LLO locklosses

O3 Status

Arnaud Pele for the LLO commissioning team

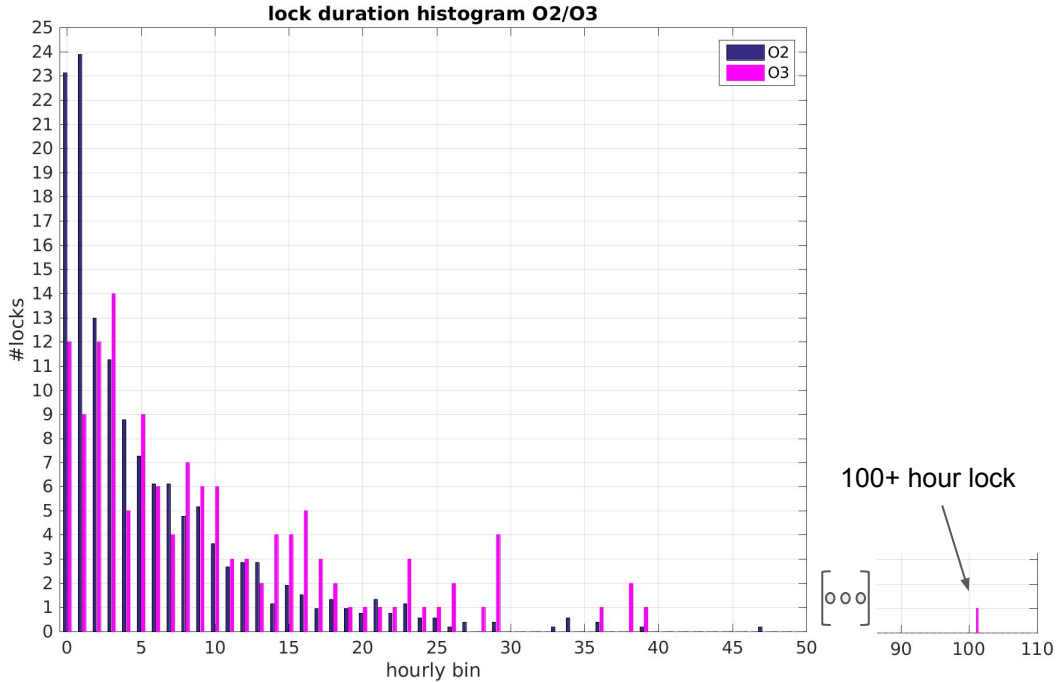
Some statistics

Counted locklosses and lock durations for O2 / O3 with change of ISC_LOCK guardian state

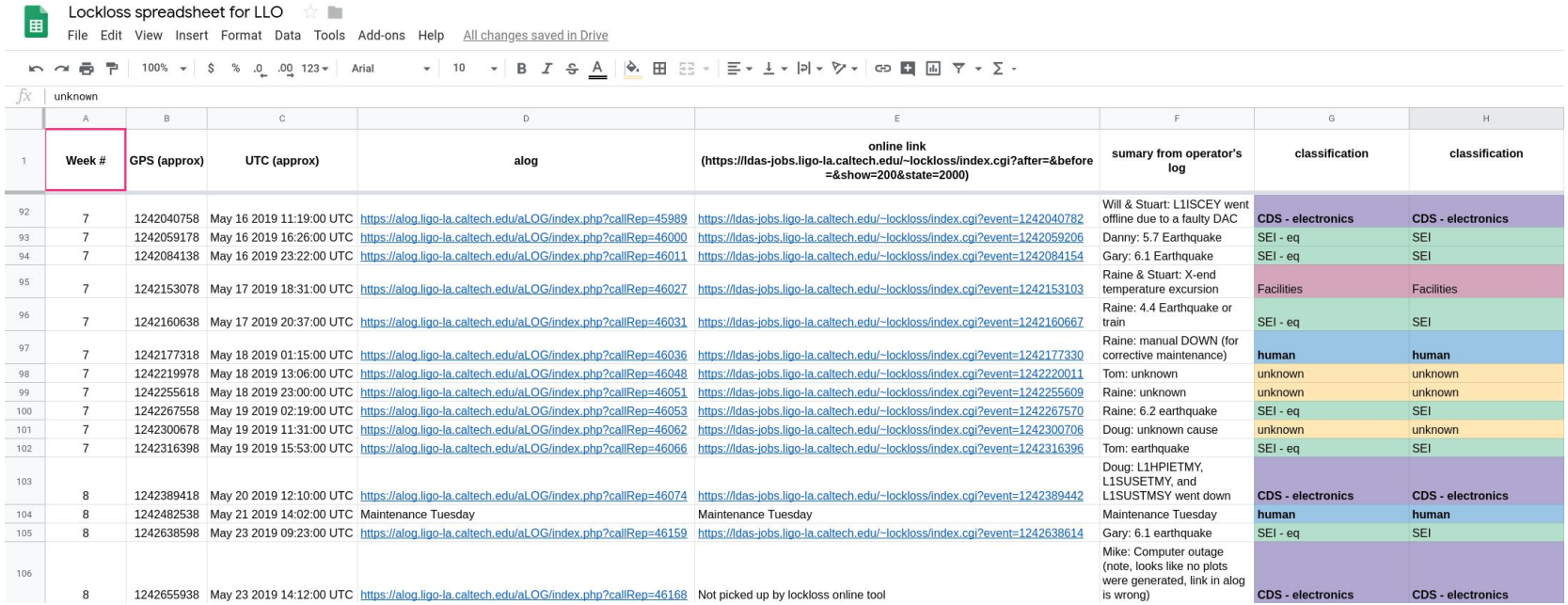
Total O2 locklosses = 717/240 days ~ 3/day
Total O3 locklosses = 137/74 days < 2/day

Main differences could be from :

+ ESD DAC filtering (35230, 35262,T1700428)
+ BRS (43874)
- Increase of locklosses from anthropogenic noise



Lockloss classification from operator notes



Lockloss spreadsheet for LLO

File Edit View Insert Format Data Tools Add-ons Help All changes saved in Drive

unknown

	A	B	C	D	E	F	G	H
1	Week #	GPS (approx)	UTC (approx)	alog	online link (https://ldas-jobs.ligo-la.caltech.edu/~lockloss/index.cgi?after=&before=&show=200&state=2000)	sumary from operator's log	classification	classification
92	7	1242040758	May 16 2019 11:19:00 UTC	https://alog.ligo-la.caltech.edu/aLOG/index.php?callRep=45989	https://ldas-jobs.ligo-la.caltech.edu/~lockloss/index.cgi?event=1242040782	Will & Stuart: L1ISCEY went offline due to a faulty DAC	CDS - electronics	CDS - electronics
93	7	1242059178	May 16 2019 16:26:00 UTC	https://alog.ligo-la.caltech.edu/aLOG/index.php?callRep=46000	https://ldas-jobs.ligo-la.caltech.edu/~lockloss/index.cgi?event=1242059206	Danny: 5.7 Earthquake	SEI - eq	SEI
94	7	1242084138	May 16 2019 23:22:00 UTC	https://alog.ligo-la.caltech.edu/aLOG/index.php?callRep=46011	https://ldas-jobs.ligo-la.caltech.edu/~lockloss/index.cgi?event=1242084154	Gary: 6.1 Earthquake	SEI - eq	SEI
95	7	1242153078	May 17 2019 18:31:00 UTC	https://alog.ligo-la.caltech.edu/aLOG/index.php?callRep=46027	https://ldas-jobs.ligo-la.caltech.edu/~lockloss/index.cgi?event=1242153103	Raine & Stuart: X-end temperature excursion	Facilities	Facilities
96	7	1242160638	May 17 2019 20:37:00 UTC	https://alog.ligo-la.caltech.edu/aLOG/index.php?callRep=46031	https://ldas-jobs.ligo-la.caltech.edu/~lockloss/index.cgi?event=1242160667	Raine: 4.4 Earthquake or train	SEI - eq	SEI
97	7	1242177318	May 18 2019 01:15:00 UTC	https://alog.ligo-la.caltech.edu/aLOG/index.php?callRep=46036	https://ldas-jobs.ligo-la.caltech.edu/~lockloss/index.cgi?event=1242177330	Raine: manual DOWN (for corrective maintenance)	human	human
98	7	1242219978	May 18 2019 13:06:00 UTC	https://alog.ligo-la.caltech.edu/aLOG/index.php?callRep=46048	https://ldas-jobs.ligo-la.caltech.edu/~lockloss/index.cgi?event=1242220011	Tom: unknown	unknown	unknown
99	7	1242255618	May 18 2019 23:00:00 UTC	https://alog.ligo-la.caltech.edu/aLOG/index.php?callRep=46051	https://ldas-jobs.ligo-la.caltech.edu/~lockloss/index.cgi?event=1242255609	Raine: unknown	unknown	unknown
100	7	1242267558	May 19 2019 02:19:00 UTC	https://alog.ligo-la.caltech.edu/aLOG/index.php?callRep=46053	https://ldas-jobs.ligo-la.caltech.edu/~lockloss/index.cgi?event=1242267570	Raine: 6.2 earthquake	SEI - eq	SEI
101	7	1242300678	May 19 2019 11:31:00 UTC	https://alog.ligo-la.caltech.edu/aLOG/index.php?callRep=46062	https://ldas-jobs.ligo-la.caltech.edu/~lockloss/index.cgi?event=1242300706	Doug: unknown cause	unknown	unknown
102	7	1242316398	May 19 2019 15:53:00 UTC	https://alog.ligo-la.caltech.edu/aLOG/index.php?callRep=46066	https://ldas-jobs.ligo-la.caltech.edu/~lockloss/index.cgi?event=1242316396	Tom: earthquake	SEI - eq	SEI
103	8	1242389418	May 20 2019 12:10:00 UTC	https://alog.ligo-la.caltech.edu/aLOG/index.php?callRep=46074	https://ldas-jobs.ligo-la.caltech.edu/~lockloss/index.cgi?event=1242389442	Doug: L1HPIETMY, L1SUSETMY, and L1SUSTMSY went down	CDS - electronics	CDS - electronics
104	8	1242482538	May 21 2019 14:02:00 UTC	Maintenance Tuesday	Maintenance Tuesday	Maintenance Tuesday	human	human
105	8	1242638598	May 23 2019 09:23:00 UTC	https://alog.ligo-la.caltech.edu/aLOG/index.php?callRep=46159	https://ldas-jobs.ligo-la.caltech.edu/~lockloss/index.cgi?event=1242638614	Gary: 6.1 earthquake	SEI - eq	SEI
106	8	1242655938	May 23 2019 14:12:00 UTC	https://alog.ligo-la.caltech.edu/aLOG/index.php?callRep=46168	Not picked up by lockloss online tool	Mike: Computer outage (note, looks like no plots were generated, link in alog is wrong)	CDS - electronics	CDS - electronics

Link to LLO lockloss spreadsheet

Lockloss classification

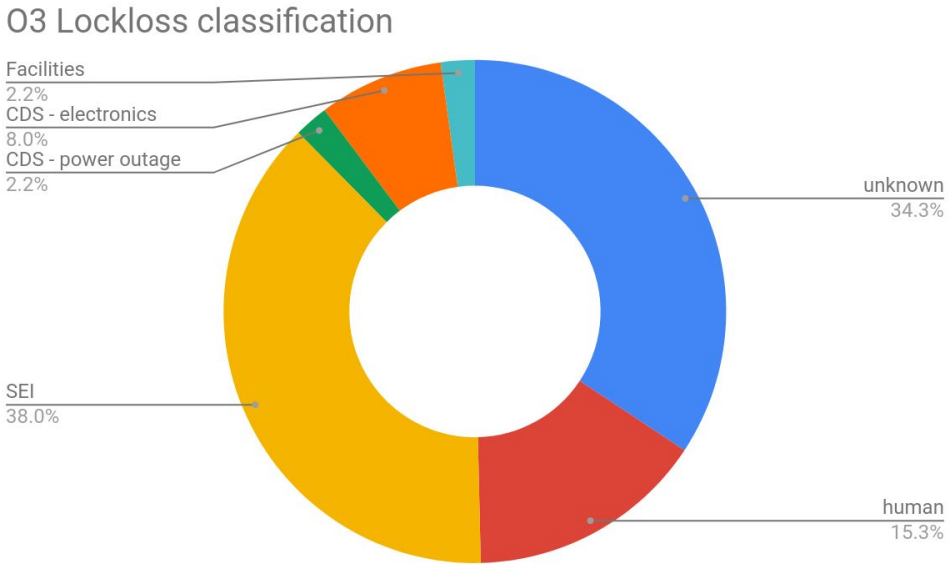
-SEI 38% [earthquakes (24.1%), wind (2.2%), trains/ anthropogenic noise (8%), useism (3.6%)]

-Unknown 34.3%

-Human 15.3% (tuesday maintenance, error, commissioning)

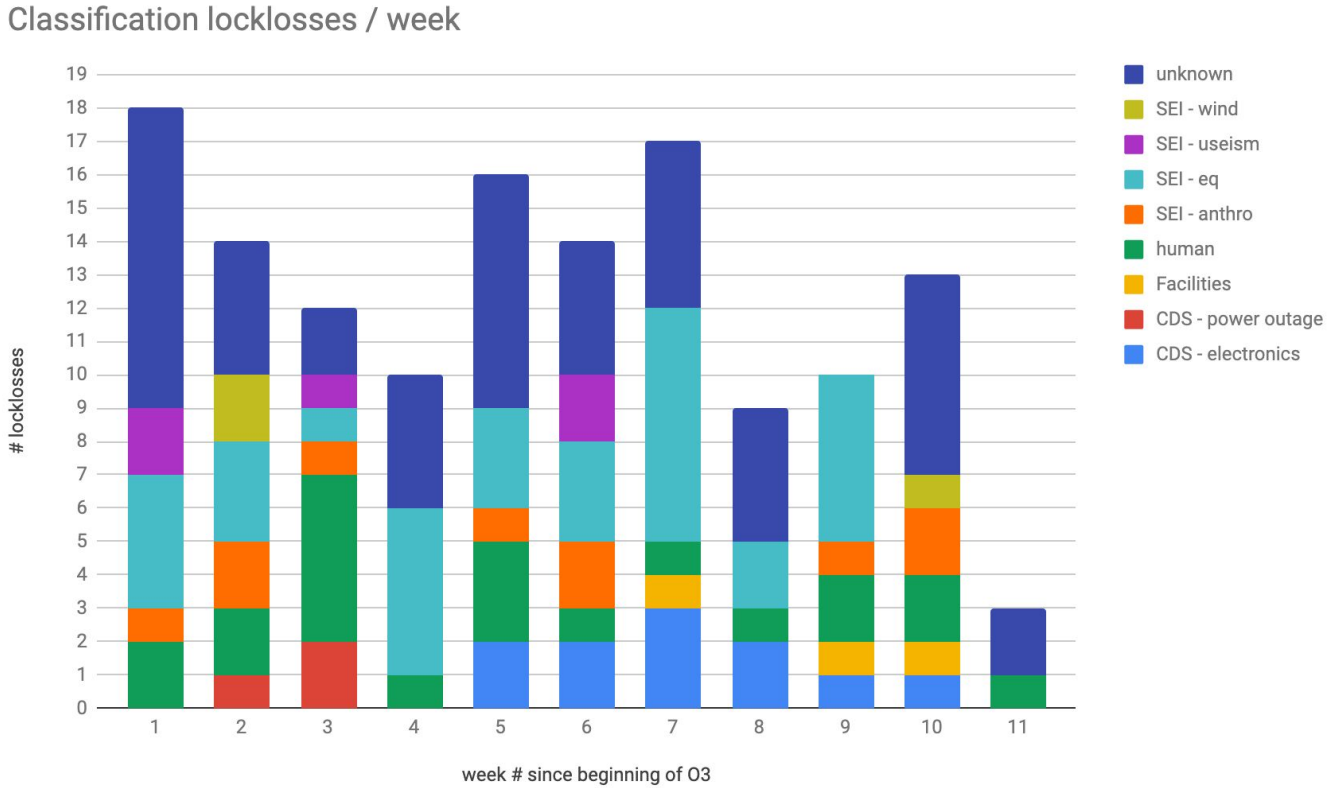
-CDS 10.2% (power outage 2.2%, electronics failure/computer lock-up 8%]

-Facilities 2.2% [temperature issue]

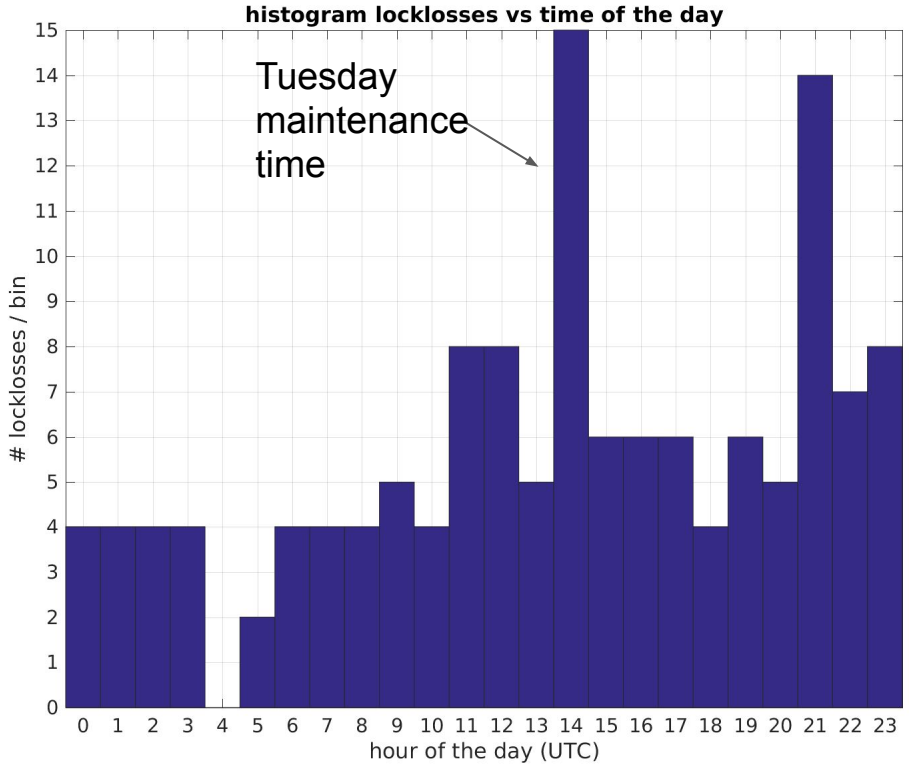


data from [LLO lockloss spreadsheet]

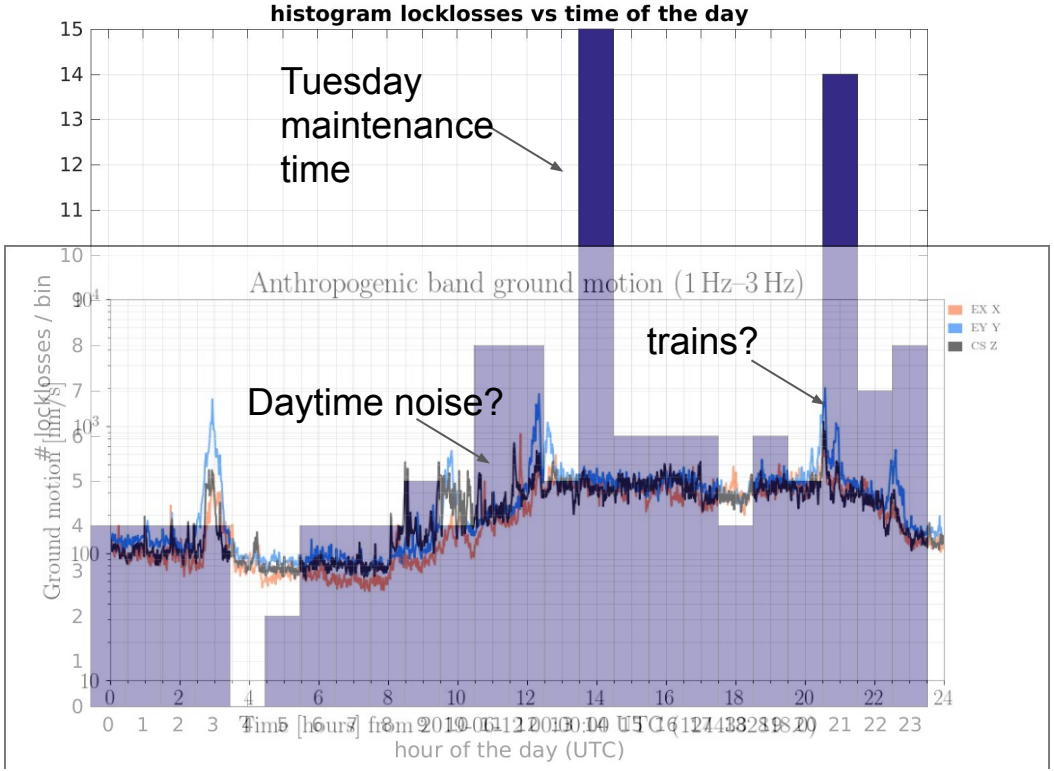
Lockloss classification



Lockloss time histogram



Lockloss time histogram



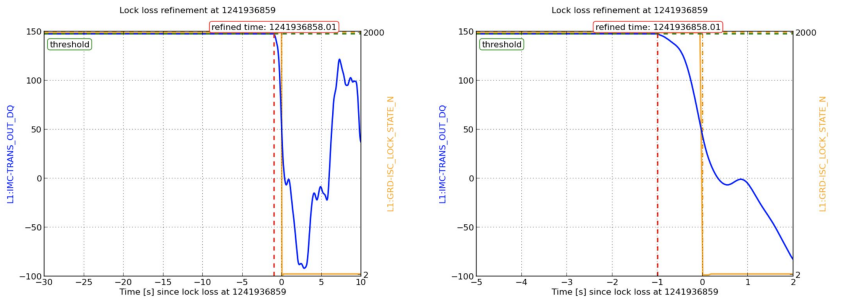
Identification process and fixes

Why do we loose lock ? non-linear signal in feedback loop

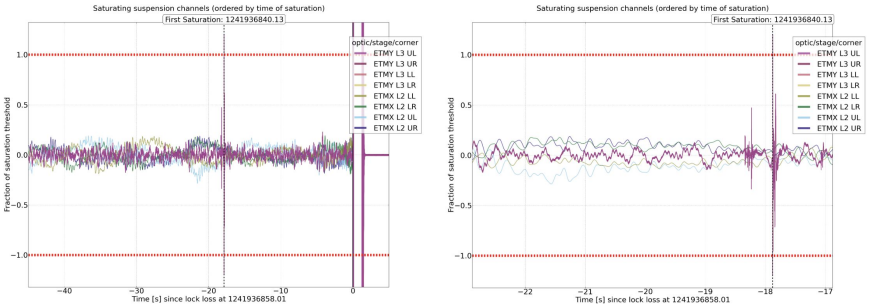
- Saturation of actuator
- Saturation of sensor/electronics chain
- Other ?

Online tool:
https://ldas-jobs.ligo-la.caltech.edu/~lockloss/

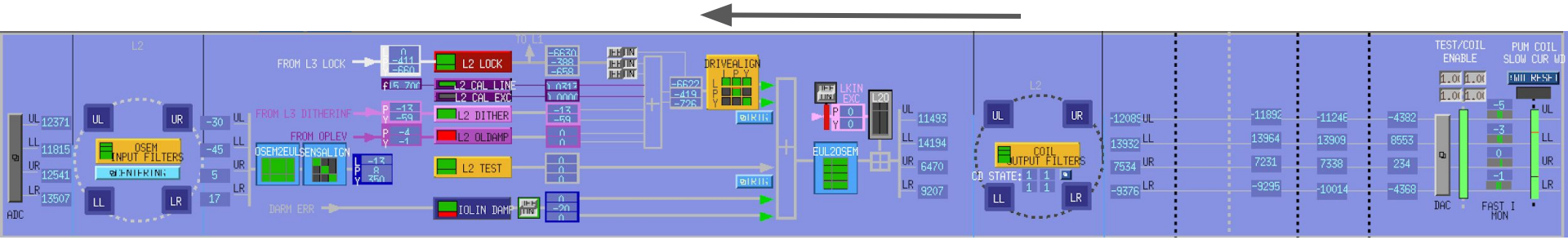
Helpful to identify suspension actuators saturations precursor to locklosses



Saturation Plots



Identification process and fixes



online tool

Saturation precursor ?

Which suspension/ stage ?

L, P or Y?

What dof dominates ? DHARD ? CHARD ? ...

What frequency ?

Can we increase the range ?

Yes

Fixed!

No

Noise budget to try identify noise source

Can we limit at the source ?

Yes

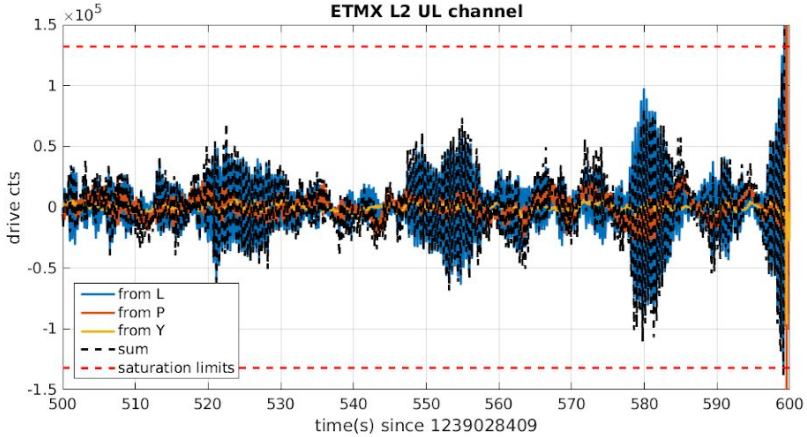
Fixed!

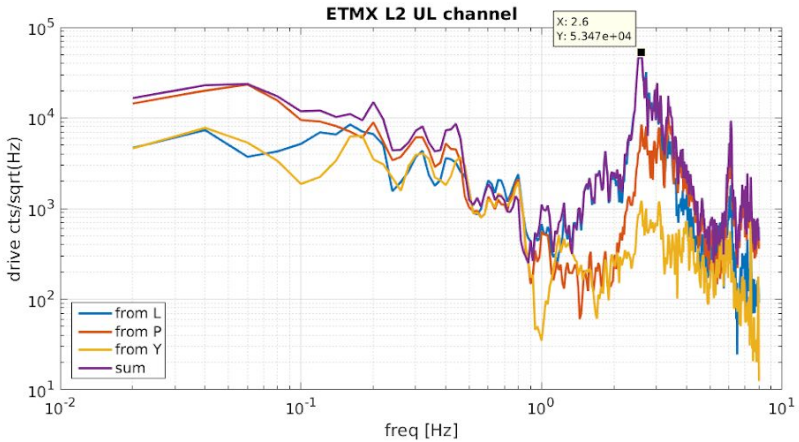
No

Keep searching!

Identification examples

SRCL FF (alog 45241)





-Lockloss tool identified EX saturation

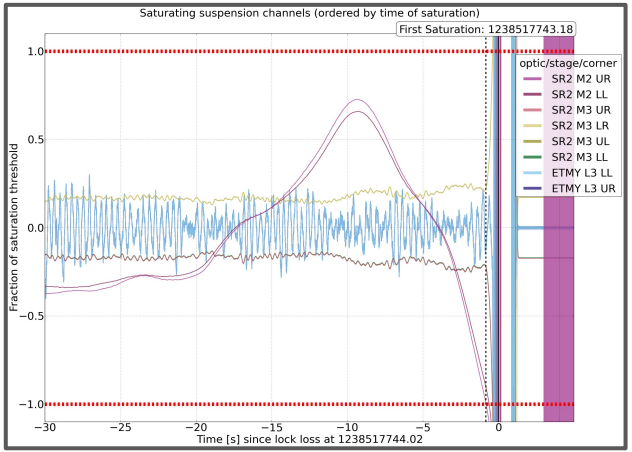
-Correlated with increase of ground motion in corner

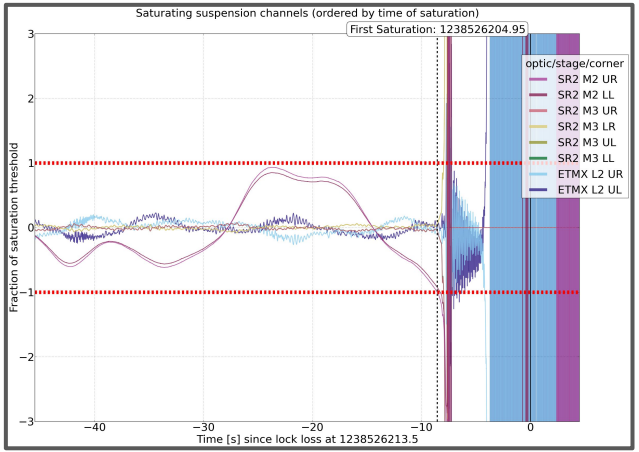
-Drive RMS from L drive @ 2.6Hz

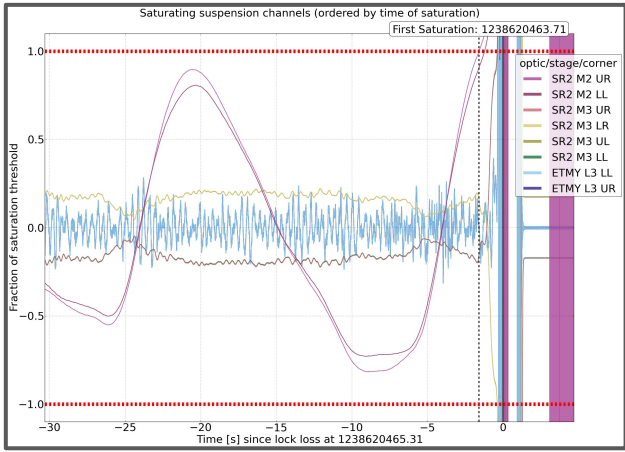
-SRCL FF coupling to DARM. Notch in FF filter @ 2.6Hz

Identification examples

SR2 cross-over (alog 44997, 45034)





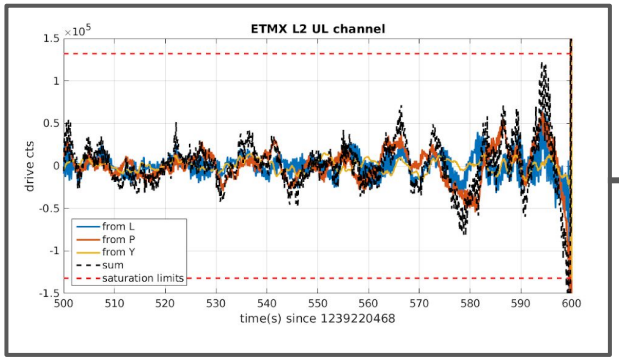


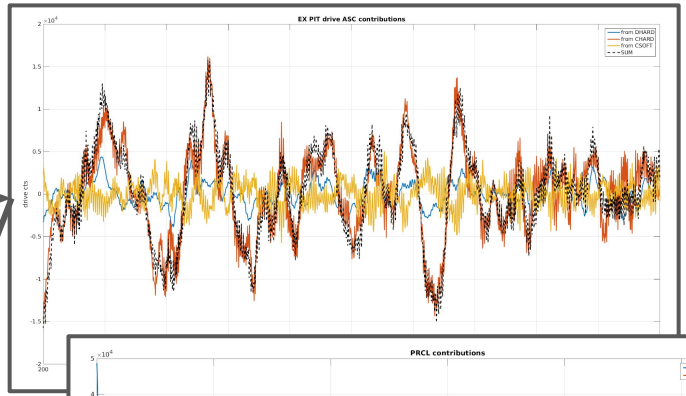
-Identified behavior during earthquakes 1st week of O3 : SR2 M2 saturations from length drive

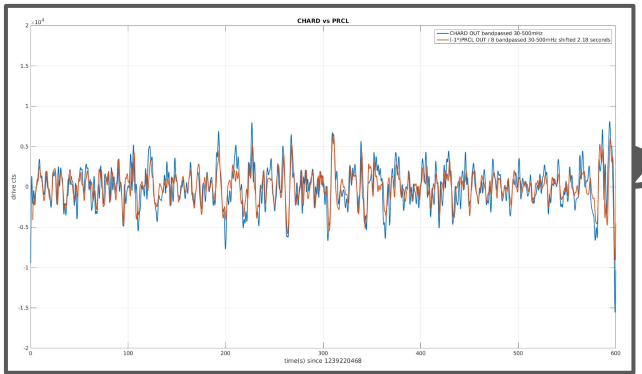
-Increased M1 control authority in eq band

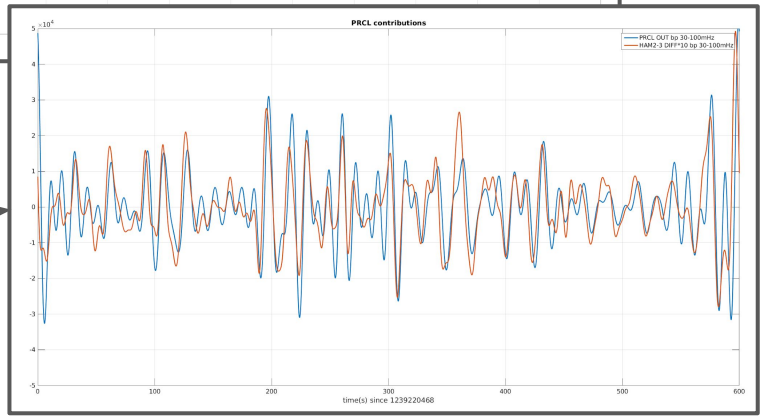
Identification examples

CHARD from HAM2-3 diff motion ? (alog 45237), unresolved









Ideas, to-do list

-If no saturation precursor, more complicated, develop new search process (43113,sei 1445)

-Try to limit SEI locklosses + unknown (=70% of locklosses)

- Some trains **are** correlated with locklosses, need to understand how (46590)

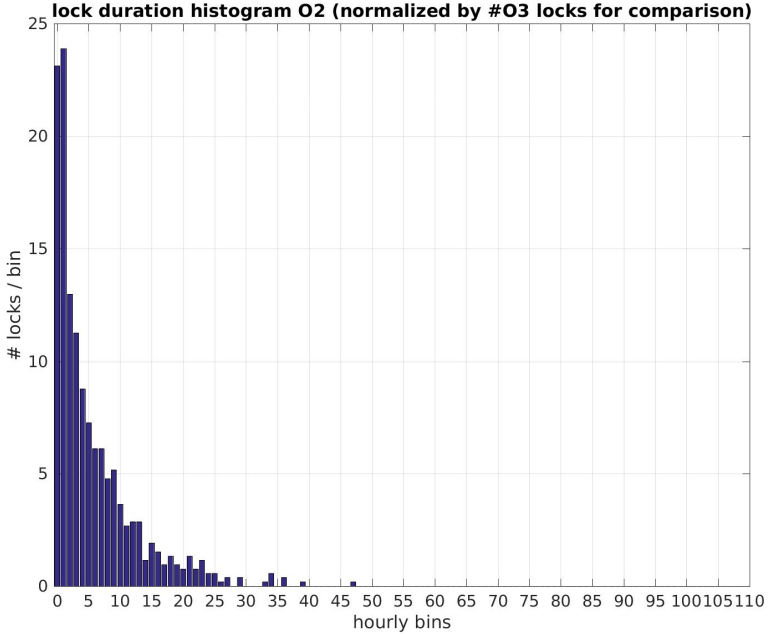
-Improve the automated process by :

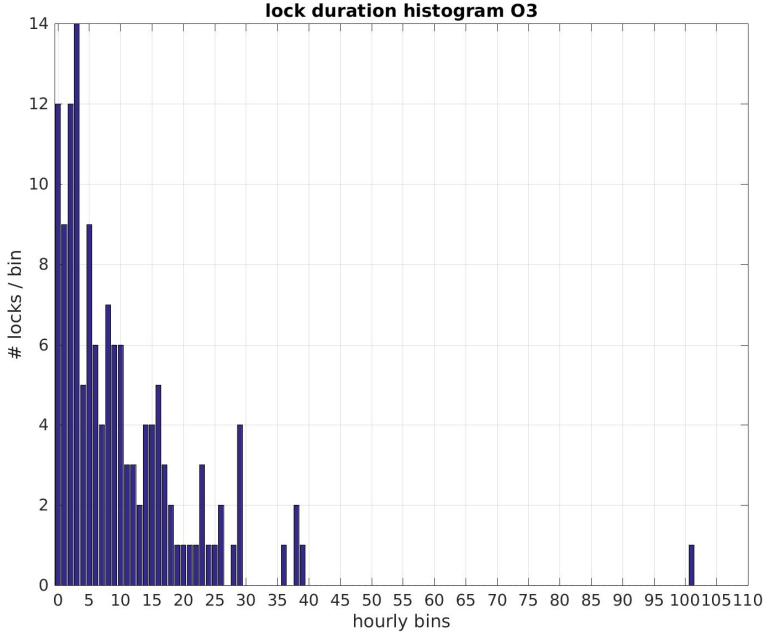
-Classifying locklosses automatically from known triggers (correlation with ground motion for example)

-Allowing **manual tagging** of events online (commissioning, human error, or others)

→ would help to build statistics and recognize patterns

Extra slides



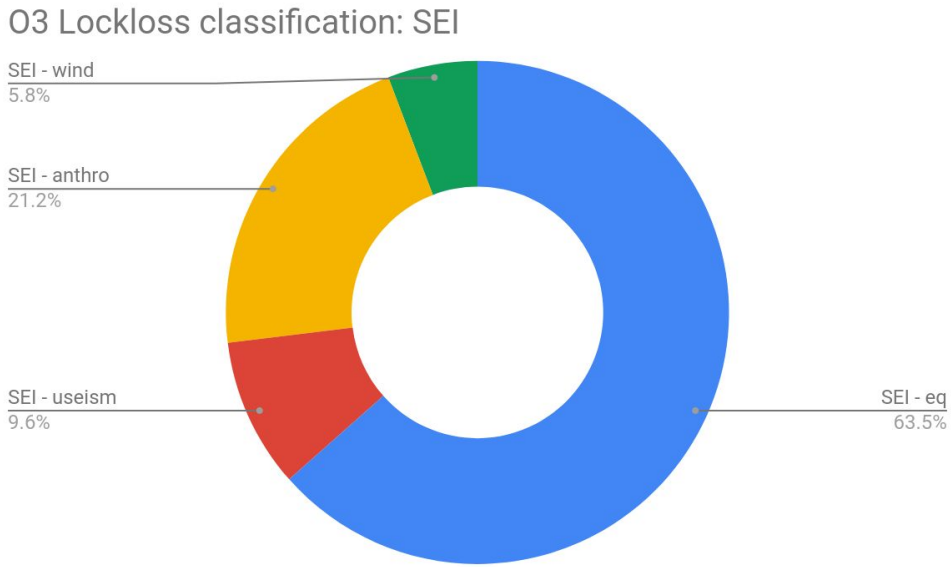


Breakdown of SEI locklosses

Breakdown of locklosses correlated with increase of ground motion :

Wind = [30mHz-100mHz]
Eq = earthquakes = [30mHz-100mHz]
Useism = [0.1-1Hz]
Anthro = trains, human activity = [1-10Hz]

Most SEI locklosses from earthquakes (63%) and anthropogenic noise (21%)



data from [LLO lockloss spreadsheet]