ILRS Station Configuration Tracking

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Abstract
Unrecorded changes to an SLR station's configuration can wreak havoc with the work of analysts, who often struggle to understand why there is a change in station bias or data scatter. The ILRS has recently revamped its method of tracking such station changes. There are now three ways in which stations need to manage configuration tracking in a timely manner. The first is the set of configuration records embedded in the normal point and full rate data files, which document changes pass-by-pass. The second is the station change history log, to which a single line record is attached every time there is a significant change to the station. The third is the station site log, which contains a history of many of the station's subsystems as well as such items as contact information, location, and survey ties. The rationale and details regarding these three tracking mechanisms are discussed along the urgency in keeping these files up-to-date.

Introduction

It is crucial for stations to report changes to their equipment, software, and procedures. Failure to do so can have ramifications for analysis of the global SLR data and cast doubts on a station's data quality and stability. To avoid such consequences, the ILRS has ways for stations to record these changes so that they are available to the analysts.

The ILRS has recently updated station change procedures and now has three different methods to report station changes, they are all inter-related, and each fulfills a separate function. The first is the CRD format configuration section, which shows the exact configuration of equipment during a pass. The second is the recently-introduced station change history log, which succinctly records major or minor changes to the station in a a cumulative fashion. Finally, the venerable station site log contain both general and specific information about the station, its location, contacts, and sub-systems. The site log gives the most general view of the station and major changes organized by sub-system. The station change history log records specific changes and their implications, in time order. Some of these changes would not be included in the site log. The CRD configuration records only deal with a limited number of parameters for several sub-systems (laser, detector, timing) that are most likely to affect pass quality or describes the mode of operation (transponder record).

Method 1: CRD Configuration Records

The configuration record format is found in CRD format document. [1] The configuration records should be present in the normal point and full rate data files for each pass .Unfortunately, some stations are not yet including these. They were not originally required, but since the update of the change tracking procedures and the introduction of the station change history log, they now are. The purpose of these records is to capture pass-by-pass changes to station configuration, such as laser, wavelength, detector, transponder setup, and the like. Unlike the

other configuration methods, these records will always stay with the data. These records must change when there is a related change to the station or pass configuration.

Below are examples of configuration records from 3 stations: McDonald, Golosiiv, and Mt. Stromlo.

MLRS (McDonald):
c0 0 532.000 std ml1 mcp mt1
c1 0 ml1 Nd-Yag 1064.00 10.00 -1.00 200.0 -1.00 1
c2 0 mcp mcp 532.000 -1.00 3800.0 0.0 unknown -1.0 0.00 -1.0 0.0 none
c3 0 mt1 Symmetricom_Cs_4310 Symmetricom_Cs_4310 MLRS_CMOS_TMRB_TD811 na -2.3

GLSL (Golosiiv):
C0 0 532.000 sys1 las1 det1 tim1 none
C1 0 las1 Nd-Yag 1064.00 10.00 2.00 52.9 15.00 1
C2 0 det1 PMT 532.000 8.00 -2500.0 0.3 photon-dep 15000.0 532.00 70.0 60.0 CFD
C3 0 tim1 MAO_Time_Servise Rubidium_C1-50 SR620 2944 1.5

STL3 (Mt. Stromlo):
C0 0 532.10 IDAA IDAB IDAJ IDAV
C1 0 IDAB Nd-YAG 532.10 60.00 21.00 12.0 0.00 1
C2 0 IDAJ CSPAD 532.00 20.00 11.0 100.0 ECL 12.0 2.00 90.0 12.0 Manual
C3 0 IDAV TrueTime_XLi TrueTime_OCXO MRCS NA 0.2322

Records for the three stations show a variety of laser fire rates, detectors, and timing equipment.

Method 2: Station Change History Log
The change history log files are available on the ILRS website [2], and instructions for updating them are available as well [3]. These log files are similar in format to the old SCH files, but with additional information on sub-system and the expected level of impact of a change. The subsystem numbering is from the site log. The expected level of impact is a judgment call by those filling out the log.

There is only one physical line per change, containing enough information for the station to locate more detailed information if questions arise. The entries are cumulative over the life of the station. Entries from the station's old SCH file should be converted to the new format and added to this file.

The file header information including the format and instructions as to where to send the file is to remain at the top of the file. When updating the file, retrieve the latest version from the ILRS web site, in case ILRS personnel needed to correct formatting for proper parsing by reader software.

The scope of the changes has expanded to include not only hardware and software changes, but procedural changes, information on nearby construction, earthquakes and the like. A recent suggestion has been to include the station name in the header information as a comment.

Below is an extract from the Monument Peak station change log. (Line wrapping is due to formatting for this paper.)

% PPPPSSMM - Site Occupation Designator (SOD)
% YYYY - Year
% DDD - Day of Year
% HH:MM - Time of Day (UTC) when change becomes active
% F - Estimated Chance of Data impact Flag: 0=none; 1=maybe, but negligible;

% 2=slight influence possible; 3=YES, needs quarantine and verification by the ILRS.
% xx[.xx[.xx]] - Subsystem: enter the subsystem number from the site log,
% e.g. "12.01" for pressure sensor.
% Use 99 for those subsystems not mentioned in the site log, e.g. computers,
% software, multiple sub-systems.
% Text - Description of the change. This must be meaningful to the station personnel,
% so that more information can be made available to analysts if needed
%
% Remember to send this file to ILRS (edc@dgfi.badw.de) after each update
…
71100412 2013 194 00:30 1 9 Installed TCG G77086 (removed G78519); new STA-RB = 4.046 microsecs; incremented processor & controller config flags 3 to 4.
71100412 2013 273 23:52 0 9 Installed M04198; incremented config flags from4 to 5. 5370B Counter
71100412 2013 276 21:00 1 9 Removed M04198. 5370B Counter
71100412 2013 276 23:52 1 9 Installed G78762. 5370B Counter
71100412 2013 280 21:20 1 9 Removed G77401 - having fluctuations) XL-DC GPS
71100412 2013 280 21:58 0 9.02.01 Installed spare XL-DC SCNS0150; Incremented config flags to a 6.
71100412 2014 024 21:20 0 9.02.01 Removed XL-DC (SCNS 0150) with SCNS00271
71100412 2014 024 23:52 0 9.02.01 Installed SCNS000271, incremented flags on 1/31/14. XL-DC GPS
71100412 2014 098 00:00 1 6 Changed receive cable.

Method 3: Site Log

These files are also kept on ILRS web site [4] with a description of the file [5]. The file consists of contact information, survey information, and a history of station configuration changes by sub-system. This file is meant to be thorough, detailed, and cumulative. When updating the file, retrieve the latest version from the ILRS web site, in case ILRS personnel needed to correct formatting for proper parsing by reader software.

The contents of the site log are listed below. Each section can contain multiple subsections, each with its own time span. When a subsystem (such as a laser or pressure sensor) is upgraded, the "Date Removed" for the old equipment's section is updated, and a new subsection with the information on the new equipment is added immediately after the old section. For example, the old entry for a station's pressure sensor is:

12.01.02 Pressure Sensor Model : Met3
  Manufacturer : Paroscientific
  Recording Interval : four times per hour
  Accuracy [mbar]: 0.1
  Height Diff to SRP [m]: 0
  Date Installed : 2003-05-16 20:00 UT
  Calibration Interval : as needed
  Date Removed : (yyyy-mm-dd hh:mm UT)
  Additional Information : (multiple lines)

Below is the same part of the site log after the hardware has been updated. Note that the new section is incremented by 1 to 12.01.03 and the "Date removed" line of the old entry (12.01.02) is filled in with a date corresponding with the "Date installed" for the new Met4 sensor.

12.01.02 Pressure Sensor Model : Met3
  Manufacturer : Paroscientific
  Recording Interval : four times per hour
  Accuracy [mbar]: 0.1
  Height Diff to SRP [m]: 0
  Date Installed : 2003-05-16 20:00 UT
  Calibration Interval : as needed
  Date Removed : 2012-06-16 21:00 UT
  Additional Information : (multiple lines)

12.01.03 Pressure Sensor Model : Met4
Manufacturer : Paroscientific
Recording Interval : four times per hour
Accuracy [mbar]: 0.1
Height Diff to SRP [m]: 0
Date Installed : 2012-06-16 21:00 UT
Calibration Interval : as needed
Date Removed : (yyyy-mm-dd hh:mm UT)
Additional Information : (multiple lines)

There are many sections in the site log, ranging from site information, contacts, subsystem, capabilities and local ties. Specifically, these are:

ILRS Site and System Information Form
International Laser Ranging Service
0. Form
1. Identification of the Ranging System Reference Point (SRP)
2. Site Location Information
3. General System Information
4. Telescope Information
5. Laser System Information
6. Receiver System
7. Tracking Capabilities
8. Calibration
9. Time and Frequency Standards
10. Preprocessing Information
11. Aircraft Detection
12. Meteorological Instrumentation
13. Local Ties, Eccentricities, and Collocation Information
14. Local Events Possibly Affecting Computed Position
15. On-Site, Point of Contact Agency Information
16. Responsible Agency (if different from 15.)
17. More Information

Coordination of All Three Methods: An Example
These three change tracking methods all tie together with common fields that must agree. The example below shows an instance of laser changes and usage at Herstmonceaux.

From the Herstmonceaux Site Log:
5. Laser System Information

5.01 Laser Type : ND:YAG
Number of Amplifiers : 2
Primary Wavelength [nm]: 1064
Primary Maximum Energy [mJ]: IR not used for ranging
Secondary Wavelength [nm]: 532
Secondary Max. Energy [mJ]: ~20
Xmit Energy Adjustable : NO
Pulse Width (FWHM) [ps]: ~100
Max. Repetition Rate [Hz]: 14
...
5.02 Laser Type : Nd:Van
Number of Amplifiers : 2
Primary Wavelength [nm]: 1064
Primary Maximum Energy [mJ]: IR not used for ranging
Secondary Wavelength [nm]: 532
Secondary Max. Energy [mJ]: 0.5

Xmit Energy Adjustable : NO
Pulse Width (FWHM) [ps]: 10ps
Max. Repetition Rate [Hz]: 2000
...

From the Herstmonceaux Change History Log:
78403501 2013 008 08:30 2 08.01 New power supply fitted to Lecroy discriminators to eliminate cause of calibration jumps
78403501 2013 128 08:30 1 05.02 2kHz Nd:VAN laser back in operation
78403501 2013 130 08:30 1 06.01.07 Gate cable to SPAD changed
78403501 2013 137 08:30 1 05.02 2kHz laser start diode adjustment
78403501 2013 207 08:30 1 08.01 TR reduction software adjusted for better performance with kHz signal to noise
78403501 2013 211 08:30 0 05 Coude mirrors M2, M3 and M4 replaced
78403501 2013 221 08:30 1 05 Emitter end optic cleaned
78403501 2014 027 08:30 1 05.01 Nd:YAG laser service and pulse selector trial. Completed 3/2/14 and selector removed.
78403501 2014 035 08:30 2 05.01 Nd:YAG start diode and discriminator adjusted to improve calibration leading edge.
78403501 2014 056 08:30 1 99 Electrical rewiring in control room, offices and in telescope dome.

Finally, from Herstmonceaux CRD Configuration Records for passes using different laser configurations:
10 Hz laser:
C0 0 532.080 ES 10hz SPD5 HMas T2L2
C1 0 10hz Nd-Yag 1064.16 10.00 20.00 100.0 20.00 4
C2 0 SPD5 SPAD5 532.000 20.00 0.0 0.0 +0.7v 0.0 0.15 20.0 0.0 Single_fot
C3 0 HMas iMaser_3000 iMaser_3000 HxET_=_3x_dassault 55 0.148

Khz laser:
C0 0 532.080 KS khz SPD5 HMas T2L2
C1 0 khz Nd-Yag 1064.16 1000.00 1.10 10.0 20.00 1
C2 0 SPD5 SPAD5 532.000 20.00 0.0 0.0 +0.7v 0.0 0.15 20.0 0.0 Single_fot
C3 0 HMas iMaser_3000 iMaser_3000 HxET_=_3x_dassault 55 0.188

Note the entries highlighted in red. The lasers are labeled “10hz” and “khz” in the configuration records. The site log distinguishes these by Max. Repetition Rate of 14 Hz and 2000 Hz. The Change History Log shows several changes related to these lasers (subsystems 5.01 and 5.02) during 2013, including reinstalling the kHz laser and examples of tracking with it.

Conclusion
Recording and reporting station changes is required to guarantee a station's data set remains useful. The procedure is not onerous, but does require diligence. When a change occurs, it must appear in the data, the change history log, and site log. Each of the 3 methods provides different information for different purposes and must agree with each other.

References
[1] http://ilrs.gsfc.nasa.gov/docs/2009/crd_v1.01.pdf
[2] ftp://cddis.gsfc.nasa.gov/slr/slrlog/slrhst/
[3] http://ilrs.gsfc.nasa.gov/network/site_procedures/configuration_files.html
[4] ftp://cddis.gsfc.nasa.gov/reports/slrlog/
[5] http://ilrs.gsfc.nasa.gov/network/site_procedures/site_logs.html