

Progress report at KAGRA

7.6-7.8

Lockloss study

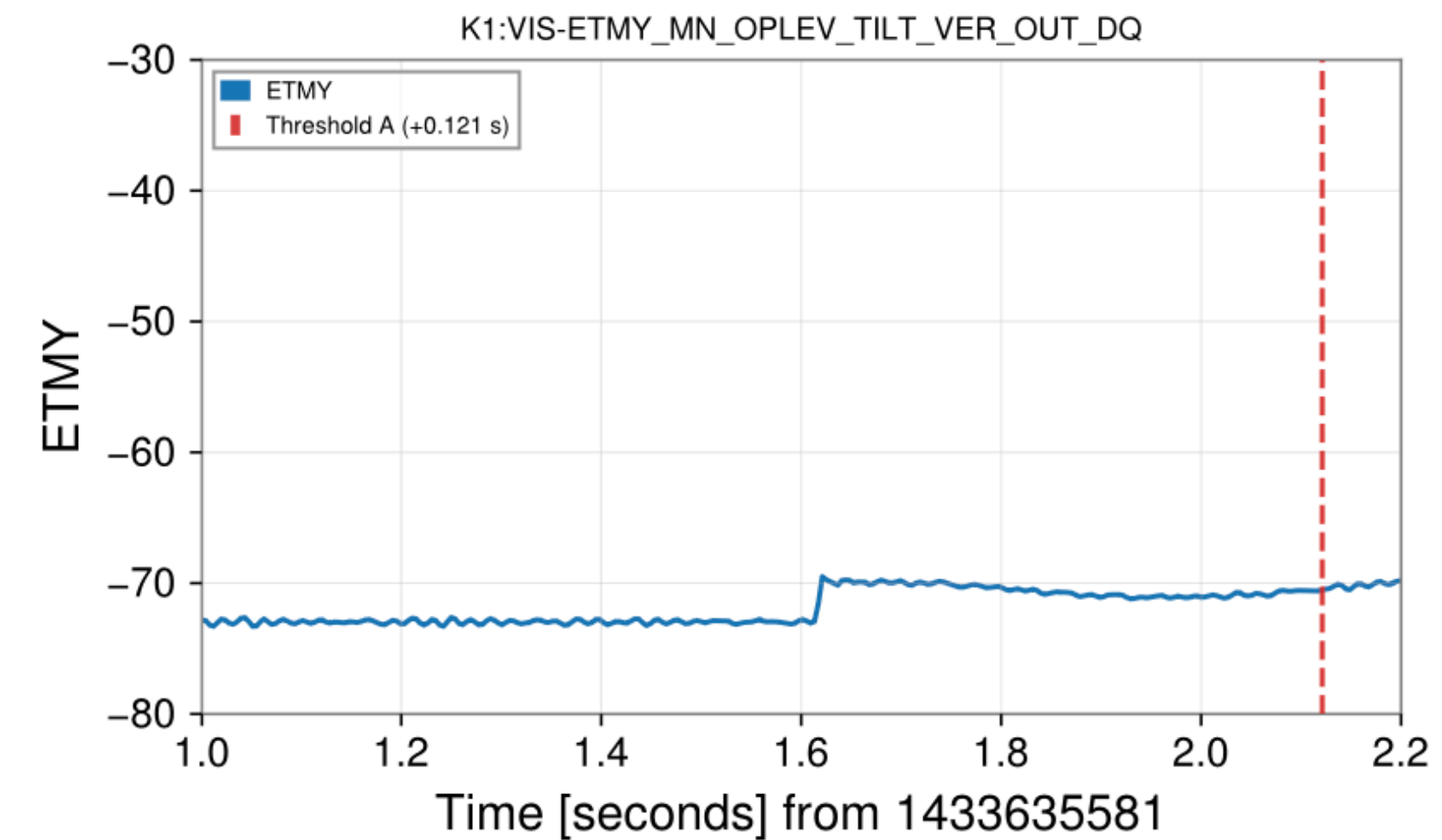
Liyang MIAO, July 9, 2026

Motivation

- Lockloss happens when the auxiliary channel K1:GRD-LSC_LOCK_STATE_N reduce sharply to 0.
- When the lockloss happens (aside from requested case), there're always some patterns emerging in other channels. Some of them are before the lockloss time.
- We want to learn the relations between the locklosses and the patterns in these channels, which would help us:
 - Report a lock loss in advance
 - Find out physical reason why lock loss happens
- Starting point: K1:VIS-ETMY_MN_OPLEV_TILT_VER_OUT_DQ channel

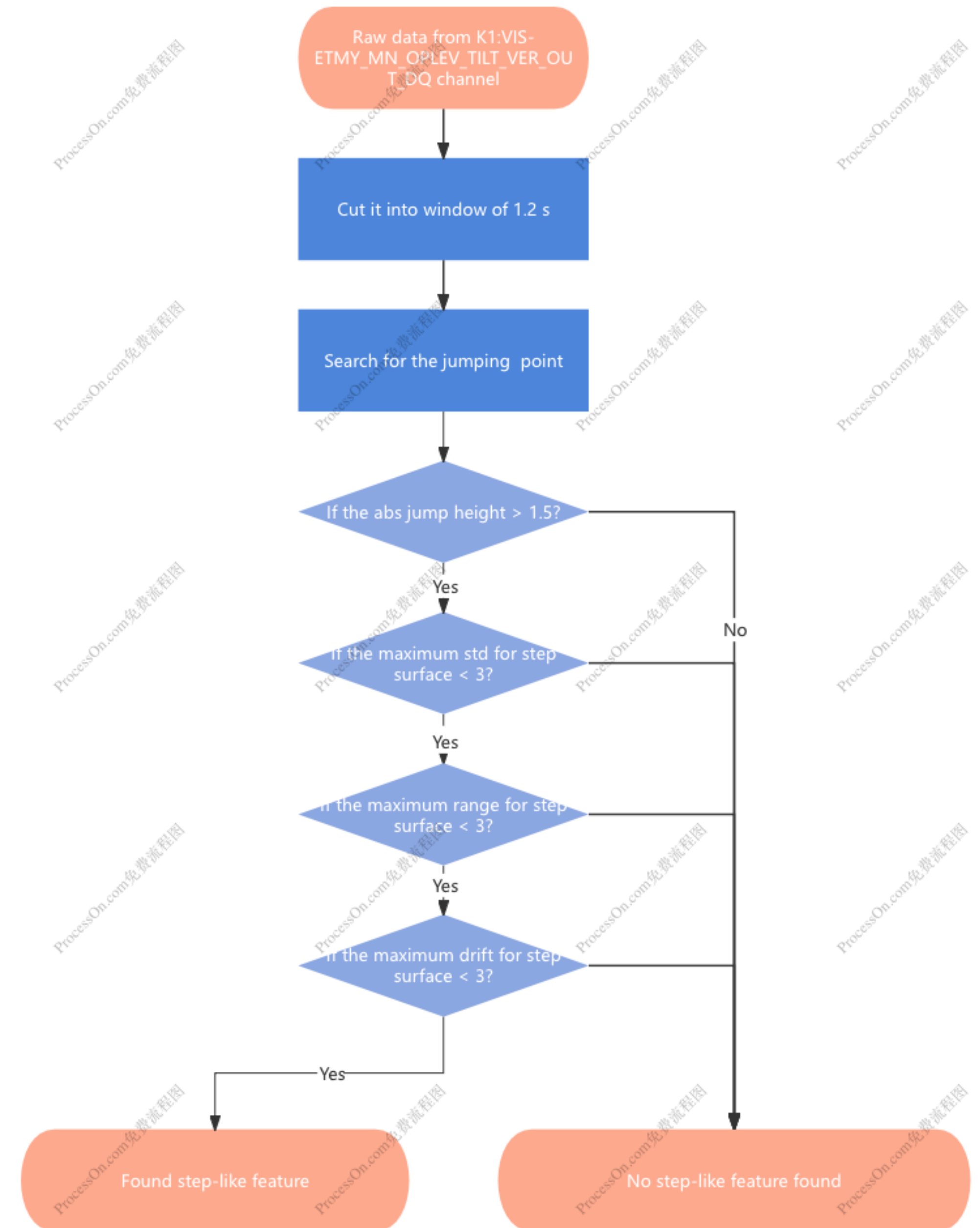
Features and criterion

- K1:VIS-ETMY_MN_OPLEV_TILT_VER_OUT_DQ channel has a step-like feature, with a sudden jump for ETMY and flat step surface.
- Criterion set: we are asking the absolute jump height to be larger than certain threshold, and for both the step surface should have its std, range and drift smaller than the threshold to keep it flat.



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Results

- For 215 lock loss event datasets, 213 of them can be properly **categorized** using the criterion, i.e. 7 of ETMY events pass the ETMY criterion and 206 non-ETMY events fail to pass the pipeline and are categorized as non-ETMY caused lockloss.
- Two special cases for the ETMY check:
 - ID 159: Not a ETMY labeled lock loss but has step-like feature
 - ID 174: Is a ETMY labeled lock loss but has no step-like feature
- Applied the criterion to the O4c data to see if the criterion will trigger alarm on science segment (False Positive)
- Not seeing any false positive for GPS time range 1433689218 - 1434540171 (Roughly 10 days)

Inspections on other channel

- We also take a look on other channels regarding the test masses' tilt and rolling motion.
- Not seeing similar step-like features as K1:VIS-ETMY_MN_OPLEV_TILT_VER_OUT_DQ