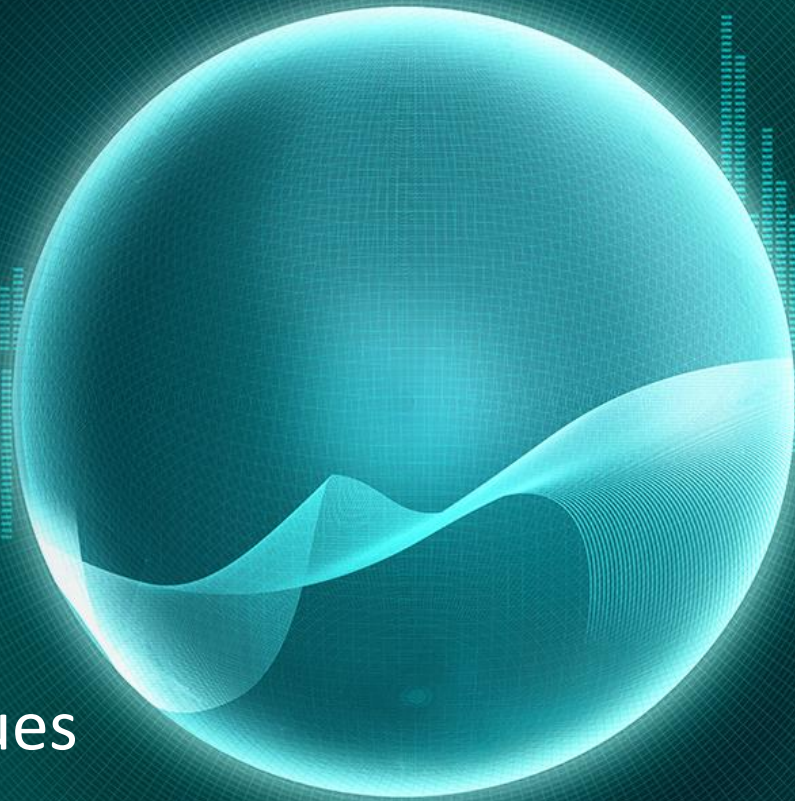


SnT 2019

CTBT: SCIENCE AND TECHNOLOGY CONFERENCE

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SSI Calibration Module



Operational Manual Requirements

- The IMS **Operational Manual** includes **strict requirements** regarding calibration of IMS seismic stations:
 - On-site calibration results are used as QC for instrument **stability**
 - “stability “: +/- 5% to the instrument nominal response
 - over the full IMS passband
 - yearly basis verification
 - **Planning** and **communication**
 - at the Network level: attribution of calibration time slots to Stations
 - at the Station level: calibration messages exchanges between SO and the IDC

Calibration Challenges

- **high number** of sensor-digitizer **combinations** (hardware/software/procedures/training)
- PTS **resources to train** Station Operators on calibration activities
- **variety** and **complexity** of hardware/software issues
- compliance with the OM requirements for **full frequency calibration** and sending of results at the **IMS2.0 format**
- compliance with **command and control** and **authentication** requirements while performing on-site calibration activities

Calibration Challenges

- On-site calibration is a **complex** and technical process involving **different** tasks and people:
 - Initial Planning (PTS)
 - Initial communication (PTS, SO) → refined planning
 - Calibration task (SO)
 - Results review (SO)
 - IMS2.0 reviewed results sending (SO)
 - Update of Calib values in the CD1.1 data stream (SO)
 - Reviewed results reception and validation (PTS)
 - Validated results publication (PTS)

Addressing Challenges

- **Engineering resources** from IMS and IDC Divisions were invested to resolve these challenges
 - **CAMT** to semi-automatize the planning and scheduling of calibration activities, the communication with SO and the receipt, storage, review and reporting of seismic calibration results
 - **SSI Calibration Module** to provide a standardized and user-friendly interface for SO to perform calibration tasks and send **interpreted full-frequency** calibration results to the IDC in **IMS2.0** format
 - development of **training material** and user manuals for station specific configurations
 - inclusion of calibration activities as part of regular SO **trainings**

SSI Calibration Module: Features

- Calibration operational **process** fully supported by the calibration module
- Communication between the PTS and the Station using standardized **IMS2.0** format (including full-frequency response presentation)
- Command and Control **authentication** (through SSI Authentication module)
- Define, perform, review and report on a calibration
- **Auto-evaluation** of the calibration results (IN_SPEC YES or NO)
- Variety of the sensor/digitizer **combinations** supported (Nanometrics Europa, Guralp D24, Quanterra Q330, MariPro DDFI)
- GUI executed locally, all communications with the workstation are using CLI commands, thus minimizing the load on GCI **bandwidth** and allowing smooth calibration of remote sites from CRF or PTS

SSI Calibration Module: User Modes

- **SEMI-AUTOMATED**. This is the **default** user mode. The Station Operator keeps the control on all the steps of the calibration
- **AUTOMATED**. This mode is meant to be used at remote stations, lacking human or technical resources to use semi-automated mode
- **MANUAL**. This mode allows the possibility to perform unscheduled calibrations by defining any scenario

Supported Hardware

- Supported **digitizers**
 - Guralp DM24
 - Nanometrics Europa-T / Europa HRD
 - Quanterra Q330HR
- Tested configurations (**digitizers/sensors**)
 - DM24 + CMG-3T
 - DM24 + STS-2
 - EuropaT + CMG-3T
 - EuropaT + STS-2
 - EuropaT + GS13
 - Q330HR + CMG-3T
 - Q330HR + STS-2



Guralp DM24



EuropaT



Q330HR



CMG-3T



STS-2



GS13

Calibration Scenario Definition and Scheduling

The screenshot shows the ssiCalibView v.2.36 interface. The main window displays a list of calibration groups. A 'Calibration Group' dialog box is open for group 499, showing a table of individual calibrations. Red arrows point from the labels 'belg_prb' and 'belg_sine' in the table to the text 'random calibration' and 'sine wave calibration' respectively.

GID	Label	Scheduled Time	Started Time	Duration (s)	Status
499	test_BELG_night	2018/06/05 01:19	2018/06/05 01:19	11100.0	Success

CID	Label	Scheduled Time	Started Time	Duration (s)	Status
593	belg_prb	2018/06/05 02:01	2018/06/05 02:01	10800.0	Success
592	belg_sine	2018/06/05 01:19	2018/06/05 01:19	300.0	Success

random calibration

sine wave calibration

Currently shown calibrations: ALL Change Exit

Calibration Signal(s) Definition

The screenshot displays the ssiCalibView v.2.36 software interface. The main window shows a list of calibration groups with columns for GID, Label, Scheduled Time, Started Time, Duration (s), and Status. A 'Calibration Group' dialog box is open, showing details for GID 499, Label 'test_BELG_night', and Status 'Success'. Below this, a 'Calibration & Signals' dialog box is open, showing details for a specific signal with GID 499 and CID 593. The signal details include Label 'belg_prb', Start Type 'Fixed', and Time '2018/06/05 02:01'. A table at the bottom of the dialog shows dependencies for TID 4900 and 4901.

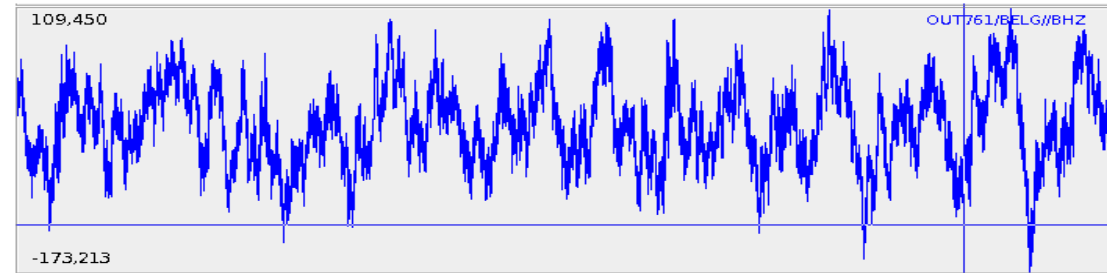
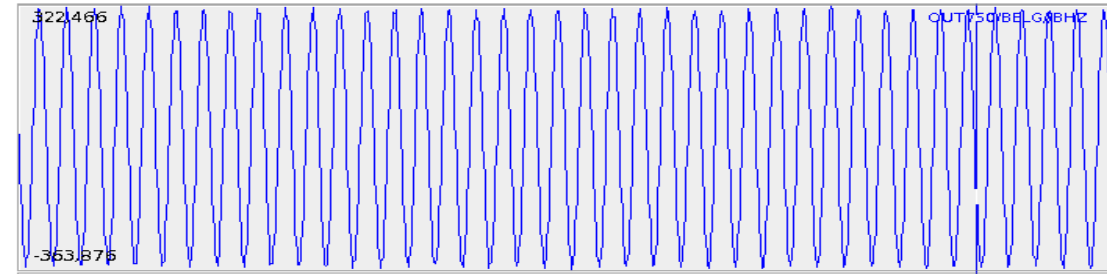
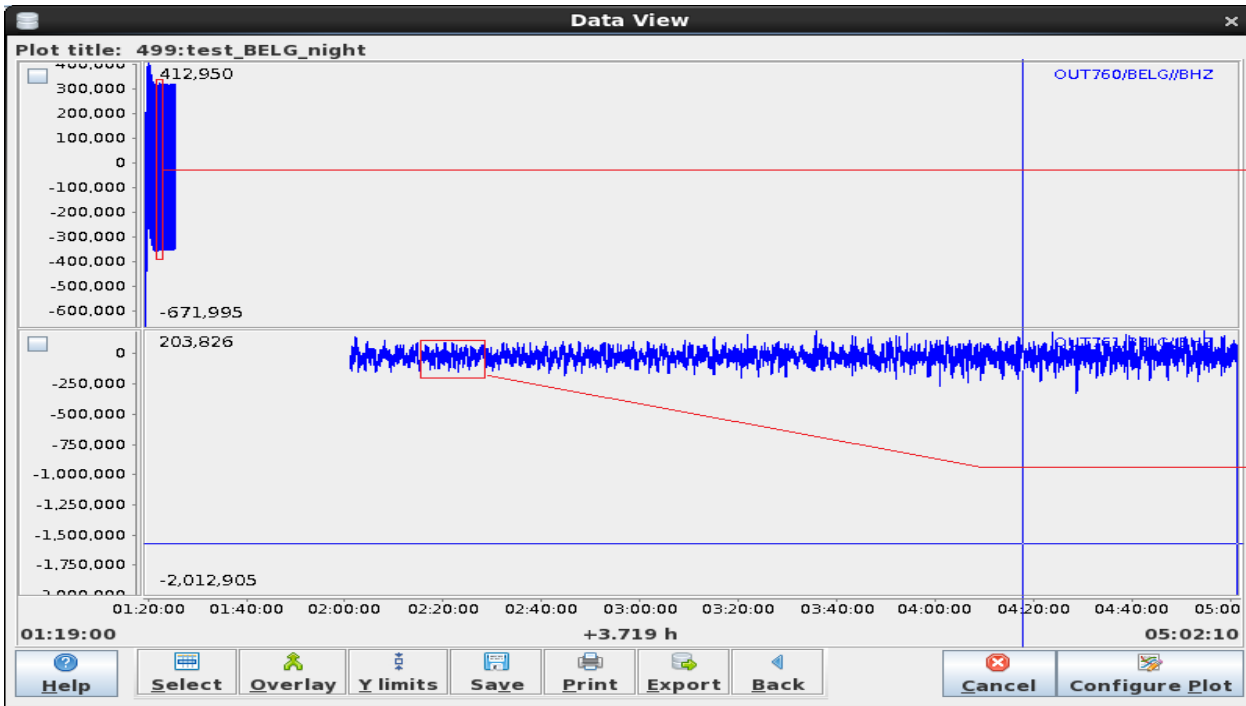
GID	Label	Scheduled Time	Started Time	Duration (s)	Status
499	test_BELG_night	2018/06/05 01:19	2018/06/05 01:19	11100.0	Success

CID	Label	Scheduled Time	Started Time	Duration (s)	Status
593	belg_prb	2018/06/05 02:01	2018/06/05 02:01	10800.0	Success
592	belg_sine	2018/06/05 01:19	2018/06/05 01:19	300.0	Success

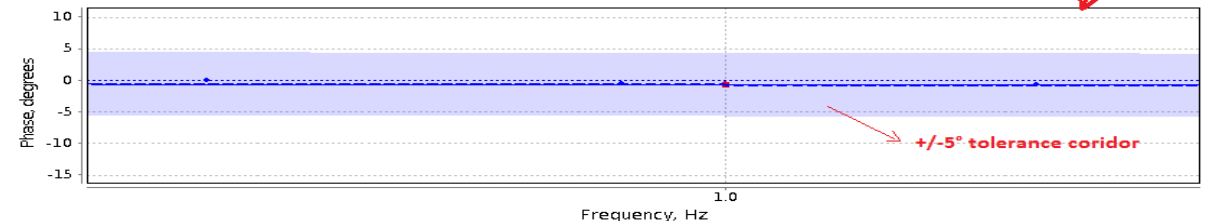
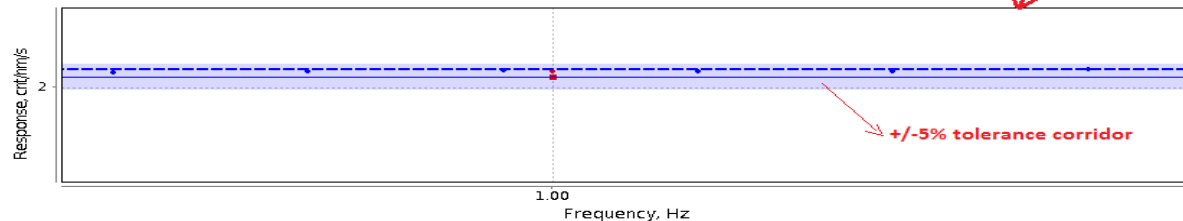
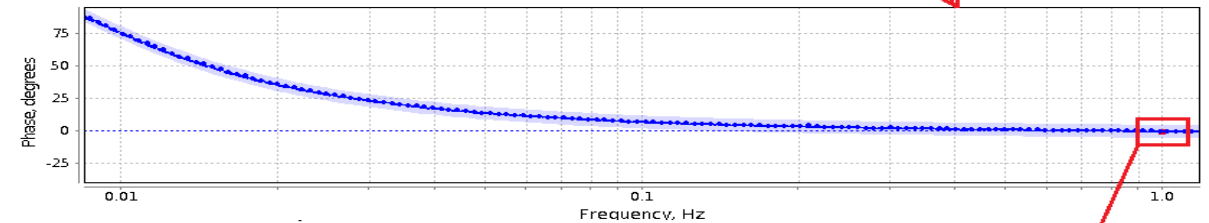
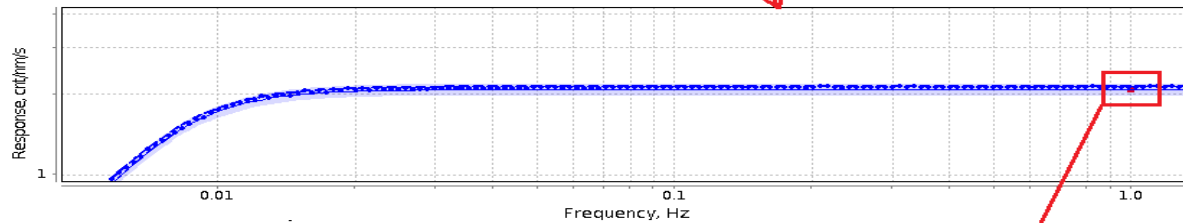
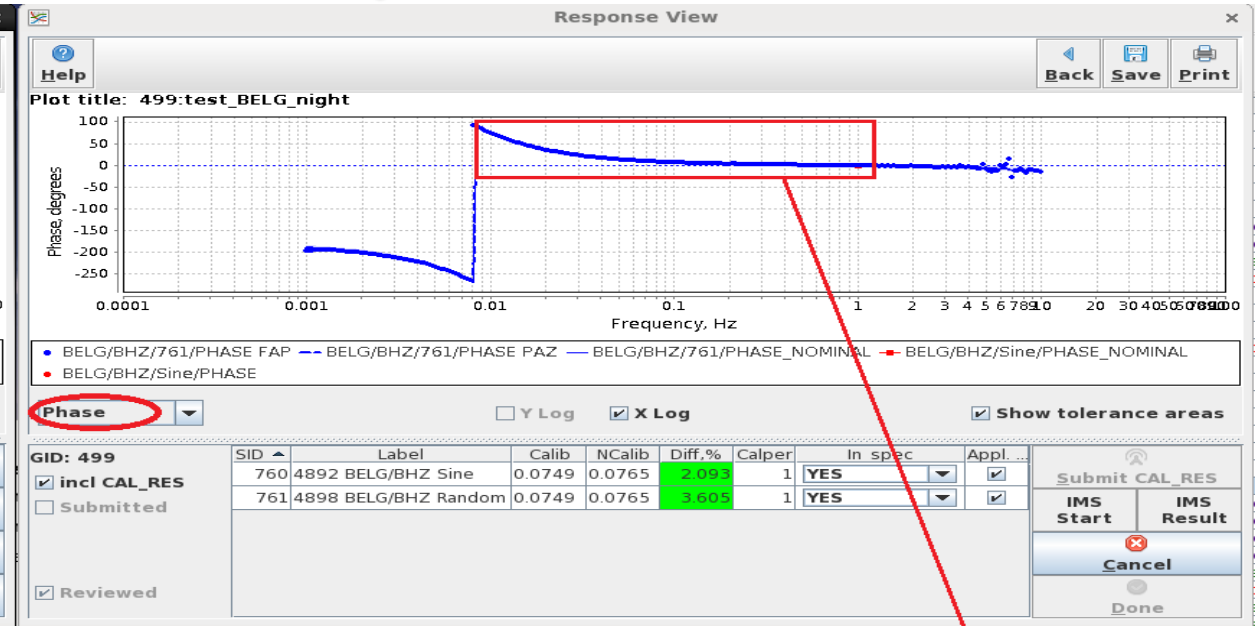
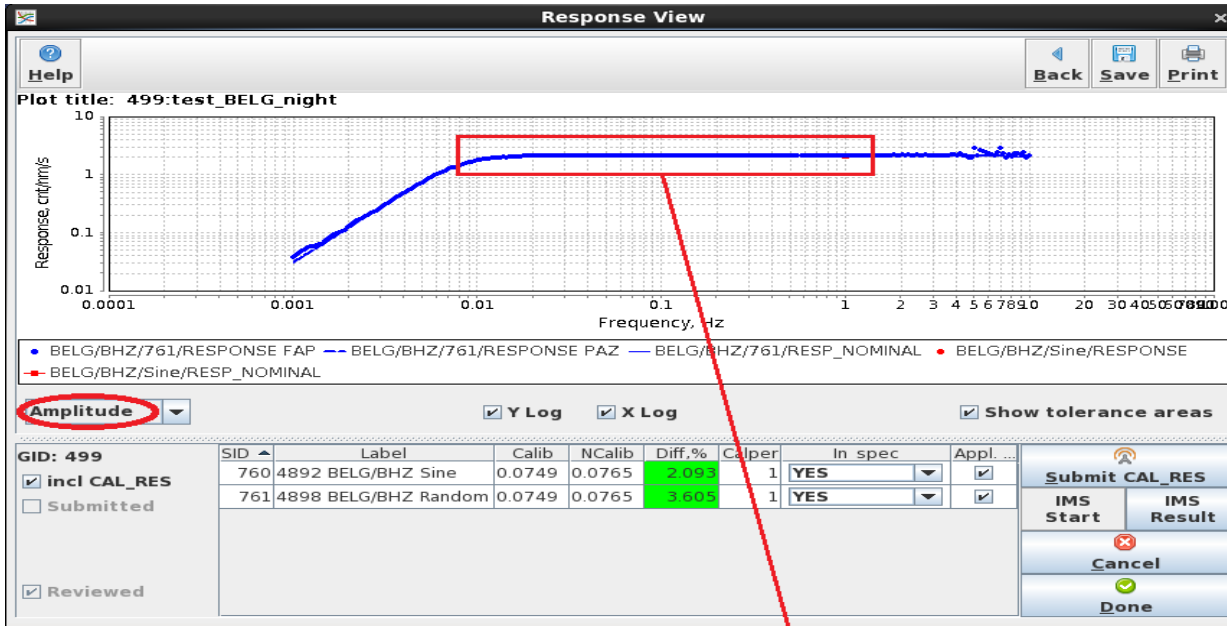
SID	Type	Station	Channel	Amp	Duration (s)	Freq (Hz)	Subwindows	Freq Bins	Status
761	Random	BELG	BHZ	10%	10800	0.001-10.0	2	256	Success

TID	Depends ...	Module
4900		xml2drm
4901		fap2paz

Output Signal Review



Calibration Results Interpretation



IMS2.0 calibrate result message

```

IMS 2.0 RESULT message
BEGIN IMS2.0
MSG_TYPE DATA
MSG_ID 201807090733220000
REF_ID
TIME_STAMP 2018/07/09 07:33:22
STA_LIST BELG
CHAN_LIST BHZ
CALIBRATE_RESULT
IN_SPEC YES
CALIB 0.074884
CALPER 1.000000
CAL2 BELG BHZ          7.48839579e-02  1.000  40.00000 2018/06/05 01:19
FAP2 1 C 0 0.000 1
      1.00000 1.33540000e+01 89
STA_LIST BELG
CHAN_LIST BHZ
CALIBRATE_RESULT
IN_SPEC YES
CALIB 0.074859
CALPER 1.000000
CAL2 BELG BHZ          7.48587995e-02  1.000  40.00000 2018/06/05 02:01
FAP2 1 C 0 0.000 256
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      0.00104 2.69874000e-04 -106
      0.00107 3.03870000e-04 -106
      0.00111 3.37866000e-04 -106
      0.00116 3.71862000e-04 -106
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      0.02307 1.00000000e-02 -106
      0.02314 1.00000000e-02 -106
      0.02321 1.00000000e-02 -106
      0.02328 1.00000000e-02 -106
      0.02335 1.00000000e-02 -106
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      0.02377 1.00000000e-02 -106
      0.02384 1.00000000e-02 -106
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      0.02412 1.00000000e-02 -106
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      0.02895 1.00000000e-02 -106
      0.02902 1.00000000e-02 -106
      0.02909 1.00000000e-02 -106
      0.02916 1.00000000e-02 -106
      0.02923 1.00000000e-02 -
```

Latest Updates

- FAP2PAZ **interpolation** developed: smoothing function ; support SO interpretation
- Rolling-out of SSI including SSI Calibration Module: **~51 stations**
- 2019
 - KEST calibration using SSI Calibration Module: 3C, Europa-T/Güralp
 - ARCES calibration using SSI Calibration Module: **25-element array, 75 channels,** Güralp/Güralp
 - NOA: 42-element array, 56 channels
 - JMIC: 3C
 - SPITZ: 9-element array, 31 channels

Conclusion

- The purpose of On-site Calibration is to ensure Station **data quality over time**.
- The SSI Calibration Module is contributing to
 - Increase the number of Stations sending **full-frequency reviewed** results in **IMS2.0** format
 - **Standardize** practices when performing a calibration task and sending calibration reviewed results to the PTS
 - **Standardize** the **validation** of these results at the PTS
 - **Reduce** the number of technical issues (due to diversity of equipment / software / calibration results format)
 - Enhance PTS capability to provide **support** and perform calibration remotely on the SO behalf
- Calibration Tasks → **Data Interpretation**

THANK YOU

