THE OFFICIAL NEWSLETTER OF THE ISPRS STUDENT CONSORTIUM

SPECTRUM

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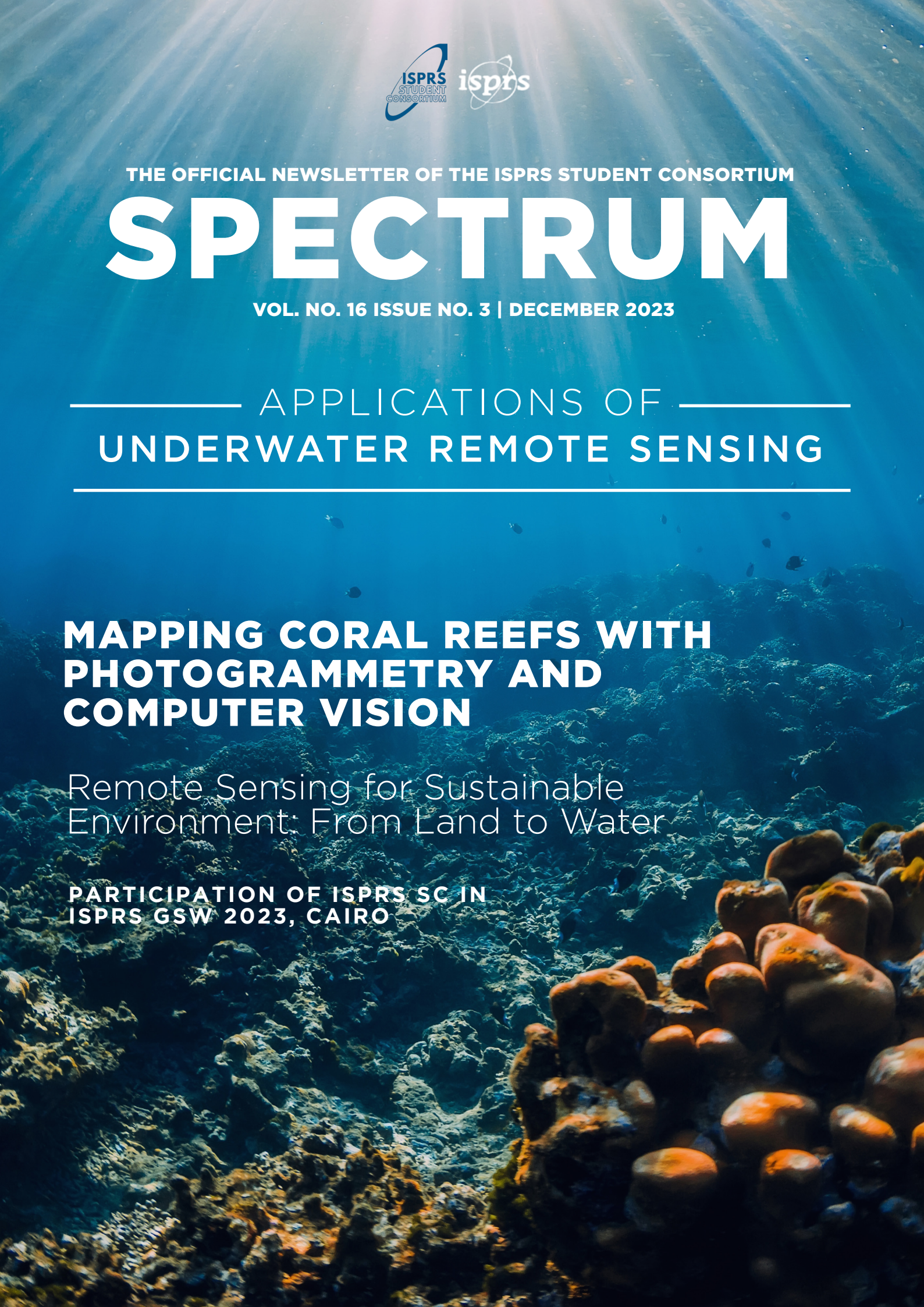
APPLICATIONS OF UNDERWATER REMOTE SENSING

MAPPING CORAL REEFS WITH PHOTOGRAMMETRY AND COMPUTER VISION

Remote Sensing for Sustainable Environment: From Land to Water

PARTICIPATION OF ISPRS SC IN ISPRS GSW 2023, CAIRO



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Have a passion for design, layout, and infographic? Be one of the volunteers of our CREATIVE DESIGN TEAM and help us in telling stories through pictures and images.

Take the opportunity to work with the international array of experts at ISPRS SC to bring the latest stories and developments in the field of Remote Sensing, Geomatics, and Photogrammetry.

If you are interested, please email us at **sc.isprs@gmail.com.** We look forward to hearing from you.

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Hi there!

On behalf of the ISPRS SC Board of Directors, I would like to thank you for taking the time to read the current issue of our newsletter. We sincerely appreciate your support!

The theme of this issue is **Applications of Underwater Remote Sensing**. According to National Geographic and the National Oceanography Centre, more than 80% of our oceans remain unexplored and roughly 25% of the ocean floors have been mapped. As a fellow mapping professional and enthusiast, I hope you were as excited as I was when you discovered that information! This presents us with numerous opportunities to put our skills to the test and challenges to develop novel techniques that could usher in a new era of mapping and provide solutions to problems for our colleagues in other disciplines.

So Kindly dive into the wonderful contribution of worldwide respected scientists in the field of underwater Remote Sensing. We have Dr. Dimitrios Skarlatos, Dr. Emad Khalil and Dr. Gottfried Madlburger in the IFOV Section and Dr. Devis Tuia in the spotlight section in the newsletter.

Lastly, I would like to convey my heartfelt gratitude to everyone who contributed to making this newsletter possible!

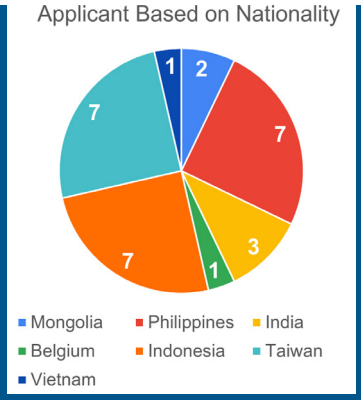
MIGUEL LUIS R. LAGAHIT
Social Media Coordinator, ISPRS SC

Report on the International Society for Photogrammetry and Remote Sensing (ISPRS) Student Consortium Summer School 2023 Taiwan

Remote Sensing for Sustainable Environment: From Land to Water

Chi-Kuei Wang, Chao-Hung Lin, and Jiann-Yeou Rau
National Cheng Kung University, Taiwan

Arrival of Summer School participants from ACRS venue in Tainan



The ISPRS Student Consortium Summer School 2023 was hosted by National Cheng Kung University, Taiwan from November 3rd to 8th, 2023. This summer school was themed "Remote Sensing for Sustainable Environment: From Land to Water". A total of 28 of students with nationality of Taiwan, Philippines, Indonesian, India, Mongolia, and Belgium. 23 students have completed the summer school.

This five-days summer school covered several lectures, hands-on training, mobile lidar scanning (MLS) Live Demonstration, social activities, and museum and city tour. Through those scheduled activities, ISPRS Summer School has fulfilled its purpose to link young researchers/students from different countries who are interested in photogrammetry, remote sensing, and spatial information sciences. This summer school also becomes an engaging and friendly platform for them to get wider networking and collaboration as well as worthwhile scientific discussion. The lectures covered various interesting fields of Remote Sensing such as Sustainable Agriculture, Sustainable Urban, Sustainable Terrestrial, Sustainable Water, Sustainable Plant, and Sustainable Building which were divided into 14 sessions. Furthermore, this summer school also consists of hands-on training including LiDAR and SAR data processing through open-source software (SNAP, CloudCompare), open-source programming language (python programming language), and commercial software (Aura).

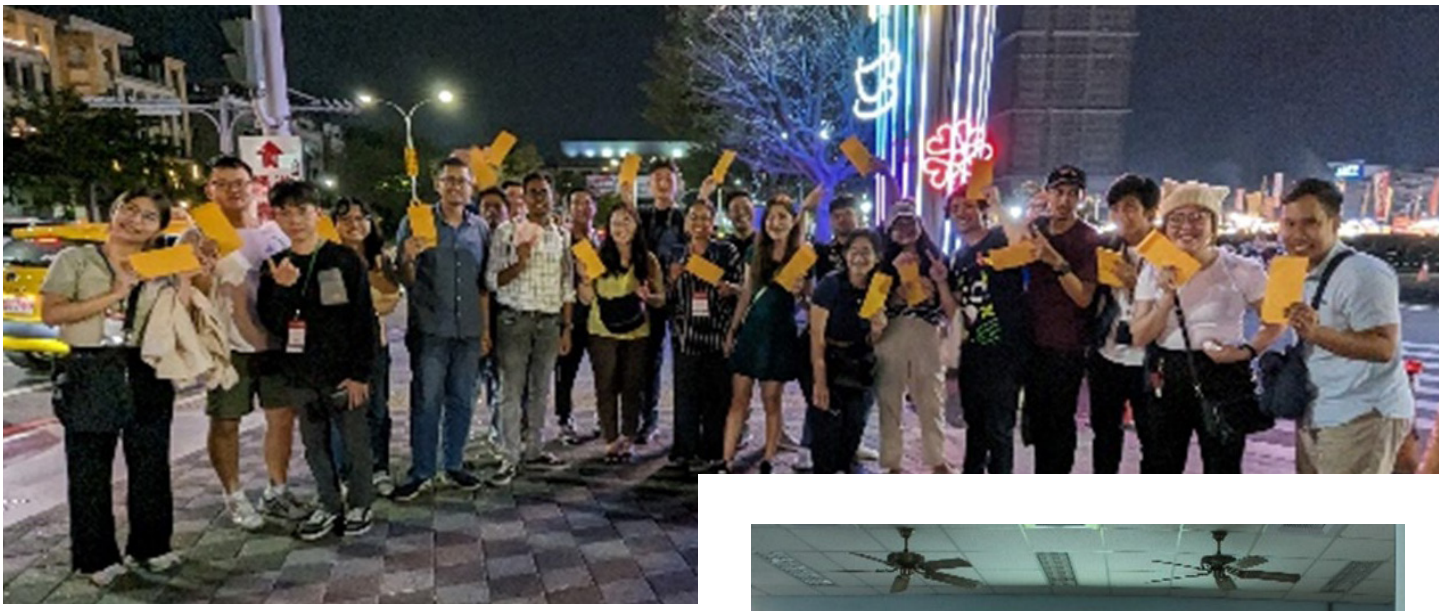
One day before the summer school began, the participants were picked-up from the Asian Conference on Remote Sensing (ACRS) 2023, Taipei by bus. The following day, the summer

Opening Ceremony

school was opened by Prof. Chi-Kuei Wang where he shared the information about the summer school and introduced the first and second speakers, Mr. An-Te Huang from The Climate Corporation, USA and Prof. Ruisheng Wang from University of Calgary, Canada. Then, the summer school continued with the speech from the ISPRS Student Consortium representative, Miguel Luis R. Lagahit who shared about The ISPRS Student Consortium.

The first lecture was started by Mr. An-Te Huang who gave a lecture titled "Sustainable Agriculture: LiDAR-Derived Crop Features". He gave the lecture in two sessions. His lecture sessions included LiDAR data processing to derive crop feature using python programming language. In the first session, he gave an introduction of the library used for LiDAR data processing in python. After the coffee break, he continued the lecture in deriving the crop features based on LiDAR data using python. After lunch, the lecture was continued by the second speakers, Prof. Ruisheng Wang who gave a lecture titled "Sustainable Urban: Aerial LiDAR and Image for Urban". In his lectures, he covered the topics of traditional urban mapping, introduction to 2D and 3D deep learning, and shared his research experience about Building3D dataset & benchmarks which can give the students more insight about the usage of LiDAR and Image for Urban mapping. After the sessions ended, the participants joined the buffet dinner and ice breaking party at night to get to know each other.

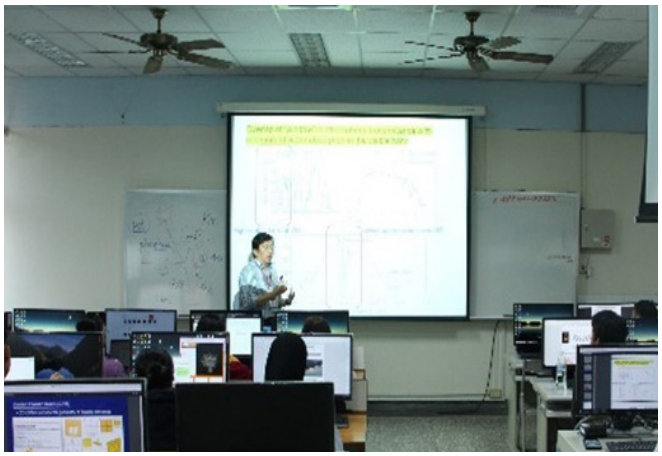
The second day was lectured by Assoc. Prof. Shih-Yuan Lin from National Chengchi University, Taipei. His lecture was about "Sustainable Terrestrial: SAR Theory and Practice". In the morning sessions, he gave a lecture about the theory of Synthetic Aperture Radar (SAR) and his experience in SAR data processing. Then, the lecture was continued by hands-on practice on SAR data processing using SNAP software after lunch. In this session, students learned about how to download SAR data (Sentinel-1) from one of SAR data sources (Copernicus Data Space Ecosystem) and how to open the data using SNAP software. Besides, the students also learned about how to generate DEM from SAR data and detecting an earthquake event using DInSAR (Case 2018 Hualien Earthquake). The second day was closed with the night market tour. In the night market, the students were introduced to the Taiwan local foods and games.



Second Day Night Market Visit

by Assoc. Prof. Chih-Hua Chang from National Cheng Kung University. In the first session, the lecture consisted of several topics such as the fundamental of interaction of light and matter, introduction to Inherent Optical Properties (IOPs) and their measurement, and biogeochemical proxies & bio-optical models. In the second session, he continued explaining about radiometry and Apparent Optical Properties (AOPs), and introduction of ocean color inversion techniques which finished at lunch time. After lunch, the participants went to Chimei Museum visit by train. The students were very excited to see the museum collection. The students also had an opportunity to watch a digital orchestra which made

Fourth Day Lectures and Tainan Old Town Visit



them more excited. In order to finish the day, the students had hotpot dinner.

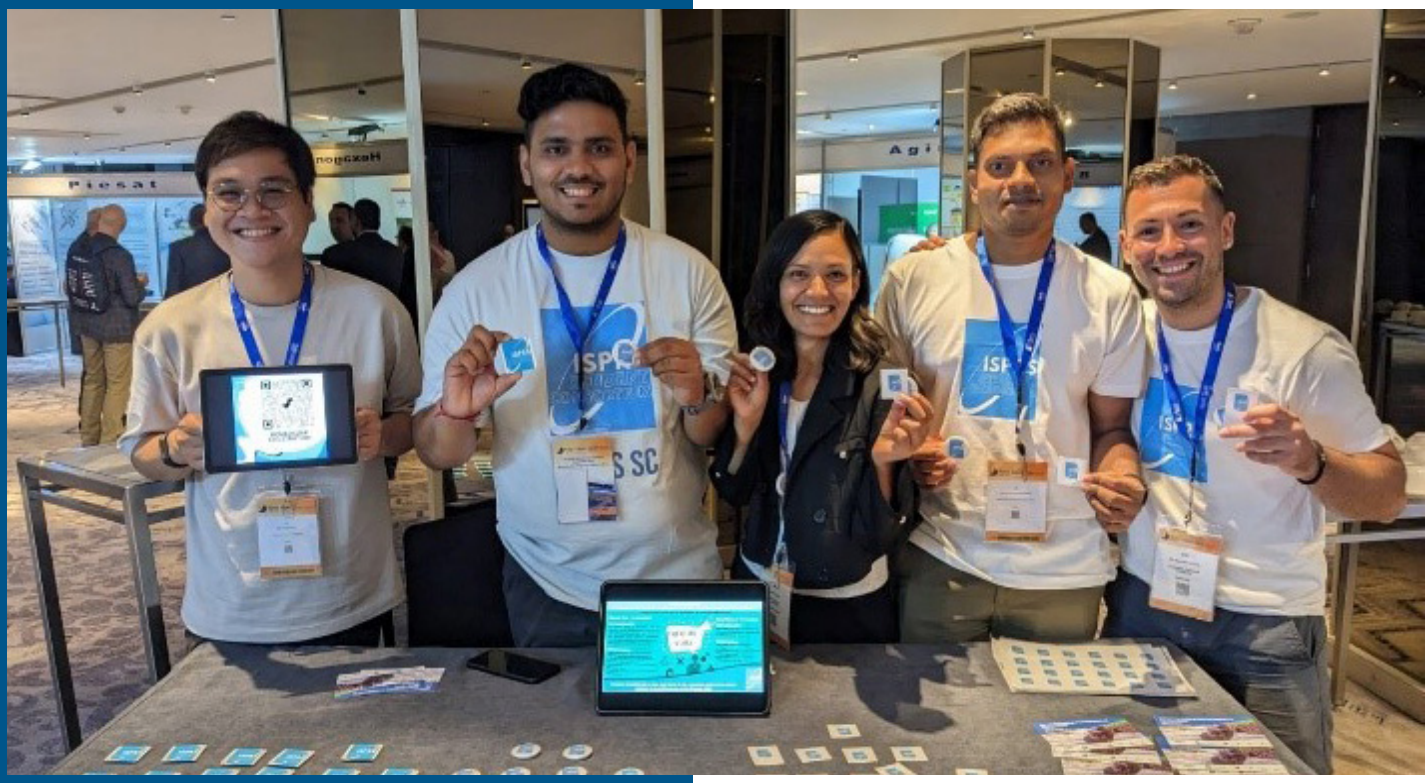
The following day started with the lecture by Prof. Cho-Ying Huang from National Taiwan University titled "Sustainable Plant: Sun-Induced Chlorophyll Fluorescence". Firstly, he introduced vegetation indices such as Normalized Difference Vegetation Index (NDVI), orthogonal-based indices, Soil Adjusted Vegetation Index (SAVI), Enhanced Vegetation Index (EVI). Here, he explained the process to get each vegetation index and gave a very attractive lecture. After that, he explained the main topic which is Solar-Induced Chlorophyll Fluorescence (SIF) and shared his experience about it. After lunch, the students had another tour to the National Museum of Taiwan Literature, Tainan Judicial Museum, and Tainan Old Town. In the National Museum of Taiwan Literature, the students had an explanation about the growth of literature in Taiwan, especially Tainan. In the Tainan Judicial Museum, the students learned more about the history of law in Tainan and the history of the building itself.

In the final day, there is a live demonstration using Backpack Mobile Laser Scanning (MLS). The lecture was given by Mr. Hsuan-Sheng Lin from

Zhong Han Technology titled “Sustainable Building: Backpack MLS Live Demonstration”. In the first session, he gave an introduction about the Mobile Laser Scanning technology. Then, after coffee break was the live demonstration of Backpack MLS. The students were very excited to join the demonstration to try the instrument. After that, some students had an opportunity to carry the backpack to do the measurements. The lecture continued with data processing, the speaker demonstrated the point cloud data visualization using commercial software (Aura) and open-source software (CloudCompare). Furthermore, all participants were encouraged to share their experiences of the summer school and the certificates were given to them. Overall, the summer school was a great success.

Finally, we would like to express our deepest gratitude to Mr. An-Te Huang, Prof. Ruisheng Wang, Assoc. Prof. Shih-Yuan Lin, Assoc. Prof. Chih-Hua Chang, Prof. Cho-Ying Huang, and Mr. Hsuan-Sheng Lin. We would also like to thank all participants who made this summer school a success. Moreover, we would like to convey our utmost gratitude to all the sponsors who have contributed to this event, namely ISPRS Student Consortium, Ministry of Interior (MOI) Taiwan, College of Engineering NCKU, Department of Geomatics NCKU, and National Land Surveying and Mapping Center (NLSC) Taiwan.

Closing Ceremony



ISPRS SC Current BODs in front of their booth (from left to right: Miguel, Yogender, Laxmi, Sunni, and Nick; BOD member Chukwuma John Okolie is missing in the picture)

Participation of ISPRS SC in ISPRS GSW 2023, Cairo

ISPRS Geospatial Week 2023 in Cairo was a memorable experience for the ISPRS SC Board of Directors (BODs) team. We, the ISPRS SC BODs, were finally able to meet in person for the first time after more than 2 years working together remotely.

During the conference, the ISPRS SC has been very busy at work all days. We are thankful to the local organizing committe for offering a free booth in a very tactical high-traffic area where we displayed our services, our gadgets (people loved our pins and we ran out of our magnets in three days!) and stood by for conference attendees to come to get to know us. In fact, lots of people stopped by our booth to have a chat with us. We leveraged this by registering almost 40 new student members and proactively started some talks toward important future collaborations, especially in the arab and african regions. Student Chapters were a hot topic during GSW Cairo; students, scientists and professors from different universities and institutions visited our booth and were particularly akin to starting student chapters locally and we are looking forward to collaborating with them. We also introduced Discord, our very new comminication and discussion channel to connect students with us and experts in the area of photogrammetry, remote sensing and geographical information systems. Additionally, we organized a youth presentation forum where students and their representatives presented about their research. We also discussed about how ISPRS SC is working and how students or young professionals can get involved in our activities.

Capturing a moment with Prof. Brovelli at her visit to ISPRS SC booth

Capturing a moment during ISPRS SC Youth Presentation Forum. visit to ISPRS SC booth

We were also encouraged by some members to get in contact with the General Authority for Survey and Geospatial Information of the Kingdom of Saudi Arabia. Also, we strengthen our relationships with Dr. Abdalla Alobeid, Vice Regional Representative of the Arab Countries and Dr. Andre Nonguierma, Regional Representative of Africa. Both figures expressed their willingness to collaborate more closely to enhance student activities in our fields in the African and Arabic regions, which aligns well with our goal of expanding student chapters into those less represented areas.

The president and vice president of ISPRS SC also attended ISPRS Council meeting where they could gain first-handed insights on how our society is led. They also presented about the activites ISPRS SC did for the past one year and its plan for future activities. Also, we had a very informative meeting with ISPRS Vice President Nicolas Paparoditis and Treasurer Stewart Walker, where we could discuss some important points about our future funding and organisation. Moreover, we had a fruitful meeting with Prof. Maria Antonia Brovelli, Vice President of ISPRS TCIV who introduced us to AI for Good, a continuous digital platform that brings together AI innovators and problem owners to collaborate, learn, and create practical AI solutions in support of the United Nations Sustainable Development Goals. Following our meeting, we intend to shape our future activities in a way to integrate with AI for Good objectives.

ISPRS Council, including President Lena Halounová and Secretary Jiang Jie and some of the most eminent people inside our society such as Prof. Armin Gruen, President of White Elephant Club visited our booth. We are sincerely very grateful to the support that the ISPRS Foundation and the TIF provided us for this incredible opportunity. Thank you!

In summary, GSW 2023 Cairo has been an amazing opportunity for getting to know each other and to connect with the audience we serve, the students.

Some members of ISPRS SC BODs with ISPRS Council

MAPPING CORAL REEFS WITH PHOTOGRAMMETRY AND COMPUTER VISION

By Devis Tuia, Ecole Polytechnique Fédérale de Lausanne

Figure 1. The Seven Brothers Islands during our mapping expedition (Photo by Lukasz Warzecha ©LWimages)

15 November, 2023, 5h45 AM. The sun rises over the Seven Brothers Islands in the Bab el-Mandeb strait in Djibouti, which marks the entrance of the Indian Ocean in the Red Sea. We are several hours of navigation from the closest town to document and map corals at the entrance of the Red Sea. But why are we here?

Because coral ecosystems are under threat. Despite them hosting almost one third of all marine biodiversity and providing important ecosystem services for humanity, factors like water temperature increase, ocean acidification and human activities are putting corals under heavy stress, which make them bleach and eventually die. Almost half of the corals of the world has died already, and without decisive actions the trend will continue.

But for such action to take place, we need evidence of such degradation and also to know what we have and what could still be lost. This is why at EPFL we have established the Transnational Red Sea Center, a cluster of researchers from different backgrounds who joined forces to monitor, analyze and understand the state and future of corals. The TRSC focuses on the Red Sea, an unique ecosystem where corals have shown unexpected resistance to

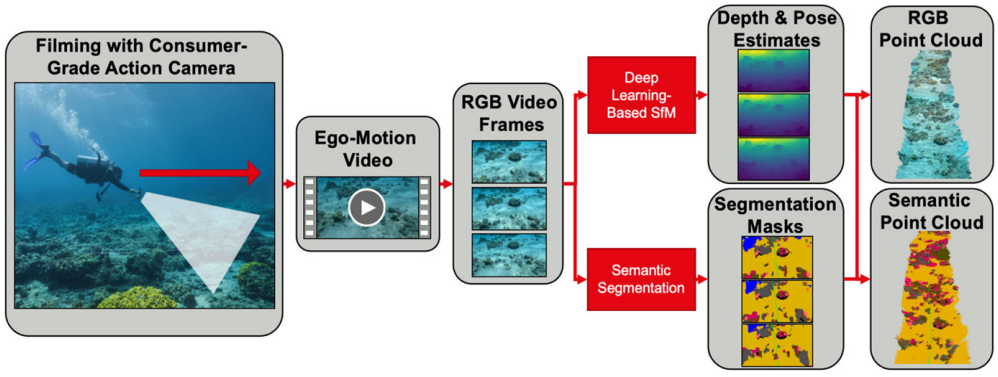


Figure 3: learning-based SfM for coral mapping. From Sauder et al., in press (4)

heat(1,2). In the Red Sea, corals can sustain increased temperatures of 4-5 degrees, which is much more than the average resistance of reefs worldwide: for example, in the Great Barrier Reef bleaching happens with increases as little as 1.5°C(3).

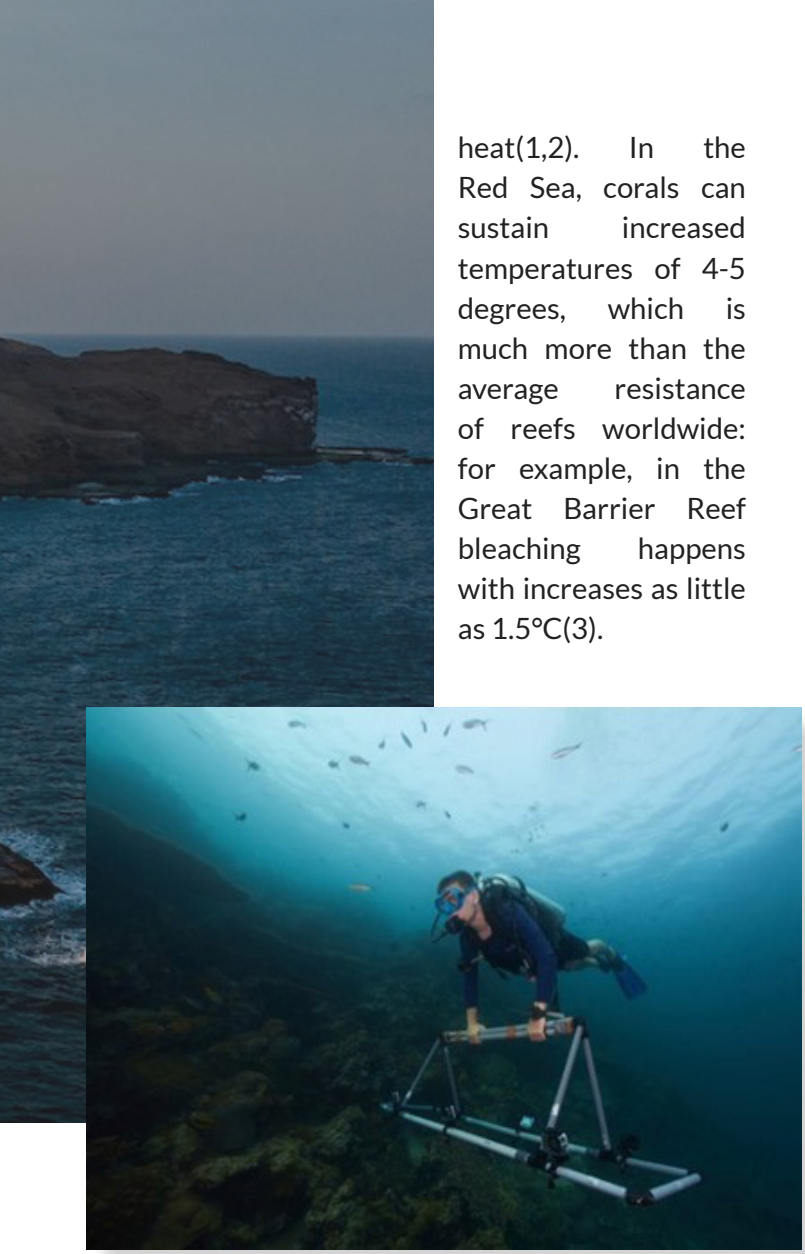


Figure 2: the camera system developed at EPFL. Photo by Guilhem Banc-Prandi, 2022.

In this interdisciplinary team, my group is in charge of the mapping effort. We decided for a close sensing approach, where we film the reef at a distance of a meter or two, while scuba diving. We have developed a camera system for computer vision which involves six consumer grade cameras mounted on a rig (Fig. 2). With these cameras we can acquire video transects of the corals we observe and construct 3D models of the reef.

Using the data acquired over our missions (we visited several sites across the Red Sea since 2022), we developed a deep learning model aiming at joint 3D reconstruction and mapping(4). Our model is composed of two learning heads, the first focused at the 3D reconstruction and the second at the semantic segmentation of every pixel reprojected in the 3D model (Fig 3).

Specifically, the first head performs learning-based structure from motion, which aims at joint pose and depth estimation of the video frames. To do so, we use a self-supervised objective that allows us to locate the camera underwater. When we know the depths and where the camera is, we can project pixels from each frame into the 3D model. Concurrently, the second head performs semantic segmentation of the exact same frames, so that we retrieve objects that are not part of the reef (which we do not reproject in the 3D model), while at the same time inferring precious information about the reef composition in terms of benthic classes. This second head is supervised, and the labels were created thanks to the efforts of our team of marine biologists, data scientists and talented EPFL students over summer projects.

But our efforts are not only about the mapping itself, we also provide trainings to build capacity locally. We work hand in hand with local experts from Djibouti and the neighboring countries; after each mission we introduce local students to the concepts of data acquisition, as well as to the marine biology of the region. This way, we build capacity in the countries who will endorse the protection of their reefs. Only working hand in hand with local communities we have a chance to protect sustainably the last standing coral ecosystems, in Djibouti and everywhere in the world.

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Photogrammetry, underwater 3D reconstruction, drones and aerial mapping, optical bathymetry, with focus to cultural heritage.

Dimitrios Skarlatos, is Professor in the department of Civil Engineering and Geomatics in Cyprus University of Technology, currently he serves as the Vice Dean of the Faculty of Engineering and Technology. He holds a Dipl. Eng. in Rural Surveying from National Technical University of Athens (NTUA), M.Sc. with distinction from University College London (UCL) and a Ph.D. from NTUA in digital photogrammetry. During his studies, he earned several scholarships and awards. Currently, he is the academic representative of Cyprus in EuroSDR (since 2010), co-chair in International Society of Photogrammetry and Remote Sensing, Commission II (2016-2026), Working Group 7, about underwater photogrammetry and co-Chair of the Commission of Technologies for Cultural Heritage Geometric Documentation in the Executive Board of CIPA (under ICOMOS & ISPRS) for the period 2024-2028.

For 12 years he worked as free-lance land surveyor in Greece, court expert and technical consultant in geoinformation companies in nationwide projects. During that period, he participated in research and innovation projects (3 European and 5 national) for archaeological site and monument recording, copies of museum exhibits, real time quality control applications using machine vision, AUAVs for mapping.

During his post in CUT, he has participated or coordinated several research projects most important of which, Parthenon frieze precise 3d modelling (Digitizing Parthenon Frieze 2010-2014), developing a low cost mobile mapping platform (CUT starting grant and MOBILO, 2018-2020) and he was coordinator of iMareCulture (2016-2020), a H2020 research and innovation grant, for underwater XR museums. He is the lead surveyor in Mazotos shipwreck, underwater excavation, since 2010, Nisia excavation since 2014 and Protaras shipwreck since 2019.

His main research interests focus on the acquisition and processing of 3D data and point clouds using image sequences. This includes underwater, UAV or close-range photos. His general interests include cultural heritage applications, two-media photogrammetry, aerial, terrestrial and underwater photogrammetry.

Can you briefly tell us about your research interests?

My research interests were focused on photogrammetry and dense point acquisition, when photogrammetry was the only science that could gather dense points to describe a 3D shape. Nowadays, with SfM-MVS and laser scanner technology this task seems trivial, but it wasn't like that during 1990s. Having said that it is also a matter of circumstances where you finally end up in your scientific and professional life. So, early on I focused on aerial mapping with radio-controlled helicopters and film cameras and many years after that in underwater photogrammetry. My interests are still in dense point cloud acquisition technologies and methodologies, despite the acquisition platform and environmental restrictions.

Who or what inspired you to become a scientist in this research field?

I was fascinated by photogrammetry when observed an aerial stereoscopic pair in a digital stereoplotter. Apart from the ability to observe earth's surface using 3D vision, it became apparent that this was the only way to collect dense enough 3D data to describe 3D shapes. The ability to take photos and then process them to create a 3D model was very challenging for me, almost as a modern 3D game. Of course, I was lucky enough to have a charismatic mentor during my studies, who encouraged me on to the subject.

Among the research projects you have conducted, can you share with us a specific project that you liked the most?

When I was first invited in Mazotos's classical era shipwreck excavation, to undertake the task of the underwater photogrammetry in 2010 , photogrammetric 3D acquisition was still performed with expensive stereoplotters using photo stereo pairs. The challenge attracted me in what proved to be a very long adventure.

Just like any other archaeological excavation in land, before removing any find from the site, the exact position of it must be recorded in 3D space. When considering the limitations of the underwater environment, in terms of time and equipment that can be used, it becomes apparent that photogrammetry is the only affordable option for 3D data acquisition.

The task was simple: "Verify that the photos that divers have taken from the trench are good enough to describe the position of each amphora before we remove it. We will not remove anything until you tell us it is safe to do so.". Given that the amphorae were stacked one upon the other, that meant that the excavation was halted until the photogrammetrist says it is OK to proceed. Considering the daily cost of an underwater excavation, the stress is apparent. The photos divers were taking, did not follow the aerial pattern with strict distances, and overlaps. To put it into context, back then photogrammetry was still performed using stereo pairs in expensive stereo plotters. Performing a full bundle adjustment in an unstructured data set of 50-60 photos in a daily basis was impossible, which translated in great delays and costs. Applying SfM-MVS for the first time in an underwater archaeological excavation has revolutionized the way the team was functioning and overall quality of documentation .

Mazotos shipwreck proved to be a very challenging and rewarding project for me. The ability to fully describe the site with a dense point cloud and reconstruct a detailed 3D textured model, revealed the opportunity to bring underwater sites to public using VR . That was realised with iMARECULTURE , a H2020 research any innovation project funding. iMARECULTURE also included AR using an underwater tablet , which could provide information to visitor divers . Such devices are now used in many underwater CH sites for visitors or researchers.

What is the importance of underwater remote sensing?

There are several flavours of underwater remote sensing other than 3D reconstruction. Oil and gas industry, biology and archaeology are the most profound applications of underwater remote sensing. Divers are instructed not to intervene and not to touch life and objects in the underwater environment, whether they are reefs or cultural heritage sites. In that context remote sensing becomes the only methodology for recording and documenting such sites.

How have the technologies helped in faster and reliable data acquisition?

Technologies have involved immensely during the last two decades. For example, underwater photography was a niche until the advent of small underwater action cameras. Underwater laser scanners have also evolved, shrunk in size and their prices have dropped, to become an alternative to underwater photogrammetry. Acoustic positioning using ultra short baselines (USBL) has become more affordable, while smaller remotely operated vehicles are able to use such technology. Overall, the technology of remotely operated underwater vehicles emerges as an alternative to diver 'platform', for 3D data acquisition. Such vehicles may now be equipped with acoustic and lidar scanners, which in addition with precise positioning will be able to perform complex 3D data acquisition projects.

What do you consider your greatest achievement? Can you tell us a challenge that you faced in your career, how you overcame it and what you learnt from the experience?

When I got involved in Mazotos excavation, which is happening at a depth of 45 m, I had no experience of underwater environment. Instructions to divers on how to take proper photogrammetric photos, failed. So, the challenge was for me to be trained as a technical diver to visit the site, understand the limitations and challenges to perform data acquisition first hand. That would have been the only way to modify methodologies, develop acquisition protocols and convey proper instructions two other fellow diver photographers in order to bring proper photogrammetric data on board, on daily basis.

What can you say about the current trends in scientific research related to efficient use of underwater remote sensing in various applications?

Machine learning is infiltrating all fields of RS, and underwater RS is no exception. Monitoring coastal sites using aerial platforms or satellite images is becoming critical in terms of environmental and financial aspects. Using remote sensing to monitor pollution, automatically detect changes in sea vegetation and algae or bathymetry , is a very active research field.

In biology and archaeology applications colour information is important, therefore restoring colour information in underwater photos will attract attention. Machine learning using hybrid models, might prove a valid alternative to physical models, which require data from many sensors.

Technological improvements in remotely operated underwater vehicles or even autonomous vehicles will revolutionise data acquisition in many applications. Techniques for autonomous navigation and improvements in acoustic and lidar sensors are essential towards this aspect. Machine learning can be applied to reduce signal-to-noise ratio of several sensors (IMU , imaging, acoustic, etc) and perform autonomous navigation.

What do you think are the possible contributions of international organizations like the ISPRS Student Consortium in knowledge dissipation in underwater remote sensing?

In ISPRS WGII/7 about underwater data acquisition and processing we realise that there is a gap in dissemination over sea and underwater research, activities, and trends. Therefore, we're trying to organise a series of web lectures every four to six months provided by international experts and mentors. Where also trying to organise open group meetings with pitch presentations about several aspects of underwater remote sensing, the first one is planned for January 15th 2024.

What is your advice to the youth and how can one be motivated to pursue research in underwater remote sensing.

Out of the Earth's surface, 70% is covered by sea, which remains unexplored. Life emerged from sea and sea remains essential for human existence. Inevitably lot of resources will be allocated to sea, either through environmental or sustainable policies. If you like sea, then you already have an advantage over the rest of your peers. It is after all, a more adventurous environment than land and if you like challenging yourself, a true character builder.

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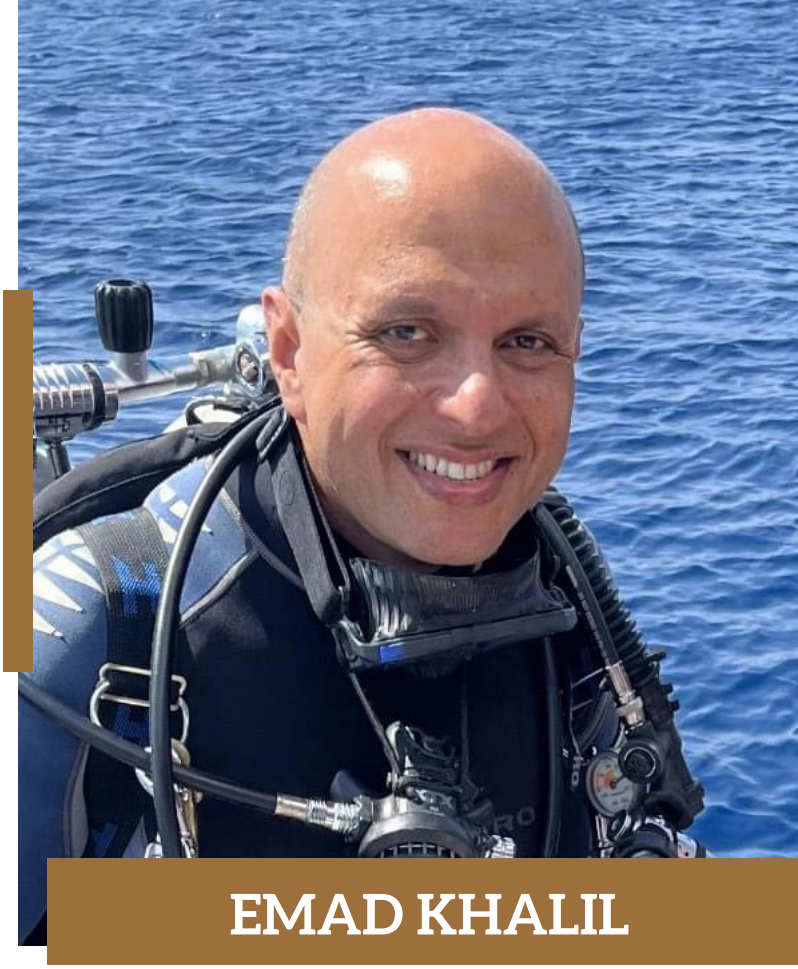

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Affiliation:
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Research Interests and Expertise:
Maritime Archaeology – Underwater Cultural Heritage – Maritime Ethnography – Museology – Education & Capacity Building

Professor Emad Khalil s a world-renowned expert in Underwater Cultural Heritage with over 25 years of experience in research and education. He has been involved in maritime and underwater archaeology since the early nineties. Since then, he has contributed to several projects in the field of maritime and underwater archaeology in both the Mediterranean and Red Seas. He is also well recognized for his contributions to capacity building in aspect of underwater cultural heritage in the Arab Region.

Professor Khalil is the President of the UNESCO Scientific and Technical Advisory Body for the 2001 Convention, and he is the holder of UNESCO Chair in Underwater Cultural Heritage.

He is a member and a former President of the ICOMOS International Committee for Underwater Cultural Heritage (ICUCH), and a member of the Scientific Committee of the Confédération Mondiale des Activités Subaquatiques (CMAS).

Can you briefly tell us about your research interests?

My research interests mainly focus on maritime and underwater cultural heritage. I am an archaeologist by training, specialized in maritime archaeology. For more than two decades I have been conducting underwater archaeological surveys and excavations focusing on Egypt. I am also interested in maritime ethnography and oral history.

Who or what inspired you to become a scientist in this research field?

I have been SCUBA diving since a very early age. Since I was 19, while diving in Alexandria, I often came across archaeological material including ancient amphorae and anchors. At that time, I had no idea what they were. But this made me very interested in underwater archaeology. I even started making maps of the sites I find. Accordingly, I have studied Greek and Roman archaeology at Alexandria University and did my MA and PhD in Maritime Archaeology at the University of Southampton, UK.

Among the research projects you have conducted, can you share with us a specific project that you liked the most?

The project I like the most, is the ongoing underwater survey project that I have been directing since 2015 at the site of Marsa Bagoush on the NW coast of Egypt . Marsa Bagoush is an ancient anchorage that has been in use as early as the Roman Period, and continued to be in use until WWII. The site is located 250km west of Alexandria, Egypt. So far, it is the largest natural anchorage that has been studied along the Egyptian Mediterranean coastline. The site contains plenty of archaeological material including a large collection of ancient anchors. During the research, satellite images were a primary source utilized to create georeferenced a map of the site. Moreover, the site was divided into a 100m X 100m grid utilizing GIS. Consequently a systematic visual survey was carried out for each square by diving teams. Archaeological finds discovered were recorded using photogrammetry techniques.

What are the importance underwater remote sensing?

Remote sensing techniques, including Side Scan and Multibeam Sonar systems, revolutionized underwater research. It enabled surveying large areas of the seabed, and accurate documentation of underwater cultural heritage finds. Moreover, satellite images have numerous uses including tracking changes in coastal geomorphology and its effect on coastal heritage sites. Photography and photogrammetry are essential documentation techniques for underwater sites. Furthermore, the use of GIS allows combining different types of data and facilitates the analysis and deducing conclusions.

How have the technologies developed and helped in faster and reliable data acquisition?

I remember very well working in an underwater excavation of a 18th century shipwreck in the Red Sea in the early 90s. At that time, it took a team of at least 20 divers almost nine months just to survey and documents less than half of the 50m-hull of the wreck, using photographs and measuring tapes. Twenty years later, I revisited the site with my colleagues from the Centre for Maritime Archaeology who were able to carry out a photogrammetry documentation of the entire sites in one dive. This is just an example on how technologies development helped in faster and reliable data acquisition. The same thing can be said about the early Side Scan Sonar systems, if compared to the highly developed Autonomous Underwater Vehicles (AUVs) that are used effectively in underwater archaeological projects.

What do you consider your greatest achievement? Can you tell us a challenge that you faced in your career, how you overcame it and what you learnt from the experience?

I believe that my greatest achievement is the creation of the Alexandria Centre for Maritime Archaeology and Underwater Cultural Heritage (CMAUCH) (www.cmauch.org). Following my return from the UK, after obtaining PhD, I decided to work on creating an academic and research facility, which could provide academic education, and professional training in aspects of maritime and underwater archaeology. However, I was faced with many logistical, financial and technical challenges. Yet, I was supported by the high management of Alexandria University at that time. Moreover, I was able to secure funding through the EU-Tempus program, and to get the technical support of a number of partners led by the University of Southampton. The project of creating the CMAUCH started in 2006, and the CMAUCH was officially inaugurated in 2009. Since then, it has developed significantly. Currently, it is internationally renowned and recognized by numerous institutions and organizations. At present, the CMAUCH hosts the UNESCO Chair for Underwater Cultural Heritage.

I believe that the main lesson learnt from the experience is the importance of passion and persistence in order to achieve any progress in any aspect of life. Passion drives our actions and fills us with a sense of purpose. On the other hand, persistence enables us to overcome obstacles and find solutions to problems. With passion and persistence almost, anything can be achieved.

What do you think are the possible contributions of international organizations like the ISPRS Student Consortium in knowledge dissipation in underwater remote sensing?

Underwater remote sensing is a tool that has significant influence on different aspects of underwater research, including underwater archaeology. One key aspect for disseminating knowledge in underwater remote sensing is training and capacity building. Hence, international organizations like the ISPRS Student Consortium can play a key role in that respect. Organizing training courses on different levels, and collaborating with scientific institution and research centers, which would enable the exchange of expertise in aspects of in underwater remote sensing, are amongst the main contributions that could contribute effectively in the development of that field.

What is your advice to the youth and how can one be motivated to pursue research in underwater remote sensing?

It is evident that there is a growing international interest in ocean sciences, which led the United Nations to proclaim a Decade of Ocean Science for Sustainable Development (2021-2030) to support efforts to gather ocean stakeholders worldwide behind a common framework. Underwater remote sensing is a major tool that is utilized on ocean sciences. Moreover, from a technical point of view, underwater remote sensing is constantly developing in order to find new solutions to different challenges facing scientists and researchers.

On the other hand, it is evident that the youth is the driving force for development; it is their passion that leads to innovation in all fields. Therefore, the are endless opportunities for the youth to contribute to the development of scientific research, including underwater remote sensing.

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GOTTFRIED MANDLBURGER

Full Name: Gottfried Mandlburger

Current Position - Associate Professor
Affiliation:
TU Wien, Department of Geodesy and Geoinformation

Research Interests and Expertise:
Photogrammetry, Optical bathymetry, Laser and photo bathymetry, Point cloud processing, Scientific software development.

Gottfried Mandlburger studied geodesy at TU Wien, where he also received his PhD in 2006 and habilitated in photogrammetry with a thesis on “Bathymetry from active and passive photogrammetry”. In November 2022 he was appointed Associate Professor.

His main research areas are airborne topographic and bathymetric LiDAR from manned and unmanned platforms, multimedia photogrammetry, bathymetry from multispectral images, and scientific software development. Gottfried Mandlburger is chair of the DGPF working group hydrography/bathymetry, a key member of ISPRS WG II/7 (Underwater Data Acquisition and Processing) and received best paper awards from ISPRS (2019) and ASPRS (2019) for publications on bathymetry from active and passive photogrammetry.

Can you briefly tell us about your research interests?

With a long experience in topographic airborne laser scanning, I did my PhD in the interdisciplinary field between photogrammetry and hydraulic engineering. Back then, the question was how to best fuse LiDAR data of the dry area and hydro-acoustic river cross section data to obtain an optimal geometric basis for flood simulations. At that time, bathymetric LiDAR had a rather coarse resolution and was predominantly used for mapping coastal areas. I dreamed of high-resolution laser bathymetry for mapping smaller inland waters like rivers and ponds. This longing became a reality around 2010, when so-called topo-bathymetric laser scanners entered the market and made high-resolution mapping of smaller water bodies, as we typically have it in Austria, feasible. I was intrigued by the new possibilities and, with my inherent interest in water, I completely switched my research focus to this direction.

Who or what inspired you to become a scientist in this research field?

One of my favorite hobbies is running and hiking. One of my standard trails is along a pre-Alpine gravel bed river next to where I live. This is close to the well-known Danube river in the eastern part of Austria. It is a riffle-pool type river, which means that sometimes the water flows gently and smooth forming deeper pools, followed by sequences with very shallow, fast flowing sections with rippled water surfaces. This tremendous variation of properties very much inspired me to do research in the direction of investigating the complex interaction of (laser) light with the water medium. Another inspiration was meeting outstanding scientists and experts from industry at various conferences and trade shows. Getting to know all the bathymetry celebrities in person – often in the course of social dinners or the late-night parties thereafter – even more inspired me to go into the bathymetry direction as my research focus.

Among the research projects you have conducted, can you share with us a specific project that you liked the most?

I have already briefly mentioned running or hiking along this pre-Alpine river, the Pielach river, in the eastern part of Austria. I started to investigate an approximately 6 km long section of this river with Airborne Laser Bathymetry in 2013. The studied section is a natural conservation area, allowing the river to develop a meandering river course with constant changes of the flow path in response to flood events. I was able to organize annual data acquisitions in this area over the last decade. In this period, a major and several minor flood events occurred with a high impact on the course of the river. Thus, one of the intriguing possibilities offered by this gap-free time series of high-resolution 3D point clouds of the entire alluvial area above and below the water surface was to do hydro-morphological analyses for monitoring fluvial changes. We also had a look into aquatic habitat mapping and monitoring together with scientist at the University of Life Science in Vienna using this excellent data basis. This research was published in 2015 (https://doi.org/10.3390/rs70506160). In a current paper for the year 2023 ISPRS GeoSpatial Week in Cairo (!!SHOULD BE PUBLISHED ANY DAY!!), we used the entire time series to highlight the progress in topo-bathymetric laser scanning over the last decade. However, we also did research on multimedia photogrammetry, with images from both crewed aircraft in this area of the Pielach river.

What is the importance underwater remote sensing?

For large area mapping, especially from the airborne perspective, optical remote sensing bridges the gap between the dry land and the shallow water area. Light is strongly absorbed in water so that the penetration depth is limited to around 50-60 m in very clear water, e.g., in the Caribbean Sea. Penetration depth further decreases due to turbidity, so that we can often measure only depths of 1-5 m in turbid waters. However, still this is an important addition to SONAR based hydrographic mapping, as shipborne techniques get less effective in shallow waters. In addition, it is even dangerous to operate surveying vessels in very shallow areas. That is where optical remote sensing methods have their specific strengths. However, optical techniques, both image and laser based, are also applied underwater. A prominent example is scuba diving for documentation of shipwrecks or coral reefs. Nowadays, underwater close range photogrammetry and laser scanning is also used for inspection purposes in the off-shore industry or for monitoring critical parts of hydropower plants.

How have the technologies developed and helped in faster and reliable data acquisition?

There are a several apparent trends in the recent past. Progress in sensor technology has enabled higher spatial resolution, with either increased laser pulse repetition rates or larger image sizes. The second aspect is sensor miniaturization, which now allows integrating both laser scanners and cameras on remotely piloted aerial systems (RPAS). The advent of UAV-borne sensors, for example, has revolutionized laser bathymetry, as the lower flight altitude has dramatically reduced the size of the laser footprint to below 10 cm. For the first time, this now enables reconstruction of dm-scale objects under water enabling applications like 3D mapping of submersed macrophytes, which are an important climate change indicator. I have also described many of these advancements in a recent review paper for the International Hydrographic Review, the official journal of the International Hydrographic Organization (https://ihr.iho.int/articles/a-review-of-active-and-passive-optical-methods-in-hydrography).

What do you consider your greatest achievement? Can you tell us a challenge that you faced in your career, how you overcame it and what you learnt from the experience?

To be honest, I consider myself rather as a slow-but-steady researcher than as a high-riser. I think one of my major achievements was developing a profound understanding of the interaction of light, especially green laser light used in LiDAR bathymetry, with the water surface. I developed several approaches to use green-only laser scanners for relatively precise reconstruction of the water surface. This sounds as a simple problem, but it isn't due to the inherent water penetration property of green laser light. I was also able to extend this knowledge to one of the emerging techniques of the last decade, namely Single Photon LiDAR (SPL), i.e., sensors enabling distance measurements at the arrival of a single or a few photons. Together with colleagues in Germany, I developed strategies to use SPL for water surface reconstruction, e.g. along the Rhine river in Germany.

What can you say about the current trends in scientific research related to efficient use of underwater remote sensing in various applications?

On the methodological side, I see two major trends. The most prominent is the use of Deep Learning (DL) for several tasks in optical bathymetry. Deep neural networks, for example, are now the standard for Spectrally Derived Bathymetry (SDB), also referred to as Satellite Derived Bathymetry as the technique is most often applied based on multispectral satellites like Sentinel-2 or WorldView-2. As it is the case in many other disciplines, AI-based approaches often outperform their traditional counterparts. Another trend is sophisticated signal analysis. In the aspect of full waveform processing, new methods are being developed which allow better separation of water surface and bottom echoes in the very shallow zone and to derive the optical properties of water (i.e. turbidity) from the laser signal. Moreover, in the underwater case, there is a clear trend towards Remotely Operated Vessels (ROV) or even Autonomous Underwater Vehicles (AUVs). This greatly helps for inspection tasks, but it requires sophisticated integration of Inertial Measurement Units (IMU) and imaging sensors (SONAR, LiDAR, images) in SLAM-based processing pipelines.

What do you think are the possible contributions of international organizations like the ISPRS Student Consortium in knowledge dissipation in underwater remote sensing?

We are constantly looking for your young researchers and PhD candidates. The bathymetry topic is often regarded as a niche, a playground for nerds with a much-focused interest. However, I strongly believe that water as such is of highest importance and will become increasingly relevant in the years to come. Of course, there are many aspects around water other than hydrography, but still optical bathymetry is a crucial contribution for our understanding of the shallow water area. The best advertisement for a field is, if there are many contributions at conferences and in scientific journals. If the ISPRS Student Consortium can motivate students to write their bachelor or master theses in the field of optical bathymetry, this would help much to create a positive and stimulating momentum. The underwater world is fascinating, not only for scuba divers!

What is your advice to the youth and how can one be motivated to pursue research in underwater remote sensing?

I see the underwater topic more and more in the context of climate change, which is - together with peace in the world - the topic of utmost global significance. For example, we are currently running a research project together with ecologists and limnologists at the Lake Constance, a large Alpine lake between Switzerland, Germany and Austria. The background is a massive invasion of neophytes threatening the whole ecosystem. Thus, if your heart beats for interdisciplinary work and ecology, underwater remote sensing has plenty of open research questions to be solved for the sake of a better and more livable world. Also if you are more the type, who wants to dig into difficult technical problems: Everything is more complicated under water than in air, thus we are far away from a sufficient understanding of all aspects in underwater environments. By the way, we are currently recruiting a PhD candidate in optical bathymetry at the Department of Geodesy and Geoinformation of TU Wien.

UPCOMING EVENTS

Event Name	Dates	Venue	Website
Geo Week 2024	11-13 Feb 2024	Denver, CO USA	http://www.geo-week.com/
SPIE Photonics Europe 2024	07-11 Apr 2024	Strasbourg, France	https://spie.org/epe_isprs
13th EARSeL Workshop on Imaging Spectroscopy	16-18 Apr 2024	Valencia, Spain	https://is.earsel.org/workshop/13-IS-Valencia2024/
ISPRS WG IV/1 Second International Digital Building Permit Conference 2024	18-19 Apr 2024	Barcelona, Spain	https://eu4dbp.net/dbpc24/
GISTAM 2024 10th International Conference on Geographical Information Systems Theory, Applications and Management	02-04 May 2024	Angers, France	https://gistam.scitevents.org/
ISAG2024 International Symposium on Applied Geoinformatics 2024	09-10 May 2024	Wroclaw, Poland	https://isagsymposium.org/
ISPRS TC I Mid-term Symposium Intelligent Sensing and Remote Sensing Application	13-17 May 2024	Changsha, China	http://www.isprs2024tc1.net/
2024 CIPA SUMMER SCHOOL 3D surveying and modelling in cultural heritage	19-25 May 2024	Rhodes, Greece	https://cipasummerschool2024.survey.ntua.gr/
ISPRS WG IV/9 8th International Conference on Smart Data and Smart Cities	04-07 Jun 2024	Athens, Greece	http://www.udms.net/

UPCOMING EVENTS

Event Name	Dates	Venue	Website
45th Canadian Symposium on Remote Sensing (CSRS) Exploring Past, Present, & Future	10-13 Jun 2024	Halifax, Canada	https://crss-sct.ca/events/csrs2024-halifax/
ISPRS TC II Mid-term Symposium **The Role of Photogrammetry for a Sustainable World**	11-14 Jun 2024 10 June 2024 - Tutorials 12 June 2024 - Job fair	Las Vegas, Nevada, USA	https://www.isprs.org/tc2-symposium2024/index.html
9th International Conference on Cartography and GIS	16-21 Jun 2024	Nessebar, Bulgaria	https://iccgis2024.cartography-gis.com/
43rd EARSeL Symposium	17-20 Jun 2024	Manchester, UK	https://manchester2024.earsel.org/
ISPRS WG IV/9 3D GeoInfo and EG-ICE joint conference 2024	01-05 Jul 2024	Vigo, Spain	http://3dgeoinfoeg-ice.webs.uvigo.es/
ISPRS ICWG IV/III/II Academic Track of FOSS4G (Free and Open Source Software for Geospatial) Europe 2024	01-07 Jul 2024	Tartu, Estonia	https://2024.europe.foss4g.org/
IGARSS 2024 SUMMER SCHOOL	4-6 July 2024	National Technical University of Athens, Greece	https://www.2024.ieeeigarss.org/summer-school_program.php
International Geoscience and Remote Sensing Symposium - IGARSS 2024	7-12 July 2024	Athens, Greece	https://www.2024.ieeei-garss.org/
COSPAR 2024 45th Scientific Assembly of the Committee on Space Research (COSPAR) and Associated Events	13-21 Jul 2024	Busan, South Korea	https://www.cospar-assembly.org/

SCHOLARSHIPS *AND* OPPORTUNITIES

PhD

PhD candidate on Study glacial sediments in Greenland and Antarctica,
University of Tromsø
Tromso, Norway
Deadline: 4 Feb 2024
https://bit.ly/3RRgyKz

PhD students in Remote Sensing
Linköping University
Linköping, Sweden
Deadline: 31 Jan 2024
https://liu.se/en/work-at-liu/vacancies/23398

PhD position in Hydrological modeling of wetland hydrology
KU Leuven
Belgium
Deadline: 1 March 2024
https://euraxess.ec.europa.eu/jobs/181808

PhD Researcher in Adaptive UAV Sensing Techniques for Flood Crisis Management
Ghent University
Belgium
Deadline: until filled
https://bit.ly/3RUC15l

Phd student - Development of Climate Informed, LIDAR Derived , Growth and Yield Models
The University of British Columbia
Canada
Link: https://www.grad.ubc.ca/ad/57782

PostDoc

Postdoctoral Researcher (W23185) (Geoinformatics Team)
RIKEN
Japan
Deadline: 9 Nov 2024
https://euraxess.ec.europa.eu/jobs/168497

Postdoctoral Scholar in landscape modeling
The Andrews Forest (AND) Program
Oregon, USA
Deadline: 14 Feb 2024
https://bit.ly/3vN1fel

Postdoctoral Researcher (W23185) (Geoinformatics Team)
RIKEN
Japan
Deadline: 9 Nov 2024
https://euraxess.ec.europa.eu/jobs/168497

Jobs

Full-time academic vacancy - Faculty of Sciences - Field: Geomatics
University of Liège (ULiège)
Liège, Belgium
Deadline: 18 Feb 2024
https://euraxess.ec.europa.eu/jobs/184505

Scientist Initiation of Mass Movements 80-100% (f/m/d)
Swiss Federal Institute for Forest, Snow and Landscape Research WSL
Switzerland
Deadline: 8 April 2024
https://euraxess.ec.europa.eu/jobs/184524

Scientist for active and passive microwave remote sensing
Eratosthenes Centre of Excellence
Cyprus
Deadline: 20 Feb 2024
https://euraxess.ec.europa.eu/jobs/183884

Jobs

Remote-Sensing Data Synergy Scientist

Eratosthenes Centre of Excellence

Cyprus

Deadline: 20 Feb 2024

https://euraxess.ec.europa.eu/jobs/183866

Professor or Assistant/Associate Professor in Terrestrial Ecosystem Ecology

University of Helsinki

Finland

Deadline: 29 Feb 2024

https://euraxess.ec.europa.eu/jobs/180076

Geospatial Deep Learning Scientist II

ETH Zürich

Switzerland

Deadline: 13 March 2024

https://euraxess.ec.europa.eu/jobs/179176

(Geo-)Informaticians, Data Scientists, Physicists or similar (f/m/x) - Artificial Intelligence for Earth observation

Deutsches Zentrum für Luft - und Raumfahrt (DLR)

Germany

Deadline: 1 June 2024

https://euraxess.ec.europa.eu/jobs/173244

Please visit our ISPRS SC web page

sc.isprs.org

where you will find more information about Student Consortium, our previous Newsletter issues, SC activities, photo galleries from previous Summer Schools, interesting links etc.

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ACKNOWLEDGEMENT

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Stay safe, everyone!


SPECTRUM