

# SUSPENSION COMMISSIONING

## **VIR-0329A-16**

E. Majorana, for AdV SUSP group

□ **HW**

**Two main subsystems involved:** SAT and PAY

**Near Commissioning groups:** ISC, ISYS...

□ **People and their main activities**

**V. Boschi:** SW implementation/DSP/control ...

**G. Cerretani:** SW issues/automation/control ...

**E. Majorana:** OpLev local control and organization ...

**P. Ruggi:** overall/control/sensing performance ...

**L. Trozzo:** modeling noise/characterization...

...

The old name of SUSP Commissioning Group was MSC

No overlap with Virgo Subsystems,

just their use/operation/performance VS interferometer

➔ MSC started once the mirrors were all suspended and ITF signals were available, for AdV SUSP the situation has been rather different

➔ SAT/PAY not fully integrated so far and SUSP activities has been interlaced with pre-commissioning issues (electronics, mechanics, software) leading to

A) settling a suitable environment for the operation

B) allowing first commissioning tasks related to ITF cavities

# SUSPENSION TASK LIST

ID	Name	Notes	Predecessors	Priority	Resource Names	Duration	ITF Time	Deliverable	Qualification Method	Qual. Status	Qual. Procedure	Qual. Report
1	BS	Top Level Task: Beam Splitter Suspension										
2	Signals Flow LCU top	Task consists in three phases. During first phase current status of LCU top is analyzed. In second phase we check that code distribution among different boards and data flow is optimize, including signal flow towards DAQ with proper signal names. During third phase, the only one requiring ITF time, we implement required changes to both hw and software configuration.		500	Alberto, Valerio			DSP Code	Review	Unplanned	Approval at review meeting	Not available
3	Signals Flow LCU bottom	Task consists in three phases. During first phase current status of LCU top is analyzed. In second phase we check that code distribution among different boards and data flow is optimize, including signal flow towards DAQ with proper signal names. During third phase, the only one requiring ITF time, we implement required changes to both hw and software configuration.		500	Alberto, Valerio			DSP Code	Review	Planned	Approval at review meeting	Not available
4	SAT Sensors Acquisition	Task consists in writing DSP code for SAT sensors readout (lvd and accelerometer) including pre-calibration activities such as demodulation phase check and accelerometer local feedback regulator design.		500	Valerio			DSP Code	Test	Compliant	Look at signals and write a report	Link to TDS doc
5	SAT Mechanical Tuning	Task consists mainly in Inverted Pendulum centering. Additional check, such as 4 crossbars position for example, could be added to this task.	4	500	Paolo			Report	Analysis	Not Compliant		
6	SAT Sensors Cross-Calibration	Sensors need accurate cross calibration (10% min, 1% goal)	5	500	Paolo, Valerio			DSP Code	Analysis	Unplanned		
7	SAT Sensing Matrices		6	500	Paolo, Lucia			DSP Code	Analysis	Unplanned		
8	PSD Acquisition	Task consists in writing DSP code for PSD sensors readout including pre-calibration activities.		500	Valerio			DSP Code	Test	Unplanned		
9	Optical Levers Optical Diag	Optical diagonalization of optical levers	8	500	Ettore			Report	Test	Unplanned		
10	SAT Actuators Calibration		7	500				Report	Test	Unplanned		
11	PAY Actuators Calibration		10	500				Report	Test	Unplanned		
12	SAT Driving Matrices		10	500				DSP Code	Analysis	Unplanned		
13	Optical Levers Calibration		11	500				DSP Code	Analysis	Unplanned		
14	SAT System Identification		12	500				Report	Review	Unplanned		
15	PAY System Identification		13	500				Report	Review	Unplanned		
16	SAT Complementary Filters	Task consist in finding the optimal crossover between position servo and acceleration servo.	14	500				DSP Code	Test	Unplanned		
17	SAT Cradle Correction	Cradle (and twist) correction	14	500				DSP Code	Test	Unplanned		
18	SAT Controller Design		17	500				DSP Code	Review	Unplanned		
19	PAY Controller Design		18	500				DSP Code	Review	Unplanned		
20	SAT Noise Budget		18	500				Report	Review	Unplanned		
21	PAY Noise Budget		19	500				Report	Review	Unplanned		
22	Data Quality		21	500				Software Tools	Test	Unplanned		
23	SAT Piezo/Tilt Control	To be better defined		500						Unplanned		
24	Operation/Automation	To be better defined		500						Unplanned		

V. Boschi, A. Gennai, E. Majorana, R. Passaquieti, P. Ruggi

**BASIC mirror suspension control operation with new digital electronics system.**

**Needs :**

- **Proper signal extraction for both accelerometers and LVDTs using the new electronics**
- **Proper inter-calibration**
- **Effective error signal reconstruction along Virgo DOFs.**
- **Driving matrixes**
- **Cradle-coupling subtraction**
- **OpLev signals with acceptable optical diagonalization**
- **Main TF measurements**

TW	Top-stage H-ctrl	Top-stage H-ID	Top-stage V-ctrl	Top stage ID-V	F7 control	Pay-Ma Control	Pay-Mi Control	Overall refinement
MC	Green	Red	Green	Red	No option	No option	Light Green	Red
IB	Green	Red	Light Green (Ltot ctrl)	Red	No option	Green	Green	Red
OB	Green	Red	Light Green (Ltot ctrl)	Red	No option	Green	Green	Red
PR	Green	Red	Light Green (Ltot ctrl)	Red	Light Green	Green	Green	Red
SR	Green	Red	Light Green (Ltot ctrl)	Red	Light Green	Green	Green	Red
BS	Green	Light Green	Green	Light Green	Green	Green	Green	Red
NI	Green	Yellow	Green	Red	Green	Light Green	Steel !!	Red
NE	Green	Yellow	Green	Red	Green	Light Green	Light Green	Red
WI	Green	Red	Green	Red	Green	Light Green	Broken !!	Red
WE	Green	Yellow	Green	Red	Green	Green	Green	Red

Done
To be adjusted
In progress
To be done

TO BE GREEN WITH 1.5 MONTH

## Towards Advanced operation VS locking issues

### Needs:

- driving matrixes refinements
- specific TF measurements
- suitable blending for hierarchical control
- auxiliary payload damping during locking/unlocking
- OpLev glitch removal during cavity alignment phases
- OpLev control optimization + cavity signals (drift control)

**Example of tentative schedule over 3 months,  
To be discussed within commissioning coordination**

SUSP	Hierarch. ctrl	Partitioned Lock	Tidal ctrl	F7 ctrl refined	Global IP ctrl	Automation
PR	7 <sup>th</sup> ...					
BS	8 <sup>th</sup> ...					
NI		2 <sup>nd</sup>				
NE	5 <sup>th</sup>	2 <sup>nd</sup>	1 <sup>st</sup>			
WI		4 <sup>th</sup>				
WE	6 <sup>th</sup>	4 <sup>th</sup>	3 <sup>rd</sup>			
SR						



Other activities in background performed by the same people (in progress).

ITF Commissioning issues/performance

Pure commissioning

Probe names rearrangements, Detector Monitoring, Guardians...

DSP cards updating ...leading to frozen versions

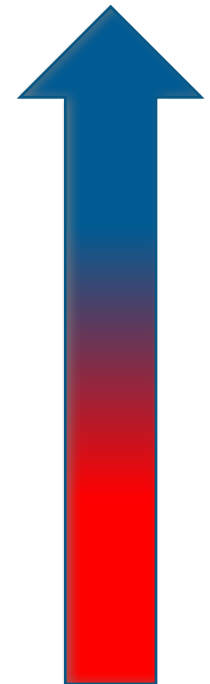
Noise budget studies and measurement campaign

Suspension control strategy validation

Active IP centering using motors

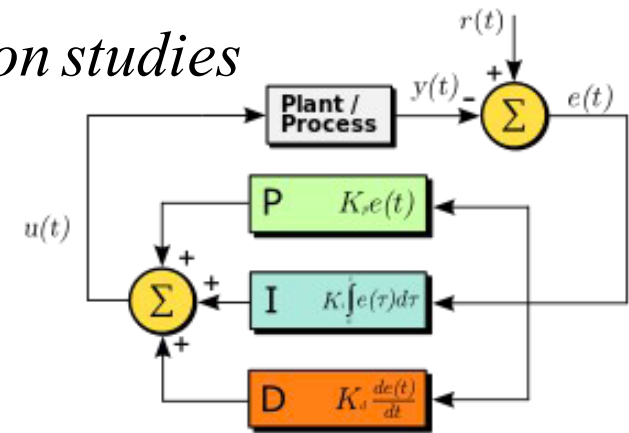
Tracking changes & DB Operation

Involvement in integration activities



Present status

An evaluation method to optimize systematically the performance of suspension control has been developed (L. Trozzo, P. Ruggi).



- ❑ The study was validated for both Vertical (VIR-0066A-16) and Horizontal DOFs using PR suspension, recovering in systematic way the Virgo experience.
- ❑ The method exploits both the presence of PZTs under the IP and environmental seism
- ➔ to estimate the noise on top stage sensors (cradles, tilt..) and is determined by predefined set of measurements
- ➔ the achievable performance using standard methods, namely featured HP-LP blending technique.

- ❑ SCF = Suspension Commissioning Friday (16:00, 30 min), a quick meeting to summarize what done and what missing WRT to what scheduled
- ❑ Every weekend the commissioning needs, arising from both sides, commissioning coordinator and SUSP, will bring to a shift request for the next week.
- ❑ A call to subscribe a mailing list will be launched tomorrow