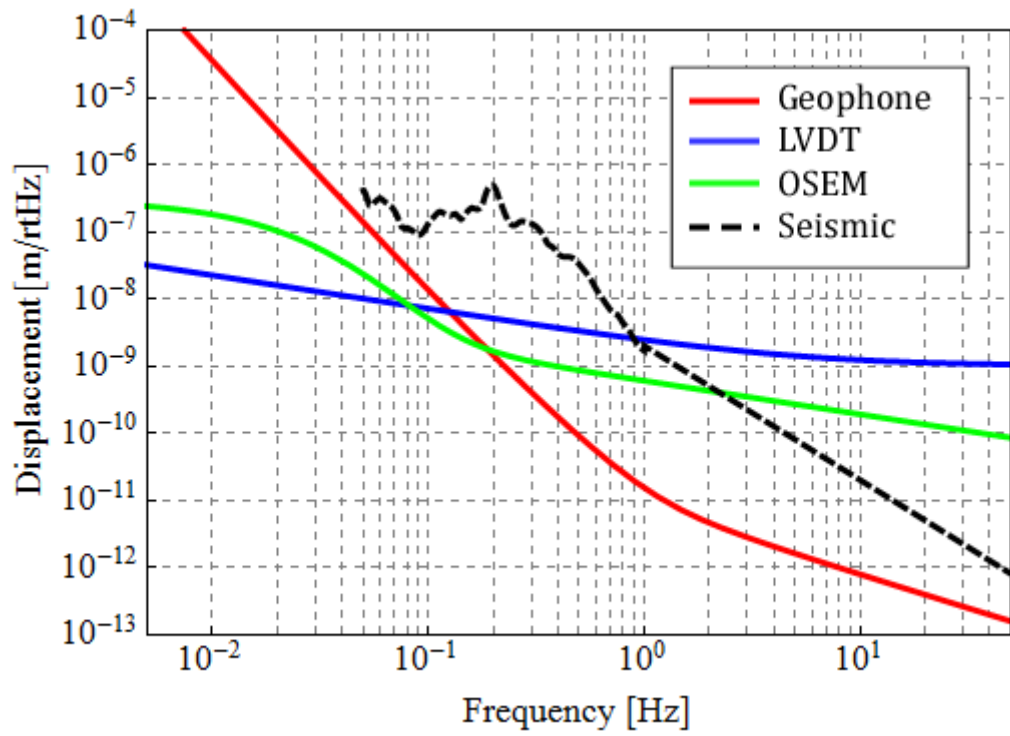


Fig.4: Sensors noise model

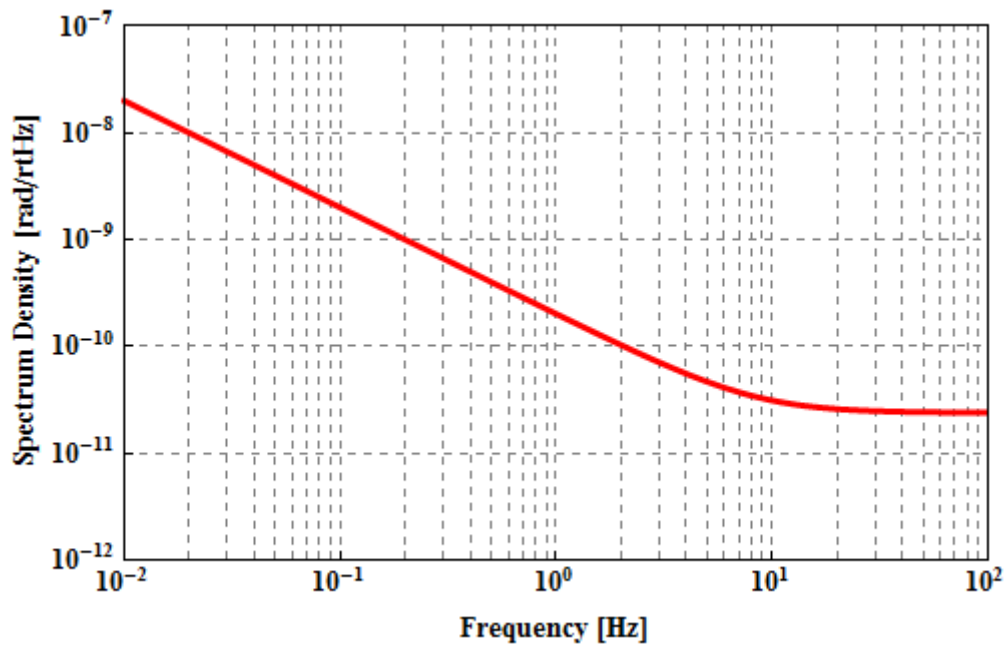


Fig.5: Sensors noise model (optical lever)

Geophone noise: calculated from electronics noise of the pre-amplifier designed at NIKHEF

([IGW-D1201466-v1](#))

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 ([IGW-T1402160-v1](#)).