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Introduction

The annual conference on Infrared Remote Sensing and Instrumentation was held 20–22 August 2018, in San Diego, California, forming a part of the annual SPIE Optics + Photonics meeting. SPIE is a technical society dedicated to the advancement of science and engineering through the use of light, more specifically photonics and optics. We completed the 26th in the series of these conferences, being among the longest running conferences at the annual meeting. The next meeting will be held again in San Diego during August 2019.

On behalf of the conference participants, and especially on our own behalf, we wish to express our most profound appreciation to the authors-presenters and the lively audience who had more questions than we were able to accommodate during the sessions. The atmosphere at this conference proved once again that a face-to-face discussion between the presenter and the curious listeners is needed for a true exchange of information, including, occasionally, a difference of opinion. Such lively discussion makes personal participation mandatory.

Approximately 35 papers were presented during the conference, with truly international scientific participation. A couple of presentations were canceled with advance warning; so alternate talks were inserted into the sessions. The great majority of presenters (21) found the necessary time to write their research accomplishments up in a technical paper and submit their work for inclusion in the Proceedings for future reference. On behalf of the readers of the Proceedings, we thank the authors for their dedication. Their papers may be downloaded from the SPIE Digital Library. The SPIE Digital Library continues to expand and offer more benefits to the SPIE members and readers by making research accomplishments published in the proceedings and journals available worldwide.

Within the last ten years or so, a little advisory note has been inserted in the SPIE Call for Papers that the chairs and members of the technical committee review all papers. Many SPIE participants used to assume that this is just *pro-forma*, so our conferences would "look good". The truth is that each paper is read carefully by at least one chair, for as long as we have been involved in these activities. The engineer/scientist who is interested in many subjects, and enjoys to some degree interpersonal interaction, is usually attracted to the conference organization. Such a researcher enjoys reading about new technology, engineering, and science and about the new projects that their colleagues have undertaken. The papers at our conference have historically been of the highest quality, so the suggestions have to do mostly with formatting: maybe the European author forgot that the European paper size is different from that in the United States, or the format changed automatically because computers nowadays think that they know everything better. We believe that one more look at the final accomplished work makes the paper even better, and the conference proceedings book becomes even more useful as a reference.

The conference this year was organized in six oral sessions and a poster session with the presentations thematically grouped within the sessions. We started with Infrared Instruments, organized by Professor Siwen Bi, from Institute of Remote Sensing and Digital Earth (China). Dr. Ling Ngo Phong and colleagues from the Canadian Space Agency described a low resource imaging radiometer for nano-satellite based fire diagnosis. This work was particularly relevant during the recent months when fires are engulfing ever larger areas of natural forests and shrubs. Fires are encroaching on the human habitat, destroying structures, forcing people to move from their homes, and disrupting life. The radiometer would be featured on a number of satellites to monitor new fires and their growth throughout a certain region.

The second presentation was canceled last minute, so the chair stepped in to present a talk on the comparison between different indirect, direct, and interferometric (also classified as direct) techniques to detect extra-solar planets.

Nathan Hagen from the Utsunomiya University (Japan) delivered the last talk in the session on the influence of the natural and artificial fogs on visible and IR-imaging. Ever since our vehicles acquired some velocity, we wanted to see through the fog, to avoid collisions on land, water and in the air, or just simply to continue navigation along the pre-chartered path. Now that some cars are already equipped with the lidar, and most vehicles feature at least a visible camera, we would also like to introduce the on-board IR camera. It would indeed help during night to see a warm body crossing the street. The experimental work failed to demonstrate the capability of an IR camera to see through the fog, due to the size and distribution of the water particles. The use of camera remains an option to detect creatures crossing the roads at night.

The second session, Remote Sensing Technologies, allowed us to appreciate extensive research on quantum imaging and its improved performance in IR, compared to traditional IR imaging. Professor Siwen Bi explained about quantum remote sensing theory and practice in two talks. This technology enables detector performance that is better than the traditionally accepted quantum noise limit.

The next paper is significant from the point of view of the engineering achievements of synchronizing two clocks that are, let us say, 400 km apart, in order to assure a "simultaneous" data transmission across large distances. The paper also represented the first practical application of the Einstein's theory of time measurement and Heisenberg's principle: that you can either measure a quantity or its conjugate to a high degree of precision, but not both. Dr. Josef Vojtech on behalf of his colleagues from CESNET (Czech Republic) and the Institute of Scientific Instruments of the CAS, v.i.i. (Czech Republic) reported on multi-purpose infrastructure for dissemination of precise stable optical frequency.

The third and the fourth sessions, Planets and Minor Bodies I and II, were only separated for the ever-important coffee break and moderated by the conference chairs. During the first part, Dr. Gabriele Arnold and her collaborators from the

Deutsches Zentrum für Luft- und Raumfahrt (Germany) delivered a review paper on how we are studying the early solar system: by exploration of minor bodies with spaceborne VIS/IR spectrometers. The talk included a review and prospects. These bodies have encapsulated materials whose physical characteristics may tell us a great deal about the history of our solar system and its evolution. They are best studied with visible and IR spectrometers brought to close vicinity as in a fly-by or an orbiting mission, or on-site.

The second and equally fascinating talk was delivered by Dr. Jörn Helbert, from the Deutsches Zentrum für Luft- und Raumfahrt (Germany), and coworkers from a number of collaborating European and United States institutions: INAF - IASF Roma (Italy), Japan Aerospace Exploration Agency (Japan), Laboratoire d'Astrophysique de Marseille (France), and Johns Hopkins University Applied Physics Laboratory (United States). The audience was treated to the presentation about mapping the Trojan asteroids in the thermal IR with TROTIS.

Determination of the material composition of a celestial object from the orbit using remote sensing techniques is challenging because of the calibration difficulties. When we were characterizing the Earth surface from Space, we always had the option of performing "ground-truth" measurement or corroboration. Then we learned to calibrate on a region of Earth with particularly attractive reflectance feature, and finally we ask the Moon to cooperate in serving as a faithful reference standard. It is more difficult to assure ourselves of real, verifiable composition of nearby hot planets, such as Mercury, or one bathing in sulfuric acid such as beautiful, deceptive Venus. On behalf of the team from the Deutsches Zentrum für Luft- und Raumfahrt (Germany), Dr. Alessandro Maturilli prepared a report on the work during the last ten years of building the planetary spectroscopy laboratory, featuring the ever wider spectral range and sample-temperature ranges.

The session was rounded off with a talk about the progress of the search for the extra-solar system planets using rotational shearing interferometry.

The second part of the session on the planets and minor bodies included five presentations. The first talk was authored by Dr. Jörn Helbert, from the Deutsches Zentrum für Luft- und Raumfahrt (Germany), and colleagues from other European and U.S. research centers: Mount Holyoke College, Jet Propulsion Laboratory, and Southwest Research Institute; Laboratoire d'Etudes Spatiales et d'Instrumentation en Astrophysique, and Laboratoire Atmosphères, Milieux, Observations Spatiales, both in France; and Università degli Studi di Pavia in Italy. Specifically, they reported on the status of the Venus Emissivity Mapper (VEM) and its successes in obtaining global mineralogy of Venus from the orbit.

Dr. Alexey Shakun, from the Space Research Institute (Russian Federation), prepared the second talk on the Atmospheric Chemistry Suite (ACS), as a part of Russian contribution to ExoMars Trace Gas Orbiter (TGO) ESA - Roscosmos mission. ACS includes three separate IR spectrometers (MIR, NIR and TIRVIM). In March 2018, the satellite achieved the nominal science orbit, leading to the first results of TIR VIM

instruments, to provide early performance assessment and initial on-orbit calibration. Researchers participated from Deutsches Zentrum für Luft- und Raumfahrt in Germany and Space Research Institute in the Russian Federation.

The next three talks were dedicated to the MERTIS instruments, forming part of the Bepi-Colombo probe toward the planet Mercury. The Bepi-Colombo mission is jointly coordinated by the European Space Agency, also known as the ESA, and the Japan Aerospace Exploration Agency, also known as JAXA. The Euro-Japanese mission to the planet Mercury is scheduled for liftoff 19 October 2018, keeping the German team very busy and preoccupied with the last-minute preparations. The team has been reporting on the preparation of this instrument for the past 6 years in our conference. We wish them all the best!

The scientists from the Deutsches Zentrum für Luft- und Raumfahrt (Germany) reported on the activities to provide global maps of planet Mercury, along with details of surface mineral composition and temperature distribution. Dr. Alessandro Maturilli, in coordination with Wilhelms-Universität Münster (Germany), organized the next presentation, "The operations plan for the Mercury radiometer and thermal IR imaging spectrometer (MERTIS) on its way to Mercury."

This was followed with a presentation on data processing of the Mercury radiometer and thermal IR imaging spectrometer (MERTIS) on board Bepi-Colombo. Dr. Mario D'Amore was the first author, while the team included the scientists and engineers from Deutsches Zentrum für Luft- und Raumfahrt (Germany), Ingenieurbüro Bernd Ulmer (Germany), and Westfälische Wilhelms-Universität in Münster (Germany), and Space Astronomy Center (Spain).

Dr. Denis Belyaev, from the Space Research Institute (Russian Federation), prepared the last presentation in this memorable session. The paper is titled, "Acousto-optic infrared imaging spectrometer for close-up sensing of planetary surfaces" [10765-17]. The collaborators include scientists and engineers from National University of Science and Technology "MISiS" (Russian Federation), Space Research Institute (Russian Federation), M.V. Lomonosov Moscow State University (Russian Federation), and AdlOptica Optical Systems GmbH (Germany).

This session was considered so important that Dr. Ford Burkhart wrote a report on it in *Optics.org*, the daily news for optics and photonics (http://optics.org/news/9/8/33). We join *Optics.org* in congratulating the dedicated MERTIS project members on their successes. The authors, participants, and the chairs appreciate the good words about the conference!

Session 5, Enabling Technologies, Simulations, and Data Processing, included several presentations. Dr. Sarath D. Gunapala from the Caltech-Jet Propulsion Laboratory in United States chaired it.

The title of the first talk was "Optical and electrical measurements of T2SL mid-wave and long-wave infrared focal plane arrays" [10765-18]. Ms. Alisha Vira from the

Smith College (United States) presented it. Her co-authors come from Harvard University (United States) and Smithsonian Astrophysical Observatory (United States). To increase the exposure time to 1 second when photographing the solar corona during the solar eclipse, a closed-loop system is proposed using a proportional-integral-derivative (PID) controller and an image cross-correlation algorithm.

Mr. Ricardo Gonzalez-Romero, from the Universidad de Guadalajara (Mexico) with co-authors from several research institutions in Mexico, discussed the model development, describing the shock-wave pressure decay in aluminum. A laser shock wave is a pressure wave in a gigapascal range propagating at speeds above the speed of sound in a medium, induced in this particular case by a high power-density laser pulse. It lasts on the order of magnitude of nanoseconds. The authors employ finite element method for the solution of shock wave propagation problems. They demonstrate a non-linear relationship between the material thickness and the shock wave amplitude that decreases with slab thickness. The authors report that they can estimate the material thickness by obtaining the attenuation ratio of the shock wave pressures.

The third presentation in the session, "Infrared simulation and implementation of virtual ocean scene" [10765-20], was delivered by Ms. Xueqi Chen, from Nanjing University of Science and Technology (China) with co-authors from the Criminal Police Headquarters of Jiangsu Provincial Security Bureau (China). The authors built a 3D ocean surface model based on P-M wave spectrum. They used LOWTRAN 7 to calculate solar irradiance and sky background radiance. Then they used thermal radiation theory to calculate the thermal radiation of the ocean itself and used bidirectional reflectance distribution function to calculate the reflection of the solar radiation from the ocean surface, and the sky background radiance. Integrating all the above radiation components, they generated the ocean background IR simulation image.

Dr. David I. Serrano-García and colleagues from the Universidad of Guadalajara (Mexico) presented a talk with a title, "Retardance polarization measurement on a dual rotating polarizer arrangement" [10765-23]. With the knowledge of polarization parameters, the polarimetry data is easier to interpret in analyzing the remote sensing data.

Dr. Sven Höfling of Julius-Maximilians-Universität (Germany), chaired the session on Mid-Infrared Devices for Sensing.

Dr. Krzysztof Ryczko and colleague from the Wroclaw University of Science and Technology (Poland) presented a talk on optimization of the active region of interband cascade lasers (ICLs) emitting in the MIR. ICLs are efficient MIR semiconductor light sources, based typically on InAs and GaInSb materials. The authors elaborate on the $k \cdot p$ theory to propose fully strain-free ICL devices, significant extension of the emission spectral range, polarization independent gain in the MIR and/or enhanced sensitivity to radiative processes.

Dr. Andreas Pfenning, from Julius-Maximilians-Universität (Germany), with co-authors from the same university and nanoplus Nanosystems and Technologies GmbH (Germany), delivered the final talk on MIR detectors based on resonant tunneling diodes and interband cascade structures. Among the most important applications of the mid IR radiation sources and detectors are sensing of gases and molecules, employed in diverse environmental, industrial and medical fields. The authors discussed two promising and novel GaSb/InAs-based detector concepts tailored to meet such needs.

Special thanks are extended to the SPIE staff for providing friendly guidance and organizational support to meet all the deadlines. Organizing a technical conference and publishing the Proceedings involves hard work of a team of dedicated and knowledgeable people without whose discrete advice to the chairs our conference would hardly be such a sound success! We thank them for their efficient assistance, patience, and constant support.

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