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DEPARTMENT OF
SCIENCE & TECHNOLOGY
सत्यमेव जयते

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भारत 2023 INDIA

Book of Abstracts

Indo-French Workshop on

Marine Science and Technology - Collaborative Research Directions and Outcomes for India and France

16 April 2024 - 20 April 2024

Organized by:

Indian Institute of Technology Goa (IIT Goa), Goa, India & Ecole Navale, Brest, France

GOa ATlantic

A Joint initiative to solve real world problems in Marine Science and Technology

Prof. B.K. Mishra
Director, IIT Goa

Welcome Message

Dear delegates from France and my esteemed colleagues,

As the Director of IIT Goa, I am delighted to extend a warm welcome to all of you for the Indo-French Workshop on Marine Science and Technology - Collaborative Research Directions and Outcomes for India and France. This workshop is being organized in collaboration with École Navale.

I am pleased to note the active participation of delegates from several esteemed French institutions, including ENSTA Bretagne, École Navale, Campus mondial de la mer, Université de Bretagne Occidentale, ENIB, and Exail. I would also like to express our gratitude to the Indo-French Centre for the Promotion of Advanced Research (IFCPAR/CEFIPRA) for their generous support. This workshop serves as a pivotal platform to strengthen our ongoing collaboration with these institutions.

The event will feature technical presentations that provide a glimpse into the cutting-edge research being conducted in IIT Goa labs. Additionally, we will have a session on academic and research opportunities in France for our students and faculty, which will be led by Prof. Philippe Maurin from the Consulate General of France in Mumbai.

During the GOAT meeting, we will engage in insightful policy discussions focusing on student and faculty mobility, joint degree programs, and our potential participation in the upcoming SeaTechWeek. Let us continue to build upon the momentum gained from our existing and past collaborations and explore new avenues for future collaboration and innovation.

I would like to thank everyone for being a part of this exciting journey, and I look forward to our engaging and fruitful discussions ahead.

Warm regards,

Dr. Sharad Sinha,
Associate Professor,
Computer Science and Engineering
Head, International Relations
IIT Goa

Indian Coordinator for the Indo-French Seminar

The international relations related presentation will include details of ongoing collaboration with GOAT partners and other organizations in France. It will give an overview of the projects, students exchanges and faculty mobility that has happened so far. Information about joint activities with institutions in a few other countries will also be shared.

The research presentation will discuss overall computing systems related research in my research group. This encompasses computing systems design, development and verification, system on chip design, computing systems for AI, computer security, embedded systems and reconfigurable computing. Project works initiated in marine science and technology will also be presented.

Prof. Manell Zakharia
Expertise France - NIOT

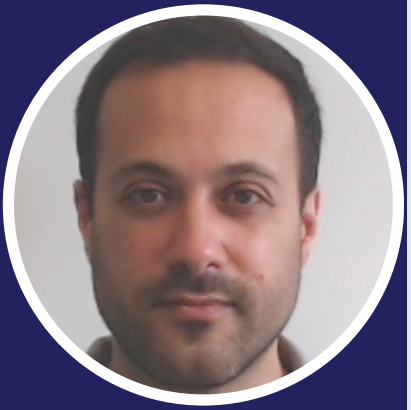
French Coordinator for the Indo-French Seminar

Presentation of India-France Road Map, on the Blue Economy and Ocean Governance (2022), in particular the "Scientific and academic pillar: better knowledge of the ocean to innovate and protect.

New actions for the revival of cooperation programme GOAT (Goa ATlantic cooperation in Marine Science and Technology) signed in Brest (2020), between the French actors of "Campus mondial de la mer" and IIT Goa.

Promotion of student and faculty mobilities (stopped during COVID period).

Coordination of exchanges and Indian programmes (in particular, the Deep Ocean Mission)



Dr. Kamal Nasreddine
Associate Professor
École Nationale
d'Ingénieurs de Brest
(ENIB)

Artificial intelligence for underwater observation systems:

In our research team at ENIB, we focus on the significant role of underwater video in marine ecology for observing and monitoring marine ecosystems. However, automatic processing of video recordings is uncommon due to the complexity of underwater information. Our goal is to develop tools and methods for the automatic recognition of fish species in underwater video images. We concentrate on modern deep learning approaches, particularly convolutional neural networks (CNNs), which have shown remarkable advancements in computer vision.
After reviewing the state-of-the-art in underwater observation, fish species recognition, and deep learning techniques, we propose a robust approach for detecting and localizing fish in underwater video images. This approach involves combining two parallel networks, referred to as Faster R-CNN, to merge features related to fish appearance and movement. Performance is significantly enhanced compared to state-of-the-art models comprising a single neural network. Subsequently, we develop methods for fish species identification based on transfer learning, employing various strategies to optimize choices regarding color space, background removal, and artificial data augmentation. Finally, fish species classification is approached within a progressive learning classification framework in two different ways. Firstly, we propose a hierarchical classification approach based on species taxonomy, enabling the classification of fishes into families and then species. Secondly, we introduce a novel model based on incremental learning principles to enhance performance on classes (species) that are difficult to identify. Initially, the model prioritizes learning difficult species, gradually incorporating knowledge of other species with stability. We validate our automatic detection and classification approaches on two benchmark image datasets, discussing their performance compared to state-of-the-art methods.

Françoise DUPRAT
École Nationale
d'Ingénieurs de Brest

The Campus mondial de la mer is France's foremost community of experts in the study and economic development of the ocean The Campus mondial de la mer has a dual purpose:

Firstly, to encourage acculturation between research and business, with the aim of creating more value: a better understanding of the ocean, more business start-ups, more innovative projects and therefore more maritime jobs. To achieve this, the Technopôle Brest-Iroise team, which runs the Campus, is networking the players in the Finistère area. The Rencontres Immersion, organised 3 times a year, for example, create links between researchers and entrepreneurs on specific subjects: metrology and marine sciences, biomimicry, naval engineering, mechanical testing, etc. These events give rise to meetings that lead to better mutual understanding and, where appropriate, to collaborations. Secondly, to highlight the expertise of the players in its community in France and internationally, in order to build bridges with other maritime regions. This will be achieved by organising international events such as Sea Tech Week®, rolling out the Ocean Hackathon® in 12 cities in France and internationally in 2022, making marine-related research infrastructures and facilities accessible to our international partners, and promoting expertise through our international journal SONAR, published every two years. Brest's hosting of the One Ocean Summit in February 2022 and the European Maritime Day in May 2023 are further recognition of the city's international profile.

Prof. Eric Rius
UBO-Lab-STICC-Collége Doctoral de Bretagne

Presentation of the lab-STICC

The Lab-STICC, with it affiliation to the INS2I institute of the CNRS, is a research unit historically recognized in Brittany and in France in the field of ICTS. It has a proven capacity to cover a broad scientific spectrum around digital sciences, and in particular with this ability to address various disciplinary fields (Information Theory, Waves & Materials, Embedded Electronics and Computing, Data Sciences, Communication and Signal Detection, Human-Machine Interfaces,...) following multiple themes/application sectors: maritime environment, communicating objects, defense, space, health, security, robotics...

The Lab-STICC's motto "From sensors to knowledge: communicating and deciding" initially underlined the intention to give "meaning" to the "sign", in terms of interpretations and increased value with respect to treatments based on a signal in all its forms. Today, this motto is even more reinforced by the importance of data, which is becoming the vector of technological and scientific innovation, undeniably boosted by the major advances in science in the field of cognition and artificial intelligence.

Presentation of the Collège Doctoral de Bretagne The Collège Doctoral de Bretagne is the forum for exchanges and decisions between the 13 doctoral schools in Brittany (around 3 000 PhD students), with the aim of developing the visibility and attractiveness of the doctoral system shared by the 15 higher education and research establishments authorized to award doctorates in the region: 4 universities and 11 engineering schools.

Prof. Guillaume Sicot
ENSTA Bretagne - M3 team - Lab-STICC

The research activities of two Labsticc teams will be presented, the M3 team and the Robex team.

*** M3 teams description :**
The increasing number of observation systems and their non-strop improvement provide today a rich, voluminous and dissociated information on our physical environment in particular the marine environment. This richness is due to a diversification of the typology (greater variety of heterogeneous data), to an improvement of the space and time resolution (increasingly resolute data for a detailed description), and to an improvement of the quality (increasingly accurate data). The M3 (Marine Mapping & Metrology) team intends to focus on understanding the physics of measurement and its exploitation for the mapping of the marine environment. The objective is to understand the measurement itself to better interpret it and thus provide a reliable description of the environment. This understanding sweeps different components, from the design of the observation system by the assembly of sensor bricks, the consideration of the physical reality of this system, the qualification, analysis, interpretation and representation of the acquired data.

*** Robex teams description:**
Over the last few decades, mobile robotics has largely developed in structured and already mapped environments. In unknown and unstructured environments, such as distant planets, volcanoes, deep caves, irradiated zones, karstic veins, burning buildings and the seabed, robotics takes on a different nature. The new Robex team is seeking to develop academic tools to design intelligent algorithms enabling robots to carry out an exploration mission autonomously. Under certain assumptions about the environment and the robot's dynamics, we are interested in guaranteeing certain properties such as avoidance of a forbidden zone, compliance with constraints on the state of the system, integrity of localisation and the ability to return to the starting point. We endeavour to take rigorous account of all types of uncertainty, to obtain theoretically elegant solutions and to carry out convincing experimental validation.

Prof. Claire Hellio
Vice President for Europe and International
Université de Bretagne Occidentale (UBO)

Fostering innovation : From Reseach to Teaching (case study: Marine Biotechnology)

The link between research, higher education, and knowledge transfer through innovation is a critical and multifaceted concept that plays a significant role in driving societal progress, economic development, and the advancement of knowledge. Collaboration between researchers, educators and industry is essential to leverage the full potential of this relationship and to ensure that new knowledge benefits society and drives positive change
During the talk we will explore, through case studies in Marine Biotechnology:

1) Research and Higher Education:
- **a. Generating new knowledge:**
  Research is the foundation of higher education. Universities and research institutions are hubs for generating new knowledge.
- **b. Educational opportunities:**
  Research is integrated into the educational process, allowing students to engage with cutting-edge ideas, theories, and methodologies.

2) Innovation
- **a. Innovation from Research:**
  Research is a catalyst for innovation. New discoveries and insights can spark innovative solutions to existing problems or create entirely new products, processes, or services.

3) Economic and social impact
- **a. Economic growth:**
  knowledge transfer and innovation can drive economic growth by creating jobs, fostering entrepreneurship, and improving the competitiveness of industries
- **b. Societal advancements:**
  Innovations can also lead to improvements in areas such as healthcare, the environment, and quality of life benefiting society at large.

Dr. Mikael Guégan
Ecole Nationale
d'Ingénieurs de Brest
(ENIB, France) /
Lab-sticc CNRS UMR6285

As the head of the ENIB international office I will present the research activities taking place in general at the Ecole Nationale d'Ingénieurs de Brest (ENIB) and more specifically whose more dedicated for SEA and submarine applications. Then I will focus on the activities of my research group who works on the combination of power-over-fiber (PoF) and radio-over-fiber (RoF) in systems sharing the same optical cable in order to simplify network installation and saves long-term maintenance costs. RF-over-fiber, also known as analog radio-over-fiber (ARoF), refers to the transmission of optically modulated RF channels through fiber links, aiming to be radiated by remote antennas or processed in the RF domain. Optical fibers can transmit signals over long distances due to their low attenuation and high bandwidth capabilities. It is reasonable to try to optimize network resources by using the same medium that carries the data signal to also transport the energy to supply remote devices. As optical fibers provide electrical isolation, they are suitable for transporting power to equipment placed in areas subject to lightning or explosive damage caused by sparks as in the framework of submarine applications. In addition, optical cables can occupy less space and be lighter in weight than electrical wires. Examples of applications in such scenarios include remote antenna units (RAU) at the top of telecommunication towers, and sensors in hazardous environments and in high-voltage installations. Adding PoF capabilities to RoF links extends system functionality, provided that sufficient electric power is available to feed the electronic devices in the remote node. It also an interesting opportunity to install subsea/seashore observatories with the the aim to efficiently reuse and extend available optical networks. PoF topologies with single-mode fibers (SMF) present an attractive appeal due to their cost-effective readiness.

Dr. Marc Pinto
Scientific Advisor, Exail Robotics
Professor, Seatech Engineering School, Toulon

The presentation will include an introduction to the Seatech Engineering School at Toulon. It also hosts 5 research laboratories including the “Mediterranean Institute of Oceanography- UMR CNRS 7294”. The research group conducts various activities related to AUV navigation, SONAR Imaging and Automatic Image Interpretation in marine environments. The activities are conducted both at Seatech Toulon and at EXAIL Robotics. Internship opportunities for students will also be presented.

Dr. Anirudha Ambekar
Assistant Professor,
Mechanical Engineering
IIT Goa

Formerly dominant as prime movers, fossil fuel-powered combustion engines now confront challenges from emerging technologies amidst mounting concerns about pollution and climate change. Sustainable transport fuel technologies present a diverse range of solutions aimed at curbing carbon emissions and reducing reliance on fossil fuels. Derived from organic matter like plant biomass, non-food feedstock, and waste materials, liquid biofuels offer reduced greenhouse gas emissions and can be seamlessly blended with existing fuels. Hydrogen combustion, either direct or facilitated by fuel cells, yields only water vapor as a by-product, providing emission-free transportation. Biogas, generated through anaerobic digestion of organic waste, can be upgraded to bio-methane or Renewable Natural Gas (RNG) for use in eco-friendly vehicles. Power-to-Liquid (PtL) fuels, created from renewable electricity and carbon dioxide or natural gas, act as direct substitutes for traditional liquid fuels. Green ammonia, sourced from renewable hydrogen and nitrogen, presents a carbon-neutral fuel option for maritime transport and power generation.

This presentation centers on the current state and utilization of alternative fuels in the pursuit of sustainable transportation. By reviewing noteworthy studies published in the last five years, it highlights the potential of alternative fuels. Further exploration of combustion processes and their impact on emission characteristics is crucial for enhancing operational efficiency and mitigating pollution in transportation. Through interdisciplinary research and collaborative endeavors, a promising pathway towards sustainable transportation can be charted. Key areas warranting additional research encompass the combustion and emission characteristics of alternative fuels, alongside the development of predictive numerical models for turbulent combustion and emission generation processes.

Dr. Bidhan Pramanick
Assistant Professor,
Electrical Engineering
IIT Goa

Internet of Things (IoT) technologies have revolutionized various industries by enabling the seamless connectivity of devices and data exchange. In the context of Marine Science and Technology, IoT devices offer numerous advantages, such as real-time data collection, remote monitoring of marine ecosystems, predictive analysis, and efficient resource management. This presentation highlights some key applications of IoT devices in marine research, including underwater sensors for water quality monitoring, smart buoys for weather forecasting, autonomous drones for marine life observation, and GPS tracking systems for maritime navigation. Integrating IoT devices in marine research not only enhances data accuracy and accessibility but also opens up new possibilities for scientific advancements and sustainable ocean management. This talk discusses the importance of efficient sensor development and the appropriate interfacing circuit implementation. This talk also discusses the challenges and future prospects of implementing IoT-based solutions in Marine Science and Technology.

Dr. Clint Pazhayidam George
Associate Professor,
Computer Science and Engineering
IIT Goa

Higher-dimensional data poses a familiar challenge for most machine-learning applications, such as cancer genomics and marine data science. I discuss traditional regression models that induce shrinkage, such as LASSO, and their Bayesian variants. I then describe the popular spike-and-slab prior for high-dimensional Bayesian modeling and its use in model shrinkage in deep neural networks, aiming at feature selection. In the marine domain, water column properties such as Total Suspended Matter (TSM) and Colored Dissolved Organic Matter (CDOM) are essential to characterizing water composition, monitoring water quality, understanding optical properties, and contributing to broader environmental health assessments. I discuss a probabilistic approach based on a well-known radiative transfer model for reflectance data to estimate critical water column parameters such as TSM and CDOM and location-specific spectral slopes of non-algal particles and CDOM. I briefly mention other machine learning estimation alternatives, such as Partial Least Squares Regression and Convolutional Neural Networks.

Dr. E. Siva Subramaniam Iyer
Associate Professor,
Chemistry
IIT Goa

Title: Photoselective femtochemistry in marine systems.

A major terrestrial phototropy occurs in the oceans. Over the years, it has been established that marine pigments harvest light and transform the absorbed light to trigger an efficient action. These processes occur in ultrafast timescales, in the order of femtoseconds to picoseconds. Recent works have shown the importance of opsin phototrophs in oceans and have estimated that photosynthesis by rhodopsin-containing microbes is more efficient than by plants. Owing to the difficulty in extracting the proteins that participate in light-induced processes in marine systems, they have yet to be understood well. Despite having similar chromophores, the opsins exhibit significantly different spectral features. It has been observed that few species have adapted themselves to the biome they survive in and display different spectral signatures. Thus, we can contemplate that these microbes have evolved to use the same bio-machinery to achieve high efficiency. This makes it essential to study such pigments from different organisms. We attempt to study pigments extracted from Indian seawater. The bacterial isolates from the saltpan have shown fast photodynamic decay.

Dr. Nandakumar Nambath
Associate Professor,
Electrical Engineering
IIT Goa

Underwater wireless communication is a fast-growing domain of interest due to its exclusive applications in commercial ocean resource exploration, defence, oceanography, etc. Real-time communication systems demand high data rates, making underwater optical wireless communication (UOWC) a promising research domain. Typical UOWC links provide a very high data rate across a short range. This talk will give an overview of the effects of underwater environmental conditions and the influence of different water types on the performance of underwater optical links. It will also touch upon the optical communication experimental setup designed and implemented for real-time full-duplex video communication capable of dealing with real-time video call services. It will also present the system's performance metrics under various water conditions evaluated with blue, blue-green, and red lasers.

Dr. Neelakandan Rajamohan
Associate Professor,
Electrical Engineering
IIT Goa

Development of Autonomous Underwater Vehicles (AUVs) has permitted the automation of many tasks originally achieved with manned vehicles in underwater environments. Teams of AUVs designed to work within a common mission are opening the possibilities for new and more complex applications. In underwater environments, communication, localization, and navigation of AUVs are considered challenges due to the impossibility of relying on radio communications and global positioning systems. For a long time, acoustic systems have been the main approach for solving these challenges. However, they present their own shortcomings, which are more relevant for AUV teams. As a result, researchers have explored different alternatives. In this talk, a summary of collaborative AUV teams and missions is also included, with the aim of analyzing their applicability, advantages, and limitations.

Dr. Neha Karanjkar
Assistant Professor,
Computer Science and Engineering
IIT Goa

Modeling and simulation are vital in advancing marine sciences and engineering. This talk will highlight our research in evolving parallel and hybrid simulation techniques and developing open frameworks for scalable digital twins. These innovations enable the creation of digital twins for marine engineering systems, offering enhanced foresight and streamlining the design and management of complex dynamic systems.

Dr. Shitala Prasad
Assistant Professor,
Computer Science and Engineering
IIT Goa

This research jointly with NCPOR, Goa, investigates the effectiveness of deep learning models such as ResNet, ConvNetX, Visual Transformer, and Attention Mechanism in underwater marine species recognition. Our goal is to develop a robust system capable of accurately identifying and categorizing marine species from underwater imagery. By harnessing the capabilities of deep learning algorithms, we aim to improve the efficiency and precision of marine species recognition, thus contributing to the conservation and comprehension of underwater ecosystems. Through extensive experimentation and analysis, we assess the performance of these models in the challenging underwater environment, with a focus on enhancing both supervised and unsupervised approaches for common and rare species detection.

Dr. Sreenath Balakrishnan
Assistant Professor,
Mechanical Engineering
IIT Goa

Health, at the scale of the individual, is characterized by parameters such as glucose level and lipid profile. Recently, several diseases such as cancer have been identified as ailments arising from single-cell abnormalities. However, there are no characterizations of single cells primarily because chemical characterizations, which are ubiquitous at the individual scale, are challenging at the single-cell scale. Physical characterization is an attractive alternative in this context. Here, we demonstrate two approaches towards physical characterization of single cells – (i) a mechanics technique using a computational model for predicting cell properties from nucleus shape and (ii) a mechanisms method wherein we develop compliant micromechanisms for measuring mechanical properties of single cells. Based on the existing literature on nuclear mechanics, we modelled the nucleus as an inflated spherical membrane compressed between two rigid flat plates. From the model, we obtained two nondimensional parameters for characterizing nucleus shape - scale factor and flatness index. An independent method, variability analysis of nucleus shapes, converged to the same set of parameters. Through multiple experimental studies, we show that the flatness index correlates with actin tension and scale factor inversely correlates with nucleus stiffness suggesting that these cellular properties could be conveniently estimated from nucleus shape through these shape parameters. In the mechanisms approach, we have designed, fabricated and demonstrated two micromechanisms for uniaxial and biaxial stretching of single cells. We converted the cell-manipulation problem, uniaxial and biaxial stretching, into a mechanism design problem and designed an appropriate compliant mechanism for that actuation mode. By further developing other modes of cell manipulation such as twisting and shearing, we aim to create a lab-on-a-chip platform for comprehensive mechanical testing of single cells. Combining this mechanism platform with our mechanics-based computational methods could pave the way for multi-modal physical characterization of single cells to enable mechanics-based disease diagnosis.

Dr. Sujit Kumar Sahoo
Associate Professor,
Electrical Engineering
IIT Goa

Synthetic Aperture Sonar (SAS) revolutionizes underwater imaging, offering unparalleled resolution and capabilities over traditional sonar systems. By synthesizing a long antenna aperture through platform motion, SAS achieves high-resolution seafloor imaging, crucial for seabed mapping, mine detection, marine archaeology, and environmental monitoring. However, speckle noise poses a common challenge in SAS imaging, degrading image quality. One of our recent works demonstrates the importance of noise reduction in object identification/classification performance from SONAR images. There are two possible approaches to reducing the speckle noise in SAS images:

- **Develop algorithms to construct an SAS image that presents a lower speckle level.**
- **Develop algorithms to enhance the quality of the SAS image after image formation.**

Reducing Speckle in SAS Image Construction: SAS image formation begins with receiving raw data echoes from the underwater environment. Pulse-compression techniques shorten wide transmitted pulses into high-energy ones, improving resolution by reducing pulse spread. Matched filtering with the signal's bandpass characteristics boosts the signal-to-noise ratio (SNR) and resolution. Efforts focus on optimizing processing parameters and employing noise reduction techniques to maintain resolution while enhancing SNR. Combining a back-projection imaging algorithm with compressed sensing methods offers an efficient means to reconstruct the SAS images and facilitates noise reduction in SAS images with fewer acquisition points.

Enhancing SAS Image Quality Post-Formation: Advanced speckle reduction techniques like spatial filtering, wavelet denoising, statistical methods, and machine learning effectively mitigate speckle noise in SAS images. These methods smooth out speckle-induced fluctuations while preserving crucial image features. Spatial filtering algorithms offer efficient noise suppression. Wavelet denoising selectively removes noise while retaining image details. Statistical approaches estimate noise-free pixel values based on local image statistics. Machine learning-based methods, like convolutional neural networks (CNNs), achieve superior speckle reduction performance. Integrating these techniques into the SAS image processing pipeline enhances image quality, improves interpretability, and facilitates accurate underwater exploration and mapping.

Dr. Thaseem Thajudeen
Associate Professor,
Mechanical Engineering
Dean (R&D)
IIT Goa

Maritime environment is an important contributor of gaseous emissions including NOx, SOx as well as particular matter (PM) emissions. Despite significant measures at reducing emissions, further actions are required in developing new fuels and to reduce emissions from marine vessels. In addition to emissions from marine transportation, coastal areas have higher PM concentrations due to the presence of marine aerosols. Most of the efforts for regulation in this sector has been towards the reduction of SOx emissions by stringent regulations on the sulphur content. Detailed characterisation and mitigation of particulate matter from marine vessels need more sustained attention. This talk focuses on the ongoing studies in IIT Goa on the characterisation of particulate matter emissions from various combustion sources. PM emissions include particles in the size range from a few nanometers to particulates in the micrometer range. Measurement of particulate matter across the entire size range is quite complicated owing to the need of specialized instrumentation, and due to the fact that they very often exist and non-spherical particles. Hence, these properties of the particles are shape and size dependent. This talk will summarize the ongoing activities in IIT Goa on the characterisation of non-spherical particulate matter using a combination of experimental and numerical studies. In addition, the efforts on understanding personal exposure in various work environments will also be discussed.

Sakthivel Samy V
Scientist F,
National Center for Polar and Ocean Research (NCPOR), Goa

This research investigates the effectiveness of deep learning models such as ResNet, ConvNetX, Visual Transformer, and Attention Mechanism in underwater marine species recognition. Our goal is to develop a robust system capable of accurately identifying and categorizing marine species from underwater imagery. By harnessing the capabilities of deep learning algorithms, we aim to improve the efficiency and precision of marine species recognition, thus contributing to the conservation and comprehension of underwater ecosystems. Through extensive experimentation and analysis, we assess the performance of these models in the challenging underwater environment, with a focus on enhancing both supervised and unsupervised approaches for common and rare species detection.

Dr. Lalat Indu Giri
Assistant Professor,
Electrical Engineering
NIT Goa

The National Institute of Technology Goa (NIT Goa) is an Institution of National Importance under the Government of India. It has recently moved to its permanent campus in Goa from where several undergraduate and postgraduate programs in engineering are offered. The presentation will be about the academic and R&D activities at NIT Goa which will help us identify areas of mutual interest for collaboration.

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