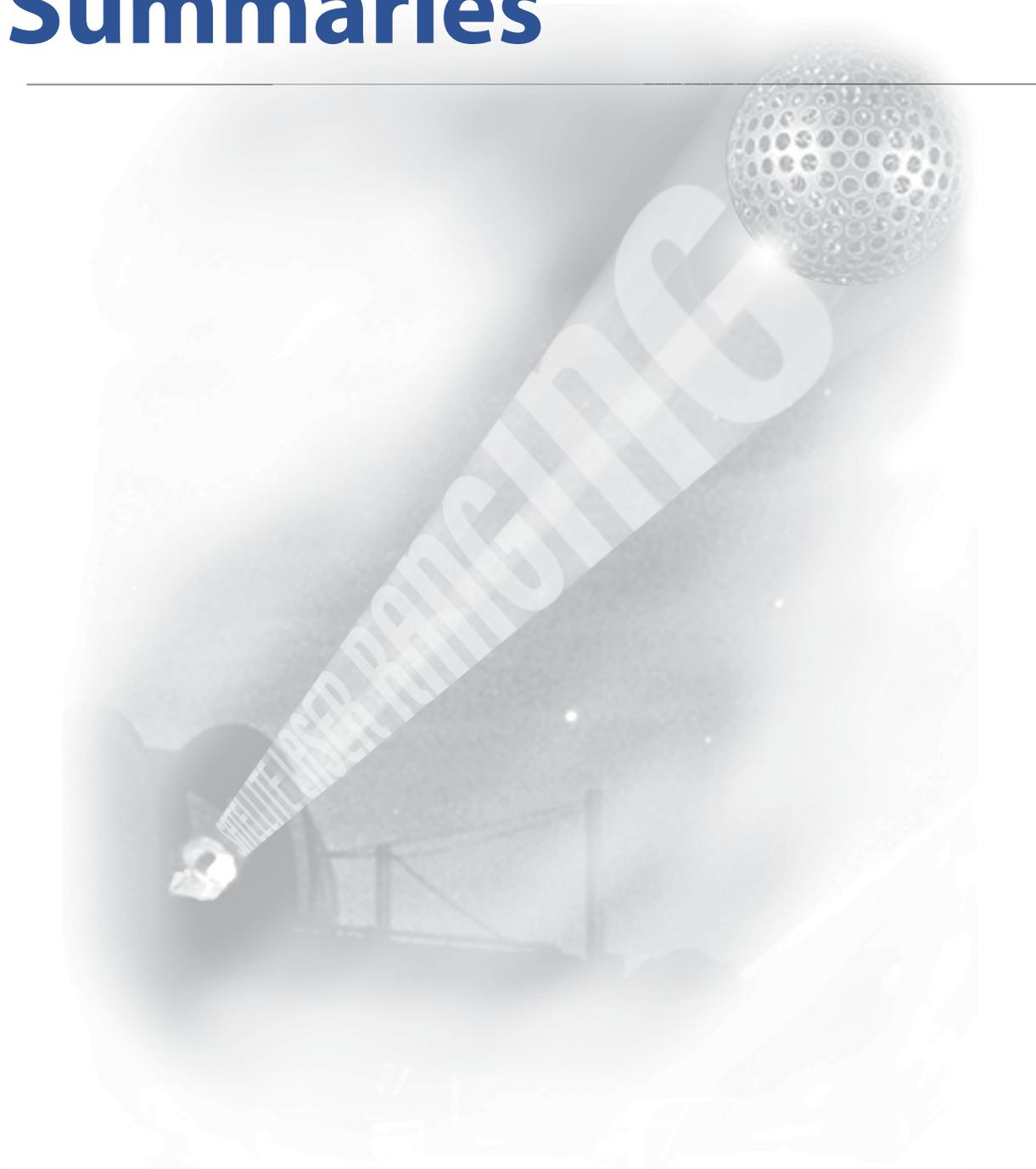


Section 10:

ILRS Meeting Summaries



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Authors: *Carey Noll, Michael Pearlman*
Responsible Agency: ILRS Central Bureau

Introduction

The ILRS sponsors International Workshops on Laser Ranging, typically held every two years. In recent years, the ILRS has conducted Technical or Specialized Workshops to focus on a few timely topics that impact the quality of ILRS data products and service operations. These workshops are held in intervening years between the full International Workshops on Laser Ranging and are intended to provide time to articulate the issues carefully, allow for in-depth discussion, and formulate a path forward.

This section provides summaries of those workshops held in the 2016-2019 time period and near-term plans for future workshops.

20th International Workshop on Laser Ranging

The Helmholtz Center Potsdam of the GFZ German Research Centre for Geosciences organized and hosted the 20th International Workshop on Laser Ranging Potsdam, Germany during the week of October 09–14, 2016. The meeting venue was located within the Science Campus “Albert Einstein” on top of the Telegraphenberg (“Telegraph Hill”), a place famous for both historic and modern science and one of the birthplaces of modern geodesy. Over 170 attendees (photo, Figure 10-1) from 25 countries participated in the meeting. The theme for this workshop, “The Path Toward the Next Generation Laser Ranging Network” allowed attendees to present ideas for future advances in SLR technology, science, and other applications.



Figure 10-1. Participants in the 20th International Workshop on Laser Ranging in Potsdam, Germany. (photo courtesy of L. Grunwaldt/GFZ).

Starting with overviews of recently achieved science and applications results through SLR, presentations reviewed current mission support and future requirements. With the increasing number of data users, the ILRS needs to balance the user needs to the available network capacity, and look for ways to increase network utility. The meeting sessions then centered on SLR station related topics including station operations, data systematics and quality control, system co-locations on the ground and in space, network tracking strategies, experience with new hardware and software, etc. The meeting was planned to start sessions with focused talks and then give sufficient time for in-depth discussions, with conclusions and recommendations by the end of the Workshop. Time was made available starting on October 8 for dedicated ILRS Standing Committee, Study Group, Governing Board, and other splinter meetings. In addition, local staff hosted informal tours of the Potsdam SLR system during the week for interested attendees.

The workshop once again included a station operations or "clinic" session where ILRS experts met in small groups of station engineers and operators to discuss common station problems and issues, including stability of operational configurations, local means of diagnosing data problems, and guidelines for interacting with the analysts in determining station biases. These station clinics were well attended and received by workshop attendees.

The workshop program included over 80 oral presentations and over 60 posters. Each day began with an invited science talk highlighting SLR contributions. The workshop's proceedings website provides information about the workshop and its program and links to presentations, posters, session summaries, and contributed papers:

<https://cddis.nasa.gov/lw20/>

2017 ILRS Technical Workshop

The 2017 ILRS Technical Workshop, sponsored by the Institute of Astronomy at the University of Latvia and the ILRS, was held in Riga, Latvia, October 02-05. The theme for this meeting was "Improving ILRS Performance to Meet Future GGOS Requirements". Over 120 people (photo, Figure 10-2) from 21 countries participated in the meeting. The program included over 50 oral presentations, as well as many relevant posters.

The first day, session topics included discussions of user requirements and how well the ILRS is addressing these requirements. It started off with a reminder that laser ranging is one of the fundamental techniques for GGOS in its role of advancing our understanding of the dynamic Earth system by quantifying our planet's changes in space and time to advance Earth science and better understand processes to help us make intelligent societal decisions.

The second day of the workshop addressed how the ILRS evaluates current performance. Examination of network data on SLR satellites over many years has revealed interesting signatures correlated with the elevation and azimuth of the passes, day versus night-time conditions, and ascending vs. descending pass segments. The main focus is now on the sources of these systematic errors and how they map into our geodetic products. Some of these issues are errors in satellite center-of-mass models, data sampling, and incorrect modeling of system processing of return signals. The third day focused on obstacles that are currently limiting network output and operational steps that could improve ranging performance. Studies continue on using correlation techniques on the return signals to reduce range biases (particularly on the spherical passive satellite) and new potential methods for bias-free range measurements at the mm-level. The fourth day concentrated on automation and autonomous station operations. Representatives from many of the stations described their activities underway and plans from partial and fully automated

scheduling and the application situational awareness from multi-sensor data. Challenges include area safety and aircraft avoidance, automating the signal discrimination, telescope pointing optimization, cloud and weather considerations, and dynamic (real-time) scheduling.

The workshop concluded with summary presentations from the chairs of the four sessions as well as the chairs of the standing committees and study groups. In addition, the participants supported resolutions that (1) urged to the community to seek more SLR stations in the southern Hemisphere, (2) asked the relevant agencies in Argentina and China to make every effort to complete the upgrade of the San Juan SLR station, and (3) thanked the University of Latvia and the local Organizing Committee for all of their work in making the Workshop a great success.

The workshop's proceedings website provides information about the meeting, the full program booklet, and links to abstracts, presentations, posters, session summaries, and contributed papers:

https://cdis.nasa.gov/2017_Technical_Workshop/



Figure 10-2. Participants in the 2017 ILRS Technical Workshop in Riga, Latvia. (photo courtesy of T. Grinbergs, University of Latvia).

21st International Workshop on Laser Ranging

The Space Environment Research Centre (SERC) and the ILRS hosted the 21st International Workshop on Laser Ranging at the John Curtin School of Medical Research, Australian National University in Canberra, Australia during the week of November 05-08, 2018. The theme of the workshop “Laser Ranging for Sustainable Millimeter Geoscience”. Daily introductory presentations were given on topics highlighting SLR contributions to science (Geodynamics, ocean and ice altimetry, gravity field, etc.) The four-day workshop program was organized into nine oral sessions, and two poster sessions focused on the oral session topics. The last day of the week was devoted to a separate event, the International Workshop on

Space Debris Management; there is very close synergy between SLR and debris tracking and many of the network stations participate in both since the hardware and operational techniques are common. The Space Debris Study Committee within the ILRS organizes the activity.

The four-day workshop program was organized into nine oral sessions, and two poster sessions focused on the oral session topics. Topics of the first day included SLR contributions to GGOS and the challenge of the 1-mm accuracy for GGOS, inter-technique comparisons and synergies between SLR and other space geodetic techniques, and improvements in the SLR contribution to the terrestrial reference frame. Day two's sessions discussed applications of the SLR technique, such as validation and support for GNSS orbit determination, laser time transfer, spacecraft attitude determination, reflector panel resolution performance, new methods of gravity field estimation, and new applications through the use of constellations of nanosatellites. Presentations on the current status and future plans for the ILRS network provided an overview of current network performance and the deployment of new technology to improve that performance, automated processing with data discrimination procedures, and development of new modeling techniques for reducing range biases. Sessions on day three included presentations of new developments in retroreflector arrays, spacecraft engineering testing and the move toward expanded system automation, including software development in scheduling, visualization, data processing, and station performance assessment. The afternoon of day three was devoted to a station operations or "clinic" session where ILRS experts met in small groups of station engineers and operators to provide solutions to common station problems, techniques to monitor ranging system stability, and guidelines for interacting with the analysts in determining and discussing station biases. These station clinics were well received and attended by workshop participants. The sessions on the final day of the laser ranging workshop focused on new technologies to improve performance, and help standardize and simplify SLR/LLR systems, and the use of existing technologies for new SLR applications such as laser communication and space debris monitoring. The last topic reviewed recent progress in Lunar Laser Ranging and lunar reflector technology.



Figure 10-3. Participants in the 21st International Workshop on Laser Ranging, Canberra, Australia. (photo courtesy of Exclusive Images, Canberra, Australia).

Over 175 registrants (photo, Figure 10-3) from 23 countries participated in the laser ranging workshop; 20 additional attendees, mainly from Australia, participated in the one-day space debris workshop. The workshop program included 80 oral presentations and over 60 posters; 25 oral presentations and 15 posters were given at the Space Debris Workshop.

All abstracts, presentations, posters, and summary papers from both workshops are available within the Program section of the workshop's proceedings website:

<https://cdsis.nasa.gov/lw21/>

Additional information, such as meeting summaries, photos, and the full program booklet are available through this website.

2019 ILRS Technical Workshop

The 2019 ILRS Technical Workshop was hosted by DLR in Stuttgart, Germany, October 21-25, 2019. The theme of the workshop was "Laser ranging: To improve economy, performance, and adoption for new applications" with presentations that focused on new concepts and ideas on the future of laser ranging, in particular, how the ILRS can make the technique more productive and more cost effective. The resulting program for the 2019 ILRS Technical Workshop included sessions on improving current station performance, new applications, safety and security, and novel concepts to improve the SLR network.

The introductory session consisted of several invited talks to illustrate the current state of the ILRS network and its possible evolution over the next few years. Subsequent sessions focused on improving systems, synergies with other techniques and technologies, and plans for future systems. The final session included presentations on laser safety in particular aircraft detection.

To encourage discussion and exchange among the participants, some sessions included dedicated time slots for panel discussions. Dedicated poster sessions were also included in the program with time for attendees to browse and interact with authors. The workshop also included a tour of the two SLR stations in Stuttgart.

Prior to the 2019 ILRS Technical Workshop, the ILRS scheduled a one-day introductory course to give non-practitioners in SLR an opportunity to broaden their knowledge about laser ranging to Earth-orbiting satellites and the Moon. The course also provided attendees with some experience in the field an opportunity to refresh and strengthen their knowledge and increase their appreciation of this powerful measurement technique that supports geoscience and applications. The program for this one-day "SLR School" is also included in the 2019 ILRS Technical Workshop website.

Talks were given in a tutorial format, with time for questions and discussion. Interested parties were able to attend the school with or without participating in the Workshop. Tutorials differed in length depending on the topic, but each session left ample time for questions and discussion.

The one-day SLR School was a great way for attendees to get an overview of an important component of the space geodesy measurement constellation. The school proved to be an opportunity for participants to obtain an overall view of satellite laser ranging and was the first time that such a school had been offered. The ILRS plans to hold these types of instructional sessions in the future.

With its 150 participants (see Figure 10-4) from more than twenty countries and more than seventy presentations (oral and poster), the workshop illustrated the importance of SLR and its application to international scientific research.



Figure 10-4. Participants in the 2019 ILRS Technical Workshop in Stuttgart, Germany. (photo courtesy of Paul Wagner/DLR).

All abstracts, presentations, posters, and supporting information from the workshop, including those from the SLR School, are available within the Program section of the workshop's proceedings website:

https://cdis.nasa.gov/2019_Technical_Workshop/

Other ILRS-Related Meetings

The ILRS standing committees and study groups hold regular meetings in conjunction with the International Workshops on Laser Ranging and ILRS Technical Workshops. The Analysis Standing Committee typically holds additional meetings prior to or after the yearly EGU General Assembly events. Announcements, summaries, presentations, actions, and other material from these meetings are linked under the activities section of each group's pages on the ILRS website. In many cases, this material can also be found within the workshop proceedings websites.

Future Plans

The next International Laser Ranging Workshop, the 22nd, is planned for the fall 2020 in Kunming China. The next ILRS Technical/Specialized Workshop will be held in Arequipa, Peru, hosted by the University of San Augustin in 2021. These timeframes for both of these future workshops may need to change, however, due to the global coronavirus pandemic of 2020.