# Monday 5 November

**The John Curtin School of Medical Research**
131 Garran Rd, Acton
Workshop location

**21ST INTERNATIONAL WORKSHOP ON LASER RANGING**
**5 – 9 NOVEMBER 2018**
**CANBERRA, AUSTRALIA**

| | START TIME | END TIME | PAPER TITLE | PRESENTING AUTHOR | AFFILIATION |
|---|---|---|---|---|---|
| **Opening Session and Keynote Address** | 08:30 | 08:45 | Welcome and housekeeping | David Ball | Space Environment Research Centre, Mt Stromlo, Australia |
| | 08:45 | 09:30 | Contributions of SLR for the next decade | Thomas Herring | Massachusetts Institute of Technology, Cambridge, United States |
| **Session 1: SLR Contribution to Global Geodetic Observing System – A 2020 Perspective**<br><br>Co-Chairs:<br>Michael Pearlman<br>Mathis Bloßfeld<br>Richard Gross<br><br>**Finkel Theatre** | 09:30 | 09:45 | GGOS and essential geodetic variables | Richard Gross | Jet Propulsion Laboratory, Pasadena, United States |
| | 09:45 | 10:00 | The role of laser ranging for the Global Geodetic Observing System GGOS | Mathis Bloßfeld | Deutsches Geodätisches Forschungsinstitut - Technische Universität München, Munich, Germany |
| | 10:00 | 10:30 | **MORNING TEA** | | |
| | 10:30 | 10:45 | The synergy of Satellite Laser Ranging (SLR) and DORIS as space geodesy techniques | Frank Lemoine | NASA Goddard Space Flight Center, Greenbelt, United States |
| | 10:45 | 11:00 | SLR tracking of GNSS constellations - Many synergies to be explored | Daniela Thaller | Federal Agency for Cartography & Geodesy, Frankfurt am Main, Germany |
| | 11:00 | 11:15 | ILRS: Current status and future plans | Carey Noll | NASA Goddard Space Flight Center, Greenbelt, United States |
| | 11:15 | 11:30 | Recent progress of VGOS and its role on GGOS | Takahiro Wakasugi | Geospatial Information Authority of Japan, Tsukuba, Japan |
| | 11:30 | 11:45 | Extension of the SLR tracking network and its potential for the realization of Terrestrial Reference Frames | Alexander Kehm | Deutsches Geodätisches Forschungsinstitut - Technische Universität München, Munich, Germany |
| | 11:45 | 12:00 | The role of ground Surveys in GGOS and recent advances in ground survey techniques | Gary Johnston | Geoscience Australia |
| | 12:00 | 13:30 | **LUNCH & POSTER SESSION A** | | |
| **Session 2: Improvements in the SLR Product Quality & Precise Orbit Determination**<br><br>Co-Chairs:<br>Erricos Pavlis<br>Vincenza Luceri<br>Krzysztof Sosnica<br><br>**Finkel Theatre** | 13:30 | 13:45 | Systematic error monitoring and modeling in ILRS data and products for ITRF2020 development | Vincenza Luceri | e-GEOS SpA, ASI/CGS-Matera, Matera, Italy |
| | 13:45 | 14:00 | Updated centre of mass correction tables for LAGEOS, Etalon, LARES, Starlette and Ajisai | José Rodríguez | BGS Space Geodesy Facility, Herstmonceux, United Kingdom |
| | 14:00 | 14:15 | Estimation of the laser retro-reflector array center location for GLONASS-M | Andrey Pafnutyev | Central Research Institute of Machine Building (TsNIIMash), Russian Federation |
| | 14:15 | 14:30 | Modeling revisions for improved reprocessing for ITRF2020 | Erricos Pavlis | JCET, University of Maryland, Baltimore, United States |
| | 14:30 | 14:45 | Precise modeling of solar radiation pressure acceleration for spherical geodetic satellites | Akihisa Hattori | SOKENDAI (The Graduate University for Advanced Studies), Tachikawa, Japan |
| | 14:45 | 15:00 | VMF3o: Enhanced tropospheric mapping functions for optical frequencies | Janina Boisits | TU Wien, Vienna, Austria |
| | 15:00 | 15:30 | **AFTERNOON TEA** | | |
| | 15:30 | 15:45 | Contribution of SLR observations to GNSS and LEO satellites for validating and improving LAGEOS-based parameters | Krzysztof Sośnica | Wroclaw University of Environmental and Life Sciences, Wroclaw, Polska |
| | 15:45 | 16:00 | Galileo precise orbit determination based on GNSS and SLR observations | Krzysztof Sośnica | Wroclaw University of Environmental and Life Sciences, Wroclaw, Polska |
| | 16:00 | 16:15 | The effect of SLR tracking scenarios to GNSS satellites in a combined GNSS/SLR solution | Florian Andritsch | Astronomical Institute, University of Bern, Switzerland |
| | 16:15 | 16:30 | Evaluating the potential of combined SLR gravity field solutions | Mathis Bloßfeld | Deutsches Geodätisches Forschungsinstitut - Technische Universität München, Munich, Germany |
| | 16:30 | 16:45 | SLR and GRACE gravity field determination and combination | Ulrich Meyer | Astronomical Institute, University of Bern, Switzerland |
| | 16:45 | 17:00 | Initial combination of our SLR weekly solutions with other Analysis Centers | Fan Shao | Shanghai Astronomical Observatory, Chinese Academy of Sciences, Shanghai, China |
| | 17:00 | 19:00 | **WELCOME RECEPTION**<br>Sponsored by the ACT Government<br>John Curtin School of Medical Research Foyer | | |

# Tuesday 6 November |

**The John Curtin School of Medical Research**
131 Garran Rd, Acton
Workshop location

| | START TIME | END TIME | PAPER TITLE | PRESENTING AUTHOR | AFFILIATION |
|---|---|---|---|---|---|
| | 08:00 | 08:30 | **Space Debris Study Group Meeting**<br>Seminar Room 1 (refer to map on page 8)<br>Meet in JCSMR Foyer at 07:45 | | |
| **Session 3: Satellite Missions & Techniques for Geodetic Applications**<br><br>Co-Chairs:<br>John Degnan<br>Ulrich Schreiber<br>Andrey Sokolov<br><br>**Finkel Theatre** | 08:30 | 08:45 | Thermal-optical design of a geodetic satellite for one millimeter accuracy | Erricos Pavlis | JCET, University of Maryland, Baltimore, United States |
| | 08:45 | 09:00 | Status of the ILRS support for the GRACE-FO mission | Sven Bauer | GeoForschungsZentrum, Potsdam, Germany |
| | 09:00 | 09:15 | Tracking of GNSS satellites – Useage in the GNSS community | Thomas Schildknecht | Astronomical Institute, University of Bern, Switzerland |
| | 09:15 | 09:30 | Precise orbit determination of the Ranging And Nanosatellite Guidance Experiment (RANGE) | Jake Griffiths | Naval Research Laboratory, Washington, United States |
| | 09:30 | 09:45 | Satellite laser ranging evaluation to Quasi-Zenith Satellite System | Ryoma Ishibashi | NEC Corporation, Fuchu, Japan |
| | 09:45 | 10:00 | Current status and expected performance of European Laser Timing | Ulrich Schreiber | Technical University of Munich, Germany |
| | 10:00 | 10:30 | **MORNING TEA** | | |
| | 10:30 | 10:45 | Verification of ELT performance by Monte Carlo simulations | Anja Schlicht | Technical University of Munich, Germany |
| | 10:45 | 11:00 | Common view time transfer by diffuse reflections from space debris objects | Ulrich Schreiber | Technical University of Munich, Germany |
| | 11:00 | 11:15 | Laser ranging to measure LightSail orbit raising | Toshimichi Otsubo | Hitotsubashi University |
| | 11:15 | 11:30 | ILRS support and flight results of distributed nanosatellite mission S-NET | Peiyuan Wang | Space Research Institute, Austrian Academy of Sciences, Graz, Austria |
| | 11:30 | 11:45 | Attitude determination of Galileo spacecraft using high resolution kHz SLR | Michael Steindorfer | Space Research Institute, Austrian Academy of Sciences, Graz, Austria |
| | 11:45 | 12:00 | Gravity field determination using post-Newtonian energy integral | Joseph O'Leary | University of South Australia / Space Environment Research Centre, Australia |
| | 12:00 | 13:00 | **LUNCH & POSTER SESSION A** | | |
| **Session 4: Network Operations & Site Upgrades**<br><br>Co-Chairs:<br>Hyung-Chul Limm<br>Randall Ricklefs<br>Zhang Zhongping<br><br>**Finkel Theatre** | 13:00 | 13:15 | Toward high-rate on-time mm-accurate SLR at Stafford, Virginia | Jake Griffiths | U.S. Naval Research Laboratory, Washington, United States |
| | 13:15 | 13:30 | Towards turnkey SLR systems: New ESA Laser Ranging Station (ELRS) | Andre Kloth | Geophysical & Geodetic Observation Systems, Potsdam, Germany |
| | 13:30 | 13:45 | Laser ranging in Main metrological center of the Russian State service of time, frequency and the Earth rotation parameters determination | Igor Blinov | National Research Institute of Technical Physics and Radio Engineering, Moscow, Russian Federation |
| | 13:45 | 14:00 | Plans and study of JAXA's next SLR station | Takehiro Matsumoto | Japan Aerospace Exploration Agency, Tsukuba, Japan |
| | 14:00 | 14:15 | EUROLAS Data Center (EDC) – recent developments (site logs, station history logs, and data transfer) | Christian Schwatke | Deutsches Geodätisches Forschungsinstitut - Technische Universität München, Munich, Germany |
| | 14:15 | 14:30 | Optimization of the current SLR tracking network: potential for SLR-derived reference frames | Alexander Kehm | Deutsches Geodätisches Forschungsinstitut - Technische Universität München, Munich, Germany |
| | 14:30 | 14:45 | Determination of the coordinates of SLR stations from the LARES satellite | Stanislaw Schillak | Polish Air Force Academy, Deblin, Poland |
| | 14:45 | 15:00 | Official IWLR2018 delegate group photo | | |
| | 15:00 | 15:30 | **AFTERNOON TEA** | | |

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| **Session 5: Sources of Systematic Errors**<br><br>Co-Chairs:<br>Daniela Thaller<br>Matthew Wilkinson<br>Toshimichi Otsubo<br><br>**Finkel Theatre** | 15:30 | 15:45 | Monitoring the time biases in laser ranging stations thanks to the Time Transfer by Laser Link T2L2 experiment | Alexandre Belli | NASA Goddard Space Flight Center, Greenbelt, United States |
| | 15:45 | 16:00 | Accurate optical time transfer between a clock on ground and in space | Ulrich Schreiber | Technical University of Munich, Bad Koetzting, Germany |
| | 16:00 | 16:15 | Some unstable factors affecting displacement in SLR range measurements | Igor Ignatenko | National Research Institute of Technical Physics and Radio Engineering, Moscow, Russian Federation |
| | 16:15 | 16:30 | Further studies on the influence of range biases | Daniel Koenig | Federal Agency for Cartography and Geodesy, Hesse, Germany |
| | 16:30 | 16:45 | Systematic SLR errors detected in precise orbit determination | Toshimichi Otsubo | Hitotsubashi University, Kunitachi, Japan |
| | 16:45 | 17:00 | Implementing consistent clipping in the reduction of SLR data from SGF, Herstmonceux | Matthew Wilkinson | NERC Space Geodesy Facility, Herstmonceux, United Kingdom |
| | 17:00 | 17:15 | Processing of SLR observations with an optimal Wiener filter – an alternative way to calculate normal points | Stefan Riepl | Federal Agency for Cartography and Geodesy, Bad Kötzting, Germany |
| | 17:15 | 17:30 | A data processing approach to high precision, high return rate kHz SLR stations | John Degnan | Sigma Space Corp, Lanham, United States |
| | 17:30 | 18:30 | **Missions Standing Committee Meeting**<br>Seminar Room 1 | | |
| | 18:30 | 19:00 | **Networks and Engineering Standing Committee Meeting**<br>Seminar Room 1 | | |

# Wednesday 7 November

**The John Curtin School of Medical Research**
131 Garran Rd, Acton
Workshop location

| | START TIME | END TIME | PAPER TITLE | PRESENTING AUTHOR | AFFILIATION |
|---|---|---|---|---|---|
| **Session 6: Characteristics of Retroreflector Arrays**<br><br>Co-Chairs:<br>Simone Dell'Agnello<br>José Rodríguez<br>Linda Thomas<br><br>**Finkel Theatre** | 08:30 | 08:45 | Thermal-optical performance of the GPS III Laser Retroreflector Array | Stephen Merkowitz | NASA Goddard Space Flight Center, Greenbelt, United States |
| | 08:45 | 09:00 | Characterization of the optical performance of COTS laser retroreflectors for ASI-INFN Joint Projects | Chiara Mondaini | Istituto Nazionale di Fisica Nucleare, Frascati (Rome), Italy |
| | 09:00 | 09:15 | kHz SLR application on the attitude analysis of Technosat | Peiyuan Wang | Space Research Institute Austrian Academy of Sciences, Graz, Austria |
| | 09:15 | 09:30 | Microreflectors for Mars, Phobos/Deimos and Asteroids/Comets | Marco Muccino | Istituto Nazionale di Fisica Nucleare, Frascati (Rome), Italy |
| | 09:30 | 09:45 | Experimental determination of photometric characteristics of the BLITS-M satellite and its range correction | Vyacheslav Murashkin | Research-and-Production Corporation Precision Systems and Instruments, Moscow, Russian Federation |
| | 09:45 | 10:00 | Retroreflector systems to determine the coordinates of SC moving parts | Andrey Sokolov | Research-and-Production Corporation Precision Systems and Instruments, Moscow, Russian Federation |
| | 10:00 | 10:30 | **MORNING TEA** | | |
| **Session 7: Developments in Software & Automation**<br><br>Co-Chairs:<br>Chris Moore<br>Pierre Lauber<br>Evan Hoffman<br><br>**Finkel Theatre** | 10:30 | 10:45 | Use of a night-tracking camera for real time correction of the pointing of the SLR system | Emiliano Cordelli | Astronomical Institute University of Bern, Switzerland |
| | 10:45 | 11:00 | The status of WLRS system automation | Johann Eckl | Federal Agency for Cartography and Geodesy, Bad Kötzting, Germany |
| | 11:00 | 11:15 | Sequential processing of ILRS observations – Experiences over the last 5 years | David Vallado | Center for Space Standards and Innovation, AGI, Colorado, United States |
| | 11:15 | 11:30 | Development of automated SLR data processing at Mount Stromlo SLR Station | Christopher Moore | EOS Space Systems, Australia |
| | 11:30 | 11:45 | Updates to the ILRS predictions and data formats | Randall Ricklefs | Center for Space Research, University of Texas at Austin, Austin, United States |
| | 11:45 | 12:00 | Station assessment software - Overview | Justine Woo | Sigma Space Corp, Lanham / National Aeronautics and Space Administration, Greenbelt, United States |
| | 12:00 | 13:30 | **LUNCH & POSTER SESSION B** | | |

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|---|---|---|---|---|---|---|---|---|
| **Clinic Sessions** | 13:30<br>14:20 | 14:10<br>15:00 | **1: Data Quality**<br>Erricos Pavlis, Krzysztof Sośnica<br>**Finkel Theatre** | **2: Data Productivity**<br>Randall Carman, Robert Sherwood<br>**Link Room** | **3: System Accuracy / Biases**<br>Toshimichi Otsubo, José Rodríguez<br>**Science Forum** | **4: ILRS Procedures**<br>Randall Ricklefs, Christian Schwatke<br>**Boardroom** | **5: Web Tools and Software**<br>Matthew Wilkinson, Michael Steindorfer<br>**Seminar Room 1** | **6: Calibration and Ground Targets**<br>Georg Kirchner, Ulrich Schreiber<br>**Seminar Room 2** |
| | 15:00 | 15:30 | **AFTERNOON TEA** | | | | | |
| | 15:30<br>16:20 | 16:10<br>17:00 | **1: Data Quality**<br>Erricos Pavlis, Krzysztof Sośnica<br>**Finkel Theatre** | **2: Data Productivity**<br>Randall Carman, Robert Sherwood<br>**Link Room** | **3: System Accuracy / Biases**<br>Toshimichi Otsubo, José Rodríguez<br>**Science Forum** | **4: ILRS Procedures**<br>Randall Ricklefs, Christian Schwatke<br>**Boardroom** | **5: Web Tools and Software**<br>Matthew Wilkinson, Michael Steindorfer<br>**Seminar Room 1** | **6: Calibration and Ground Targets**<br>Georg Kirchner, Ulrich Schreiber<br>**Seminar Room 2** |
| | 17:00 | 18:30 | **Data Formats and Procedures Standing Meeting**<br>Seminar Room 1 | | | | | |
| | 18:30 | 19:00 | **Transponders Standing Committee Meeting**<br>Seminar Room 1 | | | | | |
| | 19:00 | 22:00 | **BANQUET**<br>National Arboretum<br>Buses will depart from the front steps of the JCSMR and also Edinburgh Avenue bus stop at 18:40 (see page 7 for more details) | | | | | |

# Thursday 8 November

**The John Curtin School of Medical Research**
131 Garran Rd, Acton
Workshop location

| | | END TIME | PAPER TITLE | PRESENTING AUTHOR | AFFILIATION |
|---|---|---|---|---|---|
| **Session 8: Developments in SLR Techniques & Technologies**<br>Co-Chairs:<br>Georg Kirchner<br>Manuel Catalán<br>Daniel Hampf<br>**Finkel Theatre** | 08:30 | 08:45 | A high power laser ranging facility at JPL's TMO | Michael Shao | Jet Propulsion Laboratory, Pasadena, United States |
| | 08:45 | 09:00 | Concept for a new minimal SLR system | Daniel Hampf | German Aerospace Center, Stuttgart, Germany |
| | 09:00 | 09:15 | Development progress on NASA's Space Geodesy Satellite Laser Ranging System | Evan Hoffman | NASA Goddard Space Flight Center, Greenbelt, United States |
| | 09:15 | 09:30 | Modernization of Event Timer RTS 2006 | Kalvis Salmins | Institute of Astronomy, University of Latvia, Riga, Latvia |
| | 09:30 | 09:45 | Near Simultaneous on-orbit Testing of GOES-16 and GOES-17 GLM payloads from 2 NASA SLR sites using collocated GLM laser beacons | Thomas Varghese | NASA SLR program and Cybioms Corporation, United States |
| | 09:45 | 10:00 | Progress of space qualification of the NPET Timing System for SLR and time transfer applications | Johan Westin | Czech Technical University, Prague, Czech Republic / Delft University of Technology, Delft, The Netherlands |
| | 10:00 | 10:30 | **MORNING TEA** | | |
| | 10:30 | 10:45 | Reduction of atmospheric modelling errors using multiple wavelength ranging | Ben Greene | EOS Space Systems, Australia |
| | 10:45 | 11:00 | Space debris laser ranging test based on 1064nm laser wavelength | Dongsheng Zhai | Yunnan Observatories, Chinese Academy of Sciences, Kunming, China |
| | 11:00 | 11:15 | The results of full-scale tests of the new Russian laser station «Tochka» | Sergey Martynov | Research-and-Production Corporation Precision Systems and Instruments, Moscow, Russian Federation |
| | 11:15 | 11:30 | The Semiconductor Guidestar Laser: A novel, affordable, low SWaP sodium guide star laser for adaptive optics tracking of space objects | Celine d'Orgeville | Australian National University / Space Environment Research Centre, Canberra, Australia |
| | 11:30 | 11:45 | Airborne and spaceborne single photon 3D imaging Lidars | John Degnan | Sigma Space Corp, Lanham, United States |
| | 11:45 | 12:00 | Communications and ranging experiment using laser terminal on satellite | Hiroo Kunimori | National Institute of Information and Communications Technology, Tokyo, Japan |
| | 12:00 | 13:30 | **LUNCH & POSTER SESSION B** | | |

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| **Session 9: Lunar Laser Ranging & Deep Space Missions**<br><br>Co-Chairs:<br>Tom Murphy<br>Jean-Marie Torre<br>Sven Bauer<br><br>**Finkel Theatre** | 13:30 | 13:45 | Observations from the low LEO orbit up to the moon | Johann Eckl | Federal Agency for Cartography and Geodesy, Bad Kötzting, Germany, |
| | 13:45 | 14:00 | Development on lunar laser ranging at Yunnan Observatories | Yaoheng Xiong | Yunnan Observatories, Chinese Academy of Sciences, Kunming, China |
| | 14:00 | 14:15 | Development of hollow corner cube retroreflector for the future lunar and deep space satellite laser ranging | Yun He | Sun Yat-sen University, Zhuhai, China |
| | 14:15 | 14:30 | Testing and physics analysis of old (Lunokhod) and new (MoonLIGHT) lunar laser retroreflectors | Luca Porcelli | Istituto Nazionale di Fisica Nucleare, Frascati (Rome) / Unical, Cosenza, Italy |
| | 14:30 | 14:45 | Sub-millimeter lunar laser ranging: Novel approach to Moon reference frame | Vladimir Zharov | National Research Institute of Technical Physics and Radio Engineering, Moscow, Russian Federation |
| | 14:45 | 15:00 | Advanced lunar laser ranging for high-precision science investigations | Slava Turyshev | Jet Propulsion Laboratory, Pasadena, United States |
| | 15:00 | 15:30 | **AFTERNOON TEA** | | |
| Co-Chairs:<br>Michael Pearlman<br>Erricos Pavlis<br>Giuseppe Blanco<br><br>**Finkel Theatre** | 15:30 | 17:00 | **Wrap-up & Close** | | |
| | 17:00 | 19:00 | **ILRS Governing Board Meeting (invitation only)**<br>Seminar Room 1 | | |

# Friday 9 November

**INTERNATIONAL WORKSHOP ON SPACE DEBRIS MANAGEMENT AND MITIGATION**

**The John Curtin School of Medical Research**
131 Garran Rd, Acton
Workshop location

| | START TIME | END TIME | PAPER TITLE | PRESENTING AUTHOR | AFFILIATION |
|---|---|---|---|---|---|
| **Opening Session and Keynote Address** | 08:25 | 08:30 | Welcome and housekeeping | David Ball | Space Environment Research Centre, Mt Stromlo, Australia |
| | 08:30 | 09:00 | Keynote Address | Moriba Jah | University of Texas at Austin and SERC International Research Management Committee |
| **Session 1: Sensors & Satellite Tracking**<br><br>Co-Chairs:<br>Michael Pearlman<br>Erricos Pavlis<br>Giuseppe Blanco<br><br>**Finkel Theatre** | 09:00 | 09:15 | SERC Research Program 1 Review: Remote manoeuvre of space debris using photon pressure for active collision avoidance | Craig Smith | EOS Space Systems, Australia |
| | 09:15 | 09:30 | Adaptive optics corrected imaging for satellite and debris characterisation | Michael Copeland | Australian National University / Space Environment Research Centre, Canberra, Australia |
| | 09:30 | 09:45 | Tracking non-cooperative low earth orbit objects using GNSS satellites as a multi-static radar | Sohrab Mahmud | University of New South Wales, Campbell, Australia |
| | 09:45 | 10:00 | Photon counting detector for both passive and active space debris optical tracking | Georg Kirchner | Austrian Academy of Sciences, Graz - Lustbuehel, Austria |
| | 10:00 | 10:15 | Mission characterization of LEO targets | Pawel Lejba | Space Research Centre of the Polish Academy of Sciences, Kornik, Poland |
| | 10:15 | 10:30 | Multi-kW high beam quality CW laser for space debris manoeuvring | Yue Gao | EOS Space Systems, Australia |
| | 10:30 | 11:00 | **MORNING TEA** | | |
| **Session 2: Orbit Determination & Propagation Session**<br><br>Co-Chairs:<br>Moriba Jah<br>Michael Steindorfer<br>Igor Zayer<br><br>**Finkel Theatre** | 11:00 | 11:15 | Overview and research findings of SERC Research Program 2: Orbit Determination and Predicting Behaviours of Space Objects | Robert Norman | RMIT University, Australia; SERC Limited, Australia, |
| | 11:15 | 11:30 | Local orbit uncertainty reduction in follow-up passes based on single-pass debris laser ranging | Christoph Bamann | Technical University of Munich, Germany |
| | 11:30 | 11:45 | Real time improvement of orbits of space debris by fusing SLR and astrometric data acquired by a night-tracking camera | Emiliano Cordelli | Astronomical Institute University of Bern (AIUB), Bern, Switzerland |
| | 11:45 | 12:00 | Orbit determination for space debris tracking using laser ranging and angular data from an encoder in Geochang SLR system | Simon Kim | Korea Astronomy and Space Science Institute, South Korea |
| | 12:00 | 12:15 | Orbit determination and prediction accuracy of TOPEX with a priori solar radiation force derived from photometrics and laser ranging data | Michael Lachut | EOS Space Systems, Queanbeyan / Space Environment Research Centre, Mt Stromlo, Australia |
| | 12:15 | 12:30 | Coupled orbit-attitude evolution estimation enhancement using machine learning | Rasit Abay | UNSW Canberra, Australia |

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## FRIDAY 9 NOVEMBER CONTINUED

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|---|---|---|---|---|---|
| | 12:30 | 12:45 | Official IWLR2018 delegate group photo | | |
| | 12:45 | 13:30 | **LUNCH & SPACE DEBRIS POSTER SESSION** | | |
| **Session 3: Conjunction Analysis & Collision Avoidance Session**<br><br>Co-Chairs:<br>James Bennett<br>Daniel Kucharski<br>Quirin Funke<br><br>**Finkel Theatre** | 13:30 | 13:45 | A new Australian conjunction assessment and threat warning service | James Bennett | Space Environment Research Centre, Mount Stromlo, Australia |
| | 13:45 | 14:00 | Operational collision avoidance at ESOC | Quirin Funke | IMS @ European Space Agency, Darmstadt, Germany |
| | 14:00 | 14:15 | Enhancement software package for collision risk mitigation in KARI | Jaedong Seong | Korea Aerospace Research Institute, Daejeon, South Korea |
| | 14:15 | 14:30 | Assessing GEO close encounter warnings for spacecraft operations | Sven Flegel | Space Environment Research Centre, Canberra / Visiting Researcher to the Royal Melbourne Institute of Technology, Australia |
| | 14:30 | 14:45 | Informative optimal collision avoidance manoeuvrers using deep learning | Rasit Abay | UNSW Canberra, Australia |
| | 14:45 | 15:00 | Laser Precision Collision Avoidance: A new concept in space debris mitigation | Toshikazu Ebisuzaki | IZEST/Ecole Polytechnique, Paris, France |
| | 15:00 | 15:30 | **AFTERNOON TEA** | | |
| **Session 4: Mitigation & Remediation Session**<br><br>Co-Chairs:<br>Ben Greene<br>Matthew Bold<br>Jung Hyun<br><br>**Finkel Theatre** | 15:30 | 15:45 | Space Environment Research Centre: Space segment overview | Benjamin Sheard | Space Environment Research Centre, Mt Stromlo, Australia; EOS Space Systems, Australia |
| | 15:45 | 16:00 | A systematic study of laser ablation for space debris mitigation | Francesco Nozzoli | Trento Institute for Fundamental Physics and Applications-National Institute for Nuclear Physics, Trento, Italy |
| | 16:00 | 16:15 | Deorbiting mission of cm-sized space debris by laser ablation | Toshikazu Ebisuzaki | Riken, Wako, Japan |
| | 16:15 | 16:30 | High-definition Photometry - New tool for space debris characterization | Daniel Kucharski | Space Environment Research Centre, Canberra, Australia / The University of Texas, Austin, USA, |
| | 16:30 | 16:45 | Investigation into the rotational dynamics of the defunct satellite TOPEX/Poseidon | Luc Sagnières | McGill University, Montreal, Canada / IMCCE, Observatoire de Paris, France |
| | 16:45 | 17:00 | Collision avoidance using ground based lasers | Liam Smith | Lockheed Martin, Colorado, United States |
| | 17:00 | 17:30 | **Closing session & keynote:** Ben Greene, Electro Optic Systems, Australia | | |
| | 18:00 | 21:00 | **EOS Space Research Centre Telescope Tour & BBQ**<br>Sponsored by SERC<br>Mount Stromlo Observatory<br>Buses will depart from the front steps of the JCSMR at 17:40 (See page 7 for more details) | | |

# POSTER SESSION A

Monday 5 November and Tuesday 6 November 2018
**(during lunch)**

| SESSION | POSTER NUMBER | PAPER TITLE | PRESENTING AUTHOR | AFFILIATION |
|---|---|---|---|---|
| **Session 1. SLR Contribution to Global Geodetic Observing System – A 2020 Perspective** | A1 | NASA CDDIS: Important changes to user access | Carey Noll | NASA Goddard Space Flight Center, Greenbelt, United States |
| | A2 | New horizons for Latin American SLR network | Pablo Raul Yanyachi | Universidad Nacional de San Agustín de Arequipa, Peru |
| **Session 2. Improvements in the SLR Product Quality & Precise Orbit Determination** | A3 | A combined solution of SLR, SLR to GNSS and GNSS at Normal Equations Level: Preliminary results and facts | Dimitrios Ampatzidis | Federal Agency for Cartography and Geodesy, Hessen, Germany |
| | A4 | Expanded SLR target constellation for improved future ITRFs | Erricos Pavlis | JCET, University of Maryland, Baltimore, United States |
| | A5 | Network effects and handling of geocentre motion in SLR and GNSS solutions | Krzysztof Sośnica | University of Environmental and Life Sciences, Wroclaw, Poland |
| | A6 | A common mode error explore for GNSS/VLBI/SLR/DORIS based on PCA method | Xiaoya Wang | Shanghai Astronomical Observatory, Chinese Academy of Science, China |
| | A7 | A new model of the mean albedo of the earth: Estimation and validation from the GRACE mission and SLR satellites | Florent Deleflie | IMCCE, Observatoire de Paris, France |
| **Session 3. Satellite Missions & Techniques for Geodetic Applications** | A8 | Status of the GRGS analysis center | Florent Deleflie | IMCCE, Observatoire de Paris, France |
| | A9 | Role of laser measurements in the Geo-IK-2 mission | Natalia Parkhomenko | Research-and-Production Corporation Precision Systems and Instruments, Moscow, Russian Federation |
| | A10 | Station performance of the Sazhen-TM system at Hartebeesthoek | Roelf Botha | Hartebeesthoek Site, SARAO, Krugersdorp, South Africa |
| | A11 | Status and recent upgrades at MOBLAS5/Yarragadee | Randall Carman | Geoscience Australia, Canberra, Australia |
| | A12 | San Fernando laser station latest upgrades and news | Manuel Catalán | Royal Observatory of the Spanish Navy, Spain |
| | A13 | The improvement on data quality of Changchun High Repetition Rate Laser Ranging System | Xue Dong | Changchun Observatory, Chinese Academy of Sciences, Changchun, China |
| | A14 | Stuttgart SLR stations | Daniel Hampf | German Aerospace Center, Stuttgart, Germany |
| | A15 | Syowa Geodetic Station in Antarctica: Current status and future prospects | Akihisa Hattori | SOKENDAI (The Graduate University for Advanced Studies), Tachikawa, Japan |
| | A16 | Status of the NASA SGSLR Gimbal and telescope assembly build and test | Julie Horvath | Kbrwyle Technology Solutions, Lanham, United States |
| | A17 | The state and development of laser ranging measurements at the Mendeleevo SLR station | Igor Ignatenko | National Research Institute of Technical Physics and Radio Engineering, Moscow, Russian Federation |
| | A18 | Satellite laser ranging at station 1893 (Katzively) in 2017 | Igor Ignatenko | National Research Institute of Technical Physics and Radio Engineering, Moscow, Russian Federation |
| | A19 | The state and development of laser ranging measurements at the Irkutsk SLR station | Igor Ignatenko | National Research Institute of Technical Physics and Radio Engineering, Moscow, Russian Federation |
| | A20 | Need for a Space Geodetic Station around Indian Ocean Region | Elango Kattimuthu | Indian Space Research Organisation, Karnataka, India |
| | A21 | Current NASA SLR network operations | Rivers Lamb | NASA Goddard Space Flight Center, Greenbelt, United States |
| | A22 | Kunming Station New Satellite Laser Ranging System | Zhulian Li | Yunnan Observatories, Chinese Academy of Sciences, Kunming, China |

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| SESSION | POSTER NUMBER | PAPER TITLE | PRESENTING AUTHOR | AFFILIATION |
|---|---|---|---|---|
| **Session 4. Network Operations & Site Upgrades** | A23 | Past (LURE), present (TLRS-4) and future (SGSLR) of laser ranging at Haleakala, Maui | Daniel O'Gara | University of Hawaii Institute for Astronomy, United States |
| | A24 | Metsähovi Geodetic Research Station – a future GGOS core station | Arttu Raja-Halli | Finnish Geospatial Research Institute, Uusimaa, Finland |
| | A25 | The McDonald Geodetic Observatory (MGO) | Randall Ricklefs | Center for Space Research, The University of Texas at Austin, United States |
| | A26 | Tanegashima Station (GMSL) status report | Takushi Sakamoto | Japan Aerospace Exploration Agency, Tsukuba, Japan |
| | A27 | SLR Station Riga status report | Kalvis Salmins | University of Latvia Institute of Astronomy, Riga, Latvia |
| | A28 | Coordinates of the Borowiec SLR station in 2015-2018 | Stanislaw Schillak | Polish Air Force Academy, Deblin, Poland |
| | A29 | EUROLAS Data Center (EDC) - Status Report 2016-2018 | Christian Schwatke | Deutsches Geodätisches Forschungsinstitut - Technische Universität München, Munich, Germany |
| | A30 | Latest activities and developments at the SGF, Herstmonceux | Matthew Wilkinson | NERC Space Geodesy Facility, Herstmonceux, United Kingdom |

# POSTER SESSION B

**Wednesday 7 November and Thursday 8 November 2018 (during lunch)**

| SESSION | POSTER NUMBER | PAPER TITLE | PRESENTING AUTHOR | AFFILIATION |
|---|---|---|---|---|
| **Session 4. Network Operations & Site Upgrades** | B1 | NASA Network sustainment analysis & trends | Christopher Szwec Kate Stevenson Rivers Lamb | Peraton / NASA, Greenbelt, United States |
| | B2 | Status of the establishment of the Yebes Laser Ranging Station (YLARA) | Beatriz Vaquero-Jiménez José Manuel Serna-Puente | Yebes Observatory (IGN-Spain), Spain |
| | B3 | Station assessment software - Initial results | Justine Woo Evan Hoffman | Sigma Space Corp, Lanham, United States |
| | B4 | Installation of GNSS receivers and laser reflector in volcanoes and hills surrounding the Arequipa Station | Pablo Raul Yanyachi | Universidad Nacional de San Agustín de Arequipa, Peru |
| | B5 | Development of transportable cabin-based SLR system with 60cm aperture telescope | ZhongPing Zhang | Shanghai Astronomical Observatory, Chinese Academy of Science, China |
| **Session 5. Sources of Systematic Errors** | B6 | Analyzing prediction quality with the Potsdam Time Bias Service | Sven Bauer | GeoForschungsZentrum, Potsdam, Germany |
| | B7 | Extended troposphere delay model dedicated for Satellite Laser Ranging | Mateusz Drozdzewski | University of Environmental and Life Sciences, Wroclaw, Poland |
| | B8 | JCET web tools for the assessment of the ILRS Network's performance | Erricos Pavlis | JCET, University of Maryland, Baltimore, United States |
| **Session 6. Characteristics of Retroreflector Arrays** | B9 | Development of reflectors for motion grasp of space debris | Takehiro Matsumoto | Japan Aerospace Exploration Agency, Tsukuba-city, Japan |

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## POSTER SESSION B CONTINUED

| SESSION | POSTER NUMBER | PAPER TITLE | PRESENTING AUTHOR | AFFILIATION |
|---|---|---|---|---|
| **Session 7. Developments in Software & Automation** | B10 | ELT data filtering in presence of multiple laser retro-reflectors | Christoph Bamann | Technical University of Munich, Germany |
| | B11 | SLR analysis with the DGFI-TUM software DOGS-OC/-CS | Mathis Bloßfeld | Deutsches Geodätisches Forschungsinstitut - Technische Universität München, Munich, Germany |
| | B12 | Updates on ESA tools supporting debris laser ranging | Quirin Funke | IMS @ European Space Agency, Darmstadt, Germany |
| | B13 | Implements of cpf and crd algorithm in Python | Rongwang Li | Yunnan Observatories, Chinese Academy of Sciences, Kunming, China |
| | B14 | Multi-technique capabilities in GipsyX | Paul Ries | Jet Propulsion Lab, Pasadena, United States |
| | B15 | Raspberry Pi based temperature monitoring network at the SLR station Riga 1884 | Kalvis Salmins | University of Latvia Institute of Astronomy, Riga, Latvia |
| | B16 | Software control system upgrade at Stafford, Virginia | Walter Reed Smith | Naval Research Laboratory, Washington, United States |
| | B17 | ILRS operation centers CRD quality check upgrade | Kate Stevenson | Peraton, Greenbelt, United States |
| | B18 | Quick analysis using orbitNP.py of full-rate SLR data submitted to the ILRS in 2018 | Matthew Wilkinson | NERC Space Geodesy Facility, Herstmonceux, United Kingdom |
| | B19 | Aircraft detection using a digital camera aligned to the SLR laser at the SGF, Herstmonceux | Matthew Wilkinson | NERC Space Geodesy Facility, Herstmonceux, United Kingdom |
| | B20 | Software best practices at Crustal Dynamics Data Information System (CDDIS): Steps to consider | Justine Woo | Sigma Space Corp, Lanham, United States |
| **Session 8. Developments in SLR Techniques & Technologies** | B21 | The NASA SGSLR approach to range gate and laser fire control | Christopher Clarke | KBRwyle Technology Solutions, Lanham, United States |
| | B22 | 100 kHz satellite laser ranging demonstration at MLRO | Daniele Dequal | Agenzia Spaziale Italia, Italy |
| | B23 | Introduction to reliable SLR In-Sky-Safety methods in operation at the GGOS Site Wettzell | Johann Eckl | Federal Agency for Cartography and Geodesy, Bad Kötzting, Germany |
| | B24 | Laser activity of the Borowiec laser station in years 2017-2018 | Pawel Lejba | Space Research Centre Polish Academy of Sciences, Warsaw, Poland |
| | B25 | Coherent Optical Doppler Orbitography | Sascha Schediwy | ICRAR / University of Western Australia, Australia |
| | B26 | SLR station Graz: Station overview and current status | Michael Steindorfer | Space Research Institute, Austrian Academy of Sciences, Graz, Austria |
| | B27 | Time synchronization for Bi-static laser ranging via fiber-based time and frequency transfer | Haifeng Zhang | Shanghai Astronomical Observatory, Chinese Academy of Science, China |
| | B28 | Preliminary test results of the new 1m Aperture SLR telescope in Wuhan National Geodetic Observatory | Jie Zhang | Institute of Geodesy and Geophysics, Chinese Academy of Sciences, Wuhan, China |
| | B29 | Method for comparing time scales: Accuracy estimates and necessary corrections | Igor Ignatenko | National Research Institute for Physical-Technical and Radio Engineering Measurements, Mendeleevo, Russian Federation |
| **Session 9. Lunar Laser Ranging & Deep Space Missions** | B30 | Processing and analysis of lunar laser ranging observations in Crimea in 1974-1984 | Igor Ignatenko | National Research Institute of Technical Physics and Radio Engineering, Moscow, Russian Federation |
| | B31 | Calibration, gravity signals, and model uncertainties relating to the Apache Point Observatory Lunar Laser-ranging Operation (APOLLO) | Ulrich Schreiber | Technical University of Munich, Germany |

# SPACE DEBRIS POSTER SESSION

**Friday 9 November (during lunch)**

| SESSION | POSTER NUMBER | PAPER TITLE | PRESENTING AUTHOR | AFFILIATION |
|---|---|---|---|---|
| **Session 1: Sensors & Satellite Tracking** | SD1 | Changchun Tiangong-1 Space debris joint observation | Xue Dong | Changchun Observatory, Chinese Academy of Sciences, Changchun, China |
| | SD2 | The Semiconductor Guidestar Laser: A novel, affordable, low SWaP sodium guide star laser for adaptive optics tracking of space objects | Celine d'Orgeville | Australian National University / Space Environment Research Centre, Canberra, Australia |
| | SD3 | Data validation and fault diagnosis of APOSOS telescope using satellite laser ranging data | Pengqi Gao | National Astronomical Observatories, Chinese Academy of Sciences, Beijing, China |
| | SD4 | A summary of Graz Light curves measurements since 2015 | Peiyuan Wang | Space Research Institute Austrian Academy of Sciences, Styria, Austria |
| | SD5 | Development and architecture of the EOS Guide Star Laser | James Webb | EOS Space Systems, Queanbeyan, Australia |
| **Session 2: Orbit Determination & Propagation Session** | SD6 | Using SLR observations of Low Earth Orbiting satellites to scale neutral thermospheric density | Mathis Bloßfeld | Deutsches Geodätisches Forschungsinstitut - Technische Universität München, Munich, Germany |
| | SD7 | Search and track multi-sensor multi-target tracking for orbit determination and catalog maintenance of geosynchronous space objects | Han Cai | RMIT University, Melbourne / Space Environment Research Centre, Mt Stromlo, Australia |
| | SD8 | Benefits from the first deployment of the Expert Centre for supporting laser-ranging observations: Status report and possible implications on orbit improvement | Quirin Funke | IMS @ European Space Agency, Darmstadt, Germany |
| | SD9 | Accelerometer-derived thermosphere density from Swarm-C and advancements in physics-based modelling | Robert Norman | RMIT University, Melbourne / Space Environment Research Centre, Mt Stromlo, Australia |
| | SD10 | Multiple space objects tracking and orbit determination considering uncertain parameters | Yang Yang | RMIT University, Melbourne / Space Environment Research Centre, Mt Stromlo, Australia |
| **Session 3: Conjunction Analysis & Collision Avoidance Session** | SD11 | Design of a high-performance conjunction assessment service | Marek Moeckel | Space Environment Research Centre, Mt Stromlo, Australia |
| | SD12 | Increasing the determinacy and uniqueness of solutions to the physical characteristics and non-natural behaviours of near-earth orbiting space objects | Richard Samuel | Space Environment Research Centre / Australian National University, Weston Creek, Australia |
| | SD13 | Design & development of an optimized sensor scheduling & tasking programme for tracking space objects | David Shteinman | Industrial Sciences Group, Sydney, Australia |
| **Session 4: Mitigation & Remediation Session** | SD14 | Removal of small-sized space debris by laser-ablative momentum generation | Daniel Hampf | German Aerospace Center, Stuttgart, Germany |
| | SD15 | SLR observation of Tiangong-1 for its rotational state | You-yuan Lin | Purple Mountain Observatory, Nanjing, China |