Trasnfer Function Monitor (TFMoni) Users Manual

D. Verkindt

VIR-0459A-21

https://tds.virgo-gw.eu/ql/?c=16707

30 April 2021

Change Record

Version	Date	Section Affected	Reason / Remarks
v1	30/04/2021	All	First version

Table of Contents

1 Introduction

This document describes the TFMoni tool which computes various transfer functions and ratios of transfer functions. TFMoni is mainly used to monitor the calibration and the h(t) reconstruction of the Advanced Virgo interferometer. But it can be used also to monitor online the behaviour of the interferometer controls or the environmental noise propagation.

2 Principle and features

TFMoni can compute, for a given pair of input channels and for a given frequency, the modulus , phase and coherence of the transfer function (TF) between two channels. Optional parameters can be added like a gain and a delay applied to the modulus and phase of the TF.

For each pair of input channels, the output is a set of 3 time series that contain the value of the modulus, the value of the phase and the value of the coherence for the chosen frequency.

In addition, TFMoni can produce 2 time series containing the modulus and the phase of the ratio between the two transfer functions previously computed (even if they were not computed at the same frequency).

Whenever one input channel is missing, the TF modulus and phase values are forced to 1e-30 and -5.

3 Configuration

The configuration file used by a TFMoni process contains the usual keywords of the Cfg and Fd library, plus a set of specific TFMoni keywords which are the following.

3.1 Keyword CALI_TF_FFT_DEFAULT

CALI_TF_FFT_DEFAULT 10 12
Means that every 5 seconds, all the transfer functions (TF) are computed over 10s of data and use a default moving average done over 12 computed TFs. Any output channel is then produced on the basis of 12x5 seconds of data and is paced with one sample every 5s.
If output frame length is 1s, the same output sample will be copied 5 times in the output frames.

3.2 Keyword CALI_TF_COHEMIN

CALI_TF_COHEMIN 0.1
Means that, whenever the computed coherence is below 0.1, the TF modulus and phase computed are considered irrelevant and are thus forced to the values previously computed.
If the coherence is below the threshold since the start of TFMoni, then the modulus and phase values are 1e-30 and -5.

3.3 Keyword CALI_TF_ADD

CALI_TF_ADD outname channel1 channel2 freq maxaverage gain delay (ms)
Means that the modulus, phase and coherence will be computed at the frequency freq for the TF computed for channel2/channel1. The resulting modulus may be multiplied by a gain and the resulting phase may be reduced by the quantity 2*pi*freq*delay.
If maxaverage is non-zero, this value is used (instead of the default value) to do the moving average of the TF. The output channels are named:
TFMoni_outname_Modulus, TFMoni_outname_Phase and TFMoni_outname_Cohe

3.4 Keyword CALI_TF_RATIO

CALI_TF_RATIO outname TFname1 TFname2
Means that the ratio of the previously computed transfer functions TFname1 and TFname2 is computed. The resulting output channels are the ratio of the TFs modulus and the difference of the TFs phases and are named:
TFMoni_ratio_outname_Modulus and TFMoni_ratio_outname_Phase

4 Configuration example

The configuration file below contains an example of each keyword that can be read by TFMoni, with detailed explanation for each parameter.

```
# keyword inputfile  start GPS  duration
FDIN_FILE /virgoData/ffl/raw_O3b.ffl 1256655600 86400

# keyword   input channels tags
FDIN_TAG "V1:META_ITF_LOCK* V1:CAL* V1:PCAL* V1:Hrec_* V1:LSC_DARM"

# keyword  Destination file   nframe per file   output channel tags
FDOUT_FILE ./outdata/V1-TFMoni 1000001  "V1:TFMoni_* "

#  keyword  fftduration (sec)   maxaverage
CALI_TF_FFT_DEFAULT   10  12

#  keyword min coherence below which TF is not computed
CALI_TF_COHEMIN      0.01


# CALI_TF_ADD  outname   chname1   chname2   freq (Hz)   fftduration (sec)   maxaverage   gain  delay (ms)
# gain = the value multiplied to the result of the TF modulus
# delay = the time delay to be added (phase which will be subtracted to the TF phase is 2*pi*freq*delay)
# The results are in output channels TFMoni_outname_Modulus , TFMoni_outname_Phase and TFMoni_outname_Cohe
# Samples of the output channels are computed at frequency freq from the TF chname2/chname1

# Compare DARM and PCAL
CALI_TF_ADD   NEMIR_DARM_PCAL_60     V1:PCAL_NEB_PD1_power   V1:LSC_DARM             63.5  0  0  0  0
CALI_TF_ADD   WEMIR_DARM_PCAL_60     V1:PCAL_WEB_PD1_power   V1:LSC_DARM             60.5  0  0  0  0

# Compare Hrec and PCAL
CALI_TF_ADD   NEMIR_HREC_HPCAL_60    V1:PCAL_NEB_PD1_hpcal   V1:Hrec_hoft_raw_20000Hz   63.5  0  24  0  0.122
CALI_TF_ADD   WEMIR_HREC_HPCAL_60    V1:PCAL_WEB_PD1_hpcal   V1:Hrec_hoft_raw_20000Hz   60.5  0  24  0  0.122

# Compare Hrec and NE CAL_NOISE permanent lines injected
CALI_TF_ADD   NEMIR_HREC_HINJ_35     V1:CAL_NE_MIR_Z_NOISE   V1:Hrec_hoft_raw_20000Hz   37.5  0  0  2.43e+13  -0.337
CALI_TF_ADD   NEMIR_HREC_HINJ_75     V1:CAL_NE_MIR_Z_NOISE   V1:Hrec_hoft_raw_20000Hz   77.5  0  0  1.05e+14  -0.325
CALI_TF_ADD   NEMIR_HREC_HINJ_105    V1:CAL_NE_MIR_Z_NOISE   V1:Hrec_hoft_raw_20000Hz  107.5  0  0  2.03e+14  -0.315
CALI_TF_ADD   NEMIR_HREC_HINJ_135    V1:CAL_NE_MIR_Z_NOISE   V1:Hrec_hoft_raw_20000Hz  137.5  0  0  3.35e+14  -0.308

# Compare Hrec and WE CAL_NOISE permanent lines injected
CALI_TF_ADD   WEMIR_HREC_HINJ_55     V1:CAL_WE_MIR_Z_NOISE   V1:Hrec_hoft_raw_20000Hz   56.5  0  0  6.66e+13  -0.301
CALI_TF_ADD   WEMIR_HREC_HINJ_105    V1:CAL_WE_MIR_Z_NOISE   V1:Hrec_hoft_raw_20000Hz  106.5  0  0  2.38e+14  -0.294
CALI_TF_ADD   WEMIR_HREC_HINJ_205    V1:CAL_WE_MIR_Z_NOISE   V1:Hrec_hoft_raw_20000Hz  206.5  0  0  9.00e+14  -0.286
CALI_TF_ADD   WEMIR_HREC_HINJ_405    V1:CAL_WE_MIR_Z_NOISE   V1:Hrec_hoft_raw_20000Hz  406.5  0  0  3.50e+15  -0.282

# CALI_TF_RATIO  outname  TFname1  TFname2
# The results are in output channels TFMoni_ratio_outname_Modulus  and TFMoni_ratio_outname_Phase
# and contain for the modulus the ratio of TFname1_Modulus/TFname2_Modulus
# and for the phase the difference TFname1_Phase-TFname2_Phase

# Compare PCAL_NE and PCAL_WE
CALI_TF_RATIO   DARMPCALNE60_DARMPCALWE60    NEMIR_DARM_PCAL_60    WEMIR_DARM_PCAL_60
```