International Laser Ranging Service

ILRS Report

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ILRS Applications

- The ILRS supports many applications, such as:
  - Reference Frame and other GGOS requirements
  - Gravity Field
  - EOP observation
  - POD for altimeter satellites
  - POD for geopotential field mapping satellites
  - Tracking GNSS satellites for microwave orbits' validation
  - Fundamental physics tests
  - Engineering Applications
  - **Time transfer (e.g., T2L2)**
  - **Extended range experiments (e.g., LRO)**
  - **Tracking of space debris**

Recent activity

- Number of target satellites continues to increase (90+ satellites); LEO, HEO, GNSS, and GEO;
- New ILRS pass performance standard (3500) passes/year adopted to provide the stations new incentive;
- Newly-established data Quality Control Board: ranging data quality issues, evaluation and diagnosis of systematic errors;
- Examining “worth function” as a means of evaluating station performance; incentivize value rather than numbers;
- User survey underway for feedback on data requirement;
- Updated ToR approved by IAG; includes expansion of the GB from 16 to 18 voting members to increase scientific expertise and regional representation
- 20th International Workshop on Laser Ranging held at GFZ in October 2016 (https://cddis.nasa.gov/lw20/)
- 2017 ILRS Technical Workshop will be held in Riga, Latvia in October 2017; main topics: Network performance and station automation

SLR Stations

- New stations established or in process by the Russian Federation, NASA, BKG, India, China, Finland, Norway, Spain, etc;
- Some remote stations being outfitted with a second SLR system;
- Still have a mix of new and legacy technologies; slowly transitioning
- Spatial gaps still exit in Africa, Central America, Oceania, etc

Analysis activities

- Operational TRF products: weekly station positions and daily EOP
- Weekly combination of orbital files (SP3c format) for LAGEOS-1, -2 an Etalon-1, -2
- Station Systematic Error Monitoring Pilot Project transitioning to an operational tool:
- Next Pilot Project:
  - To deliver low-degree gravitational coefficients as a weekly product
  - To introduce LARES as the 5th target for TRF products support
- Implementation of ITRF2014 (early 2017) and SLR data reanalysis: 1983 to present
- Journal of Geodesy Special Issue, abstracts submitted, awaiting response from the editors;

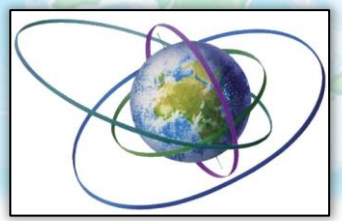
20th International Workshop on Laser Ranging

- Organized by the Helmholz Center Potsdam of the GFZ German Research Centre for Geosciences in Potsdam, Germany during the week of October 09–14, 2016
- Over 170 attendees from 25 countries
- Workshop theme: "The Path Toward the Next Generation Laser Ranging Network"

- 88 presentations, including daily invited presentations on key science topics, and over 50 posters: SLR, LLR, intercontinental time transfer; ranging and time transfer through the solar system via the use of asynchronous laser transponders, tracking space debris
- Station clinics on current operational issues
- Proceedings website now collecting all presentations, posters, and papers: https://cddis.nasa.gov/lw20/Program/index.html

Issues & challenges

- Many geographic gaps, primarily in Latin America, Africa, and Oceania
- Mix of new and old technologies and levels of financial support
- Number of target satellites continues to increase
  - Need to implement more effective tracking strategies
  - Need to be more selective on time spent on each target
- Lack of standardization in system hardware and operations
- Data quality issues (efforts underway to detect and reduce systematic errors)



Current trends in SLR

- **Lower energy, higher repetition rates (kHz)**
- **Single photon sensitive detectors (Geodetic Satellites)**
  - **Single Photon Avalanche Diodes**
  - **Micro-channel Plate (MCP) Photomultiplier Tubes**
  - **Other devices (silicon photomultipliers, nanowires etc.)**
- Other wavelengths (near infrared, blue, etc.)
- Shorter normal point intervals (take data more quickly) and faster slewing for increased pass interleaving
- Real-time data evaluation for real-time decision making
- Automated to autonomous operation with remote access
- Environmental monitoring and awareness for instrument integrity and safety
- Real-time network communication and information sharing
- Embedded software for real-time updates and decision making