INFN Istituto Nazionale di Fisica Nucleare	**Istituto Nazionale di Fisica Nucleare** *Sezione di Pisa* Largo Bruno Pontecorvo, 56127 Pisa – Italy. http://www.pi.infn.it

VIRGO Collaboration

MSC Commissioning Progress Report

Commissioning Report MSC-403
May 2010

Document Number: VIR-0265A-10

Issue: 1.0

Date: 28/04/2010

Authors: Alberto Gennai

Change Record

Issue	*Date*	*Affected Paragraphs*	*Reason/Remarks*	*Author*
1.0	28/04/2010	All	First release	A. Gennai

Table Of Contents

1. INTRODUCTION

Last 6 months activities were all focused on two items:

- New DSP Installation.
- Setup of new payloads local control (written by E. Majorana)

This document is a short report summarizing achieved results.

2. NEW DSP

Figure 1 New DSP Board

After more than 10 years of continues operation, old DSP boards developend by INFN Pisa group reached the end of their lifecycle. Replacement was necessary for two independent reasons. A technical one, since DSPs were used close to 90% of their computational capability, thus preventing any further improvement in control algorithms, and a practical one, since the old processors are no more available on the market.

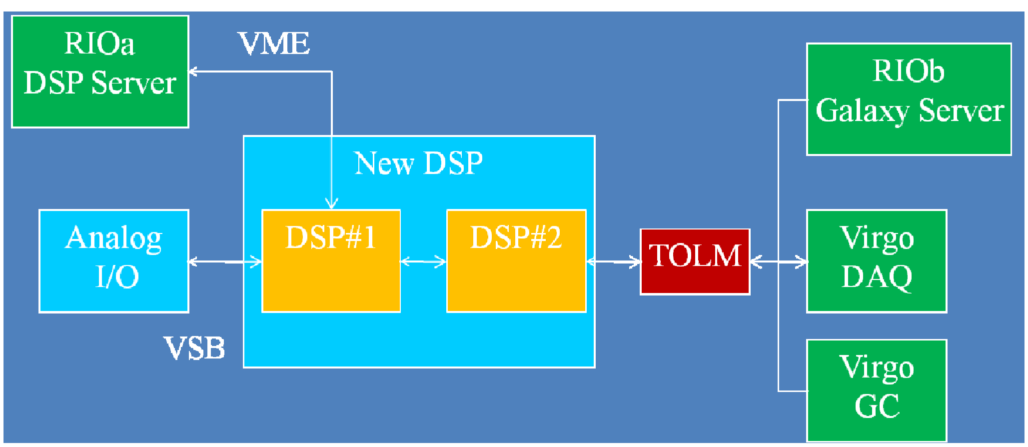


Figure 2 New DSP (INFN Pisa) and its connections to Virgo subsystems

Each old DSP was replaced by new boards hosting a cluster of 2 or 6DSPs. All communication with other Virgo sub systems is via TOLM (Timinig and Optical Link Module, developed by LAPP) and DSPs handle communications using DMA channels.

Basically, one DSP (DSP #2) is in charge of communication with Virgo subsystems such as Data Acquisition System, Alignment and Global Control. A second DSP (DSP #1) reads local sensors, performs required computations and delivers results to local actuators. At terminal suspensions, 4 additional DSPs are available to provide an increased computational power necessary to study improvements to the digital controllers used in our Suspensions. Additional computational power will allow implementing Multiple Input Multiple Output (MIMO) and adaptive controllers, with major advantages in terms of performances

2.1 *Installation*

New DSP were successfully put in operation at the following subsystems: Output Bench, Power Recycling, Beam Splitter, Injection Bench, Beam Control, Mode Cleaner. Still to be installed at the moment when this document was written are DSPs at North End, North Input, West End and West Input. Their installation is foreseen in the incoming weeks.

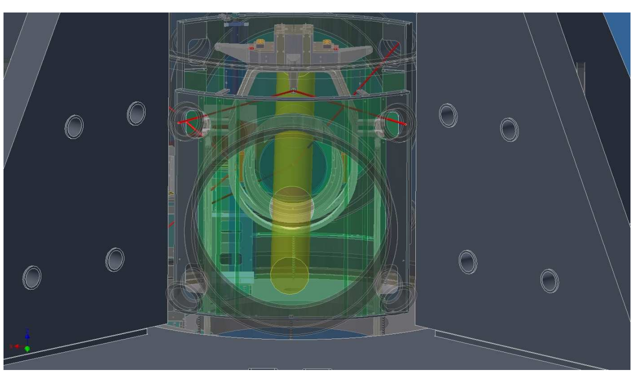
Software

New DSPs operate using an updated version of our custom compiler known as ‘Damping’. Old code need to

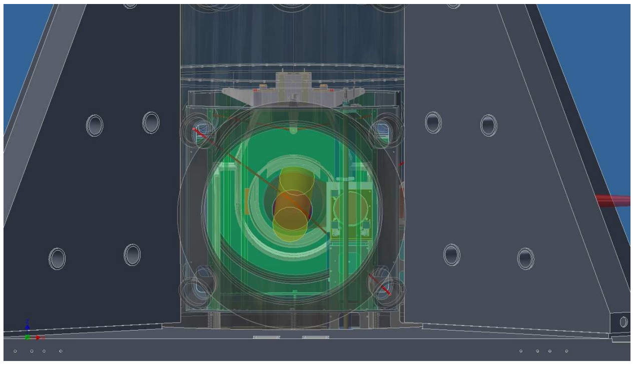
3. NEW PAYLOADS LOCAL CONTROL (E. MAJORANA)

The monolithic-suspension payloads for Virgo+ have several new features that involve update and upgrade of local controls. The main ones are the following:

CCD: the digital-camera view-side is the rear side of mirror reaction-mass; according to this change, CCD and marker imaging illumination have been set at the view-port dedicated to marionette control laser.

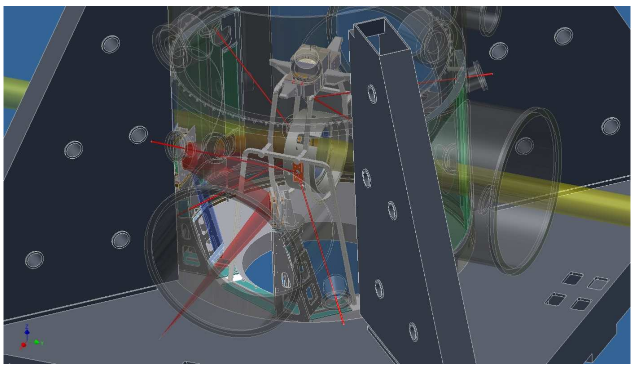


Marionette OL: for NI and WI the position of marionette control benches have been re-arranged in order to set the optical lever on the horizontal plane. Previous incidence plane was inclined by 9 deg and such a layout required specific patches in control filters to avoid readout coupling of roll into yaw.



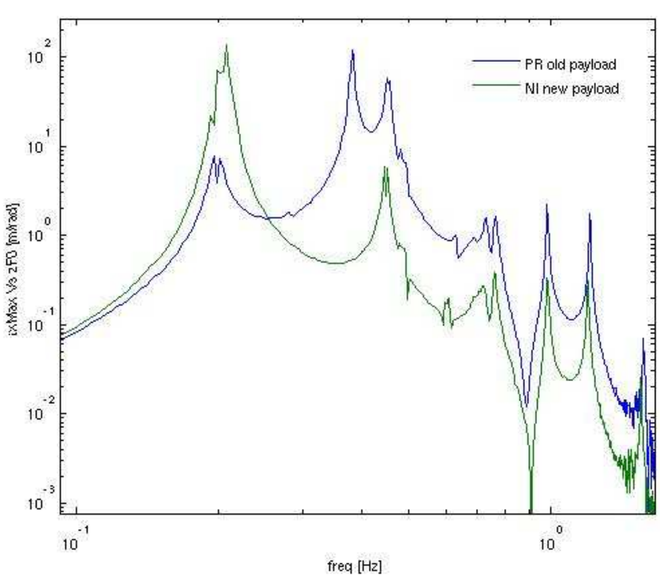
Mirror OL: it was used to recover the mirror pre-alignment after the payload replacement. After the payload replacement the optical lever was reversed in order not to let the illuminator light be gathered by the lever position sensor.

PSD are at the top viewport.



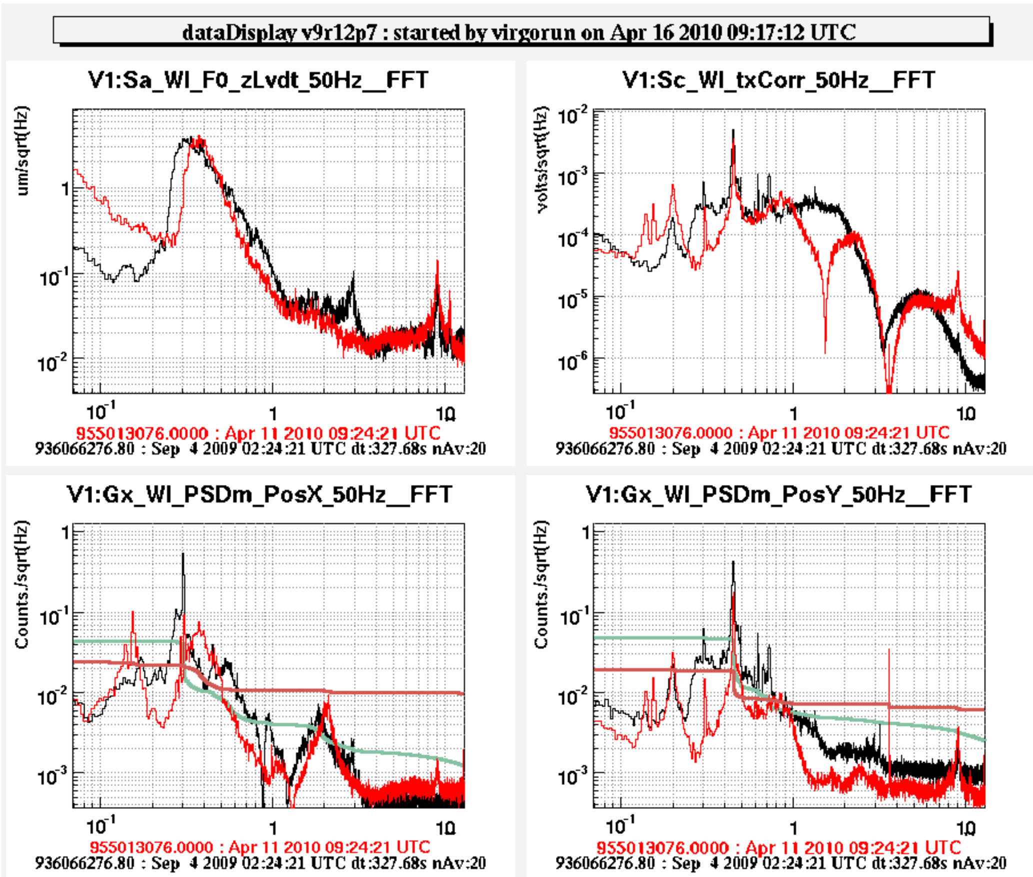
Transversal OL: it was designed to provide a reliable and low noisy error signal for transversal motion damping (x,tz). This implementation required the installation of two small external benches, two viewports and a specific 1 inch-mirror installed on the RM side. For NI and WI this OL is installed on the same sides through which the TCS is injected. Preliminary the GxServer (payload local-control error signal SW) was developed and tested to provide suitable operation.

New payloads have fused silica fibers and this slightly changes differential RM-Mirror tilt modes but the largest change is related to low frequency modes of pitch and roll involving a common motion of payload elements. That happens due the designed different suspension point of the marionette. Hence the major changes have been related to pitch control of marionette.

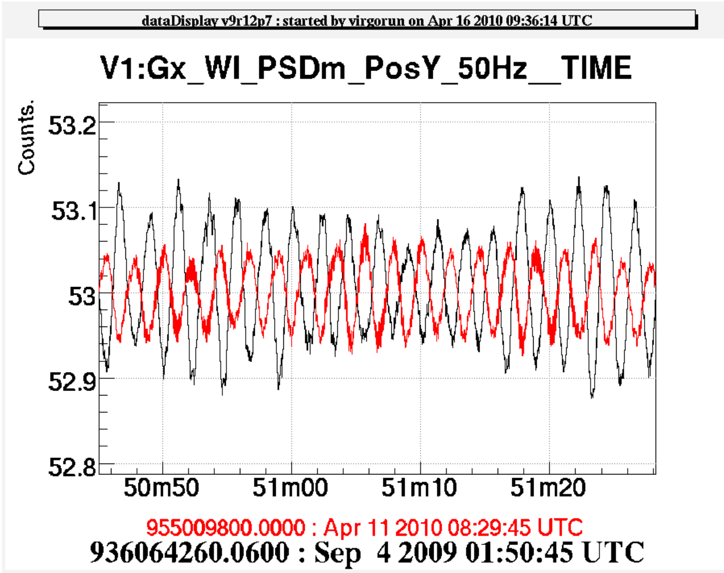


Pitch transfer function difference between PR and NI last-stage suspension, namely a comparison between an old and a new monolithic suspension payload. No interference between SA and payload resonances in the micro-seismic region (and attenuation due to the lowering of payload elements common mode).

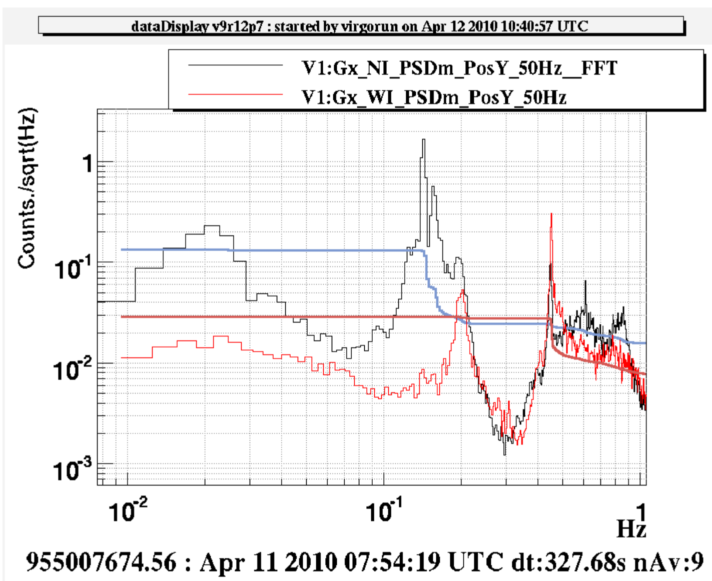
Following ideally that line such a frequency should be lowered even more but payload assembly would became somehow critical.



In the plot-set above two situations with sustained suspension micro-seismic excitation very similarly featured (up-left) are considered for WI. Below, yaw (left) and pitch (right) read-out by PSD and calibrated are shown. In the up-right plot the related correction applied from F7 to the marionette pitch is shown as well. We notice that in the newer situation the overall suspension tilt is reduced by a figure of about 60%, being micro-seismic excitation gathered by the payload at 450 mHz (step in green line). The next step, according to the standard procedure, is the improvement of correction roll-offs to reduce noise reinjection to the level of the past, i.e. suitably below the sensitivity impact.



We remark that actually input mirrors are under local control whose drift is controlled upon automatic alignment base. Hence it is important to show what is the effect, in the time-domain, of input mirrors oscillation as the micro-seism is significantly active. Consistently to the spectra shown above, we see that 450 mHz component, crucially affecting the overall misalignment of the interferometer, is now significantly reduced.



IN case of microseism NI is still strongly affected by the microseism due to a non-trivial mechanical coupling among the d.o.f. of the payload (critically involving the roll, poorly controllable). Pitch corrector has been featured in order not to sustain the excitation. Consequently, an effort will be directed to combined control strategies and, of course, to better understand and remove the mechanical (or electromechanical) cause of this problem.

oOo