Impulse
NEWSLETTER
AMRITA MIND BRAIN CENTER

AMRITA
VISHWA VIDYAPEETHAM
DEEMED TO BE UNIVERSITY UNDER SECTION 3 OF UGC ACT, 1956

CONTENTS

Amrita Mind Brain Center, Amrita Vishwa Vidyapeetham
Amritapuri Campus, Clappana P.O., Kollam-690525, Kerala, India
☏ +91 476 2803500, +91 476 2899722
e-mail : mindbrain@amrita.edu

🐦 Mindbraincenter   f AmritaMindBrain   ⊙ amritamindbrain

DIRECTOR'S MESSAGE

Dear Readers,

I hope that this New Year 2024 brings happiness, peace and health to you and your loved ones.

Several challenges and advances have taken place at Amrita Mind Brain Center since the impulse newsletter volume 1 in 2022. We do look at our current and exciting times as they offer new opportunities for collaboration, innovation and research.

Extending our research into training, we are excited to launch a new M.Sc. program in Yoga and Congnitive Science. This year will also see us pursue a few new projects connecting us with Schools of Ayurveda, AI, Computing and Engineering. The conclusion of some of our international projects with EU in 2023 have extended those into developement of novel strategies and ideas.

We do hope this issue of the Impulse newsletter will give a glimpse into what had transpired in 2023 and our research achievements. We appreciate the confidence that all our colleagues at Amrita, students, researchers and readers have placed in our work.

Thank you for taking the time to read and give us your thoughts!

Warm regards,

Prof. Shyam Diwakar

RESEARCH HIGHLIGHTS

COMPUTATIONAL MODELLING OF CORONA VIRUS INFECTION PATHWAYS IN PREDICTING DISEASE PROGRESSION

Since March 2020, Coronavirus disease (COVID-19) has been declared a pandemic by the World Health Organization. During the initial stage, to slow down the spread of the virus, reduce strain on healthcare, and prevent deaths government enacted social distancing, quarantine, isolation, lockdown, and curfews all over the world bringing threat, associated fear, stress, and anxiety among public domains. Lack
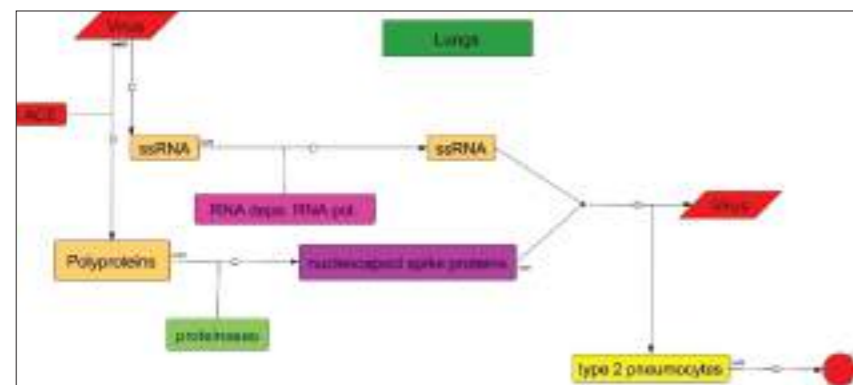
vascular illness, acute respiratory distress syndrome, and kidney dysfunction, which have been attributed to multi-organ failure and death. How to best tackle the situation and tailor realistic long-term treatment strategies challenged both medical and research communities.
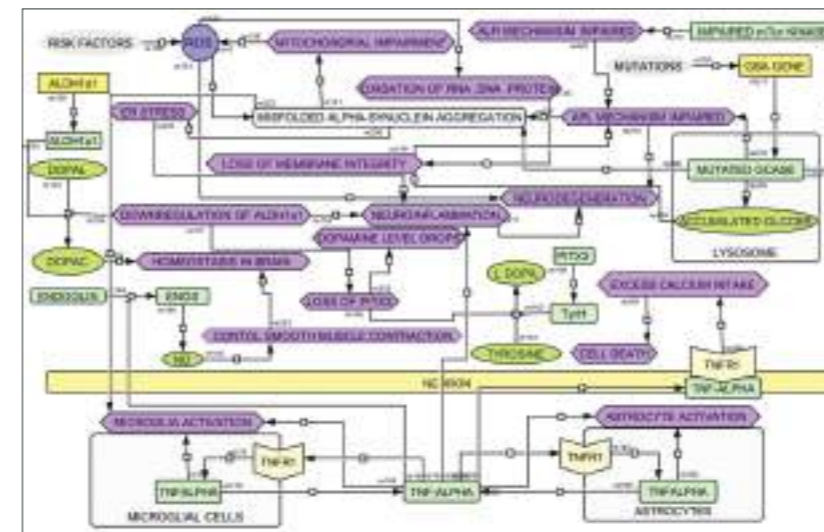
Dr. Hemalatha Sasidharakurup, Research Associate, at Amrita Mind Brain Center, took advantage

of computational modeling, which is a relatively cheaper and safer method to understand disease progression mechanisms and the prediction of infection pathways and in mapping and risk factors at different stages of COVID-19. Detailing new insights into the infection mechanism and understanding specific infectivity characteristics of variant strains of the virus is necessary to bring conclusive ideas to this novel computa-

of knowledge on the nature and origin of infectious agents, transmission cycle, and treatment strategies were a question of concern in early phases. Even though the viral infection begins with a lower respiratory tract infection, the disease progression influences comorbidities such as diabetes, coronary heart disease, cerebro-

tional model. In her point of view "although recent studies have reported infection-associated comorbidities, a detailed analysis on cellular level reactions is needed for a better understanding of the disease progression and therapeutic strategies".

INSPIRING APPROACHES TO USING LOW-COST EEG SENSORS IN BRAIN MAPPING STUDIES.

For adaptation to the real world, a basic need for an individual is to perform their life activities independently, called Activities of Daily Living (ADLs). In the case of persons with severe motor disabilities, there is difficulty in skillfully manipulating objects around the environment and therefore boosting the development and implementation

of innovative devices and related biomedical devices for their assistance was a primary requisite. Understanding how the brain controls motor movements presents an interesting source of study for researchers in neuroscience, engineering, and robotics. A research study conducted by Dr. Sandeep Bodda, Research Associate at

BRINGING COMPUTATIONAL APPROACHES FOR DEEP INSIGHTS INTO NEURODEGENERATIVE DISORDERS: ALZHEIMER'S DISEASE AND PARKINSON'S DISEASE

With the boosting of life expectancy of the global population including lifestyles, environmental factors, and genetics, age-related diseases, particularly neurodegenerative disorders constitute a major public health issue. Alzheimer's disease (AD) and Parkinson's disease (PD) are on the

front-line notes of neurodegenerative diseases with AD associated with escalating dementia and PD with a characteristic movement disorder. I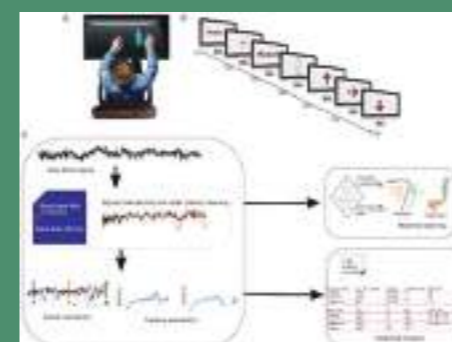n the quest for understanding the disease progression of AD and PD, project interns Mr. Dheeraj Pisharody, Ms. Haritha Bose, and Mr. Dijith Rajan, of Amrita School of Biotechnology with the guidance of Dr. Hemalatha Sasidharakurup reconstructed Glucocerebrosidase signaling pathways, a specific genetic variant associated with Parkinson disease, for mapping biomarkers for the disease progression. Regardless of existing clinical and pathological features between AD and PD, the present study marked better ways to understand disease progression which will stimulate subsequent research.

EMPOWERING SUCCESS IN VIRTUAL LABORATORIES: VIRTUAL LAB PAPER PRESENTED AT EDUCATION FOR TECHNOLOGY CONFERENCE (T4E, 2023)

Mrs. Rakhi Radhamani, Researcher at Amrita Mind Brain Center, presented at the IEEE T4E conference held at IIT Bombay from Nov 24-26, 2023, on Implementing a Student-Centric Free and Open-Source Virtual Laboratory in Bioinformatics and Computational Biology. The work highlighted the scope, design, technical considerations, and implementational constraints in developing a virtual laboratory, that explores the training-to-practice goals for promoting learners and supporting teachers in higher education.

Amrita Mind Brain Center, explored neural activity and mechanisms underlying a grasped movement task with scalp electroencephalography (EEG) signals in healthy volunteers. This explores establishing the relationship between neural signals and motor movement patterns that could be a source to drive commands in neuroprosthetic devices or brain-machine interfaces. According to the researcher's point of view, these low-cost consumer-grade EEG devices could provide critical information related to movement patterns, and executing similar discrimination models may be valuable tools in studying brain mapping studies in clinical conditions of patients with amyotrophic lateral sclerosis (ALS) or spinal cord injury (SCI).

MATHEMATICAL MODELING OF SPIKING NEURONAL MODEL DYNAMICS – A-PILLAR TO COMPUTATIONAL NEUROSCIENCE RESEARCH IN NEURONAL INTEGRATION AND INFORMATION PROCESSING

Today's science is expanding with the integration of mathematical approaches, computer applications in numerical calculations and simulations, and theoretical physics in exploring the functions of biological systems. Studying the properties of the brain is interesting due to the presence of billions of nerve cells (neurons) connected in a complex network. Exploring the interconnections and network behavior at the microscopic level and macroscopic systems level is a fundamental feature in understanding neuronal dynamics. The Hodgkin-Huxley model emphasizes a single-cell contribution and dynamical aspects, but it is not computationally reliable in describing the properties of entire neurons. Spiking neuronal model dynamics can be used to build large-scale neu-

ronal networks, and to reconstruct phenomenological models for action potential production in neurons due to their simplicity and with less computational power in simulation. A study by Mr. Gautham Dathatreyan, who graduated with an MSc in Physics, from the Department of Science, Amrita School of Physical Sciences, Amrita Vishwa Vidyapeetham, Coimbatore Campus, and Dr. Arathi Rajendran, Research Associate at Mind Brain Center was focused on the reduction of complex multicompartmental biophysical neuronal models into simple spiking neuron models including Izhikevich. The biophysical models of cerebellum neurons including GrC, GoC, and DCN were reduced. This approach is computationally more effective while reconstructing large-scale circuits for behavioral modeling. The work in collaboration with Università degli Studi di Milano's Prof. Giovanni Naldi guided by Dr.Shyam Diwakar was presented by Mr. Gautham Dathatreyan at the Seventh International Symposium on Intelligent Informatics (ISI'22), August 31–September 1, 2022. This work was part of MSBFIINE - Multiscale Brain Function India-Italy Network of Excellence.

HANDLING DIVERSITY AND NEOCOLONIALISM IN DIGITAL RESEARCH

Prof. Shyam Diwakar, Director of Amrita Mind Brain Center, co-authored the publication titled "Diversity and Neocolonialism in Big Data Research: Avoiding Extractivism while Struggling with paternalism.

SPIKING NEURAL NETWORKS AND MACHINE LEARNING IN SENSOR-FREE CONTROLLERS FOR ROBOTIC ARMS

The use of robotic arms in various human ventures has increased over past years, ranging from industrial applications, domestic purposes, and in the medical field, especially for people with neurological disorders, and amputees. With the advances in artificial intelligence including artificial neural networks, intelligent information processing has been utilized to tackle the human thinking process, especially in decision-making and strategy learning. To understand how the human brain processes information, it is crucial to construct neural models

able to mimic the way that biological neurons do. There exists a wide range of biological neural models ranging from point models to more complex compartmental models. A recent study led by Dr. Asha Vijayan, Assistant Professor, Mind Brain Center, implemented a cerebellum-inspired spiking neural network with dynamics of cerebellar neurons and learning mechanisms attributed to the granular layer, Purkinje cell (PC) layer, and cerebellar nuclei interconnected by excitatory and inhibitory synapses to reproduce spiking behavior as compared to empirical data. The network model showed a generalized processing capability for a range of signals, modulating the data through the interconnected neural populations and adding implications to motor learning theory.

ARTIFICIAL INTELLIGENCE (AI) PROMISES IN DIAGNOSTICS AND TREATMENT MANAGEMENT

The promising role of Artificial Intelligence (AI) has been widely accepted across different domains of the medical field, especially in disease diagnostics and treatment strategies. To date, a wide range of research and data is available to show how AI can influence clinical manifestations to support physicians' judgment in disease diagnosis. Collaborators of Mind Brain Center, Dr. Ravi Sankaran, Department of Physical Medicine and Rehabilitation, Amrita Institute of Medical Sciences, and Dr. Anand Kumar and Dr. Harilal Parasuram, Department of Neurology, Amrita Institute of Medical Sciences, carried out a systemic review studies on humans on the accuracy of AI in pain considering Brain Imaging, the ability of AI to predict pain, to differentiate stratify severity or types of pain and the patient-reported measures with electrophysiology techniques.

TOWARDS UNDERSTANDING THE BETTER SOLUTION OF GAIT PREDICTIONS

Gait analysis is the study of how people walk, which involves looking at the movement of the joints in the legs and how they work together. This is important for walking efficiently. The joints in the lower body, such as the lower back, knee, and ankle, change as people walk in different ways. This can be used as a system to measure the movement of the body for monitoring changes that help people to walk better. In this recent study, a simple and inexpensive device, a mobile phone accelerometer, was used to measure the movement of the joints in the legs. The study looked at how different groups of people, based on their weight, walked and used machine learning to analyze the data. It was found that the angles of the joints varied depending on a person's weight and that some joints moved faster than others. This information can be used to help people with walking problems, especially those with hip-related issues. The study "Towards Better Gait Predictions: Sensor-based Detection of Flexion and Extension of Human Lower Limb Joints During Walking" led by Dr. Chaitanya Nutakki, Research Associate at Mind Brain Center, and Junior Research Fellow, Mr. Abhijith Balachandran together with project interns from Department of Electronics and Communications Engineering, School of Engineering, Akhil Kuchimanchi, Vagdevi Maddineni, Meghana Reddy, Ganesh Avugaddi, was accepted for publication at IACC-2022.

PERSONALIZED MOBILE-SENSING INFERENCE MODELS AMONG COLLEGE STUDENTS

Mental well-being-related issues are common among young adults due to a plethora of personal and societal reasons such as leaving home study workload, poor financial stability, and complex social relationships. These issues are even more prominent in the post-pandemic world, where social relationships have taken a toll due to more emphasis on remote work/study settings. Mood and related behaviors could vary based on a person's culture, and perceptions and beliefs regarding different moods stemming from one's culture. Issues of generalization and fairness concerning the geographical diversity of data sources have been

discussed extensively in domains such as computer vision, speech, and natural language processing. A recent exploratory study collected a mobile sensing dataset and around 329K self-reports from 678 participants from 8 countries (United Kingdom, Italy, Denmark, Mongolia, China, India, Paraguay, and Mexico) for over

3 weeks to assess the effect of geographical diversity on mood inference models. The study defined and evaluated country-specific (trained and tested within a country), country-agnostic (tested on a different country not seen on training data), and multi-country (trained and tested with a mix of countries) models trained on sensor data for two mood inference tasks with population-level (non-personalized) and hybrid (partially personalized) models. With the country-agnostic approach, this study showed that models do not perform well compared to country-specific settings, even when models are partially

personalized. This collaborative study also showed that continent-specific models outperform multi-country models in the case of Europe. Overall, the study uncovers generalization issues of mood inference models to new countries and how the geographical similarity of countries might impact mood inference. The paper won the distinguished paper award in 2023.

MULTISCALE BRAIN NETWORK MODELS PROMISE AS A POWERFUL TOOL TO EXPLORE NEURONAL MECHANISMS OF BRAIN DISEASES

The human brain is the most complex network consisting of billions of interconnected neurons performing cognitive brain functions. Nowadays, multiscale brain modeling is an interesting field in neuroscience for understanding how the brain has passed through different philosophical, experimental, and theoretical phases. There exist demands for creating a virtual brain and structured modeling framework of the human brain with neuronal microcircuit models to extend studies on robotic controllers and neuromorphic hardware, for understanding brain disorders that are difficult to implicate with experimental studies. Modeling of the brain can be done at the microscale (single neurons), mesoscale (a group of neurons), and macroscale (large-scale brain network). In a recent collaborative research work by

researchers at Università degli Studi di Milano, Milan, Italy, and Amrita Mind Brain Center, Amrita Vishwa Vidyapeetham presented a methodology to infer the connectivity of a population of neurons from their volt-

age traces. The work proposed a Multi-Class Logistic Regression with L1 penalization (MCLRL) which was benchmarked against data obtained from in silico network simulations. An ambitious application of the MCLRL algorithm could be used to study realistic in silico neural networks including the cerebellum, striatum, hippocampus, and the thalamocortical circuit. There is an increasing interest in studying the impact of neural diseases on brain function through computational models of the brain and it could be suggested to apply the proposed MCLRL algorithm to experimental data for studying neural diseases.

MODELING OF COMMON CELLULAR MECHANISMS IN PARKINSON'S AND ALZHEIMER'S DISEASES

Although the underlying mechanisms of Parkinson's and Alzheimer's Diseases have been extensively studied, there is still a lack of a comprehensive understanding of the molecular basis of both diseases. Modeling pathways of PD and AD are important as it has the potential to disease-modifying therapeutics to combat neurodegenerative disease. A recent study highlighted the reconstruction of the mathematical model of PD and AD including different cellular networks of neuroinflammation (NI), oxidative stress (OS), insulin resistance (IR), and other mechanisms leading to neurodegeneration. The model has shown that mutations in some of the proteins such as α-synuclein (αS), amyloid beta (Aβ), and tau have major roles in influencing other signaling pathways in neurons leading to NI, OS, and IR. The cellular biomarkers predicted from this model were mapped to clinical symptoms and cognitive impairment in AD/PD.

Mathematical Modelling of Common Cellular Mechanisms in Parkinson's and Alzheimer's Diseases
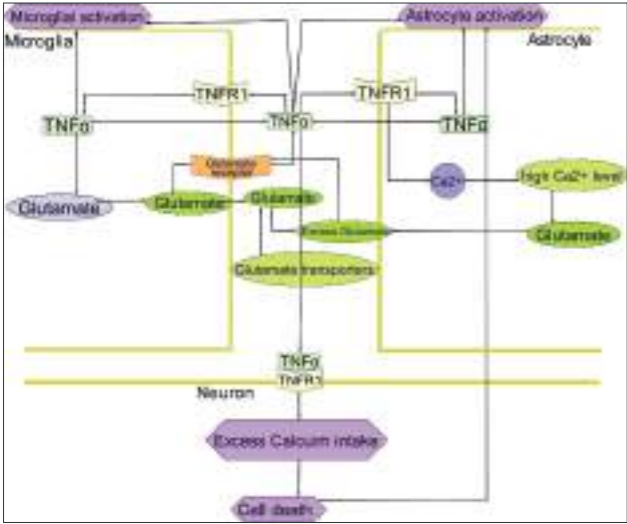
2023 WITNESSED OUTSTANDING PH.D. STORIES OF THE CENTER'S RESEARCH SCHOLARS.

On a remarkable and joyous occasion, the Amrita Mind Brain Center witnessed another successful doctoral thesis defense of four outstanding scholars, Dr.Hemalatha Sasidharakurup on the topic Systems Modelling of Common Cellular Mechanisms in Parkinson's and Alzheimer's Diseases, Dr. Sandeep Bodda on the topic Decoding a Hand Grasped Movement Using Electroencephalography, Dr. Arathi G Rajendran, "Modelling Neuronal Circuit Dynamics and Physiological Functions of Rat Cerebellum and Basal ganglia" and Dr. Chaitanya Kumar Nutakki on the topic "Computational Modeling of Neurovascular Coupling and fMRI BOLD Response in Cerebellar Circuits". More than 100 faculty, students, and researchers attended the hybrid event held at Amrita School of Biotechnology.

WEB-BASED VIRTUAL LABORATORY AS EDUCATION RESOURCES FOR PREPROCESSING AND CLASSIFYING LARGE DATASETS.

On December 20th, 2023, Mrs. Bhavya Ottappurakkal from Amrita Mind Brain Center presented at the Fifth International Conference on Computing and Network Communications (CoCoNet'23) at PES University, Bengaluru, on Developing and Deploying Open Access Web-Based Educational tools for Teaching Data Preprocessing and Classification in Bioinformatics. The work highlighted software implementation on virtual laboratories to allow student learners to preprocess and classify data with usage simplicity.

Researchers expressed their heartfelt gratitude to their advisors, mentors, family, and friends who provided unwavering support throughout their academic journeys. They also extended their appreciation to the Amrita School of Biotechnology for offering a nurturing and conducive environment for research and learning.

MODELING STUDIES SHOWED SEVERAL SINGLE-NEURON EXCITABILITY CHARACTERISTICS RELEVANT TO CURRENT DISEASE MECHANISM THEORIES: COCONET'23

On December, 18th, 2023, Dr. Arathi Rajendran from Amrita Mind Brain Center presented at the Fifth International Conference on Computing and Network Communications (CoCoNet'23) at PES University, Bengaluru, on "Computational Modelling of Spiking in the Layer 5 Projection Neurons of the Mouse Motor Cortex". MSc Bioinformatics final year students at Amrita School of Biotechnology, Ms. Navya Ajith and Ms.Aiswarya Chandrabhanu Nambiar, along with Prof. Shyam Diwakar, Amrita Mind Brain Center and Prof. Giovanni Naldi from the University of Milan co-authored the work.

EVENTS

MASTER OVER MIND MEDITATION AS A PART OF UN'S SUSTAINABLE DEVELOPMENT GOALS

Conceptualized and created by our Chancellor Sri Mata Amritanandamayi Devi, Master Over Mind (MA-OM), a University-wide meditation program launched on February 23rd, 2022 for all faculty and staff members launched by Amrita Darshanam - International Center for Spiritual Studies as part of our ongoing efforts for UN's Sustainable Development Goals SDG3: Good Health and well-being. Amrita Mind Brain Center researchers attended a university-wide free-of-cost guided meditation program on February 24, 2022. During the occasion, Swami Atmananda Puri introduced that the goal of meditation was not to discover peace but to see that our very nature is peace. He explained the need for a meditative mind focusing on peace and harmony for oneself and all beings in the universe. Meditation practices have been known to bring in benefits can include a reduction in stress, academia people as careers have become busier, and work and home-based stress impact daily life, diminishing symptoms of anxiety and depression and increasing energy and greater concentration.

ARTIFICIAL INTELLIGENCE FOR FUTURE HEALTH CARE

Dr. Shyam Diwakar was an invited speaker and a panelist at the two-day virtual conference CME on Artificial Intelligence and Machine Learning in Medicine, jointly organized by Amrita Institute of Medical Sciences, Kochi, and ICMR National Institute of Medical Statistics (ICMR-NIMS) held on April 29 and 30, 2022. Dr. Shyam Diwakar delivered a talk on From Neuroscience to AI: The Next AI Frontiers for Better Health Care". As a panelist, he addressed artificial intelligence, the Internet of Things, and the future of medicine and AI.

ARTIFICIAL INTELLIGENCE IN NEUROLOGY AND MEDICAL DIAGNOSTICS

Dr. Shyam Diwakar delivered an invited lecture titled *"AI in Neurology, Neuroscience, and Medicine: Use Cases and Beyond"* at the Artificial Intelligence in Medical Diagnostics workshop hosted by JIPMER, Puducherry, on November 25, 2022. The workshop was attended by faculty members from various institutions including AIIMS, IIT, Indian Institute of Science (IISc), and Anna University, among others.

DELVING INTO THE SCIENCE OF MEDITATION MASTERY OVER MIND (MA-OM)

Dr. Sandeep Bodda delivered a session on the science of meditation at the pedagogy workshop on the MAstery Over Mind course. A one-day pedagogy workshop on teaching and delivering the MAstery Over Mind (MAOM) course was organized on September 17, 2022, at our Amritapuri Campus with 150 faculty members from Amrita campuses at Coimbatore, Amritapuri, Kochi, Bengaluru, Mysuru, Chennai, Amaravati. On July 16th, 2023, Dr. Shyam Diwakar, Director, Amrita Mind Brain Center, spoke at the inauguration function of a 12-week online certificate course, titled ' Mastery Over Mind. The program was organized by the Amrita School of Spiritual and Cultural Studies, Amrita Vishwa Vidyapeetham.

CONNECTING NEUROSCIENCE TO MACHINE LEARNING AND ROBOTIC CONTROL ATTRIBUTES TO ARTIFICIAL INTELLIGENCE

On March 29, 2022, Prof. Shyam Diwakar, delivered the invited lecture "From Neuroscience to AI: Exploring the Cerebellum as a Deep Learning Framework for Pattern Classification and for Robotic Control" at the 6th Brain Mapping and AI workshop organized by Neurocomputing Lab, Department of Electrical Engineering, IIT Delhi from March 28-April 6,2022 through online mode.

In his talk, he explained new methods in neuroscience for deep learning and pattern recognition. He addressed the role of cerebellum-based neural networks in machine learning and robotic control.

INDIA-ITALY NETWORK OF EXCELLENCE MSBFIINE WORKSHOP AT VARANNA, ITALY

The first Multi-Scale Brain Function India-Italy Network of Excellence (MSBFIINE) workshop was held on December 9, 2022, at Villa Monastero, Varenna, Italy. The workshop was organized by University of Milan's Prof. Giovanni Naldi and Dr. Thierry Nieus along with Dr. Shyam Diwakar and Indian colleagues, Prof. Srinivasa Chakravarthy of IIT Madras and Prof. Mohan Raghavan, IIT Hyderabad. Dr. Shyam Diwakar joined Prof. Naldi in

introducing the project partners from the 6 universities in India and Italy and delivered the first scientific talk on modeling fMRI BOLD signals in the brain from a bottom-up approach at the event.

COMPUTATIONAL APPROACHES FOR UNDERSTANDING BRAIN FUNCTION WITH SYNERGISTIC INTERACTIONS AMONG NEUROBIOLOGISTS AND COMPUTER SCIENTISTS - BRAIN, COMPUTATION, AND LEARNING (BCL) 2023

Dr. Shyam Diwakar delivered a talk on Multi-Scale Modeling of the Cerebellum: Computational Neuroscience of single Neuron Models, Circuit Reconstructions and Emergent Responses, Workshop on Brain, Computation, and Learning (BCL), IISC, Bangalore, Jan 11, 2023. This workshop is aimed at creating this useful dialogue between neurobiologists and computer scientists and educating

research students of each area with relevant topics of the other.

BRAIN BODY DYNAMICS WORKSHOP @ VIDYUT 2023 - A NATIONAL-LEVEL MULTI-FEST

A one-day workshop, as part of Vidyut 2023 on 5th May 2023, aimed at providing a comprehensive understanding of the neural mechanisms underlying gait and mobility and EEG signals. The workshop was attended by more than 70 participants and included lectures, practical demonstrations, and hands-on activities to provide participants with a range of knowledge and skills related to GAIT analysis and EEG measurement. Dr. Shyam Diwakar, Director, gave a talk about the latest research and insights into mind-body connections. The researchers Mr. Abhijith Balachandran and Dr. Chaitanya Nutakki, explained the basics of gait analysis, including key gait parameters. Dr. Sandeep Bodda, Mrs.Rakhi Radhamani, and Mrs. Nijin Nizar presented an overview of the fundamentals of EEG signal processing, from data acquisition to analysis and interpretation. During the hands-on demonstration, participants explored a 14-electrode EEG device for observing their brainwaves in real-time on various motor activities.

TECH-ENABLED GLOBAL EXPANSION STRATEGIES FOR INDIAN YOGA

Dr. Shyam Diwakar was an invited speaker and panel coordinator at the Yoga Tech Conclave organized by IIT Hyderabad on May 14, 2023. Session highlighted how technology has transformed the way Yoga classes are conducted in the recent times and can potentially disrupt the way the Yoga industry has traditionally grown. Yoga Tech Conclave was targeted to address key questions related to today and future technology in Yoga training and industry. Shri Madhava Madanapalli of SVYASA, Dr. Raghavedra Rao of Central Council for Research in Yoga and Naturopathy and Shri Mayur Karthik of Art of Living. Smt.

Ekta Bouderique of Heartfullness Institute, Ms. Ganga Nandini of Parmarth Niketan, Smt. Padmini Rathore of The Yoga Institute, Shri Subodh Tiwari of Kaivalyadhama Yoga Institute and Research Center also contributed to valuable insights on ongoing research, models of understanding, and outreach of technology-enabled yoga classes.

C20 EDUCATION AND DIGITAL TRANSFORMATION SUMMIT

The Civil 20 Summit on Education and Digital Transformation took place at Hyatt Regency Trivandrum with several dignitaries from India and abroad in attendance. Hundreds of delegates from civil society organisations (CSOs), experts, and stakeholders identified the most pressing challenges faced by education and the evolution of digital access. On May 20-21, 2023, a team from Mind Brain Center with Dr. Achyutamrita Chaitanya of Amrita School of Spiritual and Cultural Studies attended the C20EG EDT summit.

LINKING FROM BRAIN SCIENCE TO AI, AND A CONNECTION FROM KNOWING THE BRAIN TO SIMULATING THE BRAIN

Dr. Shyam Diwakar was an invited speaker for the Workshop on AI/ML application to develop biomarkers for neurological disorders from 21st to 25th August 2023 at KLU University, Vijayawada, Andhra Pradesh. The workshop focused on the need for Computational Neuroscience not only to understand the brain but also to predict disorders early and even manage or cure the patient. The talk highlights the necessity to establish a bridge between brain science and AI research in the future.

CONNECTING THE FIELD OF COMPUTATIONAL NEUROSCIENCE AND BILINGUALISM

Dr. Shyam Diwakar was an invited speaker for the International Conference on Computational Neuroscience and Bilingualism, Oct 6-7, 2023, at BITS Pilani, Goa. The talk aims to foster and promote networking between researchers, academics, and scientists working in the field of Computational Neuroscience and Bilingualism.

CENTER'S ACHIEVEMENTS

MULTISCALE BRAIN FUNCTION INDIA-ITALY NETWORK OF EXCELLENCE (MSBFIINE) LAUNCHED AS PART OF THE EXECUTIVE PROGRAM OF COOPERATION (EPOC) 2022-24

Dr. Shyam Diwakar, Director, Amrita Mind-Brain Center, Indian coordinator of MSBFIINE network of excellence

To establish a strong connection through conferences, and student exchanges along with other collaborations between India and Italy, a virtual launch of the Executive Program for Scientific and Technological Cooperation between Italy and India for the years 2022-2024 was organized by the Embassy of Italy in India. Amrita Vishwa Vidyapeetham became an Indo-Italy network of excellence, and coordinator of "Multiscale Brain Function India-Italy Network of Excellence (MSBFIINE)" alongside the University of Milan and with the partners University of Pavia, University of Modena, and Reggio Emilia in Italy and Indian Institute of Technology Madras (IIT- M) and Indian Institute of Technology Hyderabad in India (IIT-H). Vincenzo de Luca, Ambassador of Italy to India, Government representatives of the executive program, Dr. S K Varshney, Department of Science and Technology, and Minister Plen, Cecilia Piccioni, Directorate-General for Country Promotion, Ministry of Foreign Affairs and International Cooperation, Italy, attended the meeting.

HIGHLIGHTS OF NEUROSCIENCE SESSIONS AT THE 7TH ANNUAL EVENT OF THE SCI-ROI (SCIENCE AND RESEARCH OPPORTUNITIES IN INDIA)

Sci-ROI strives to serve as a gateway for early-career Indian STEM professionals abroad to successfully transition back to India. On September 24-25, 2022, Dr. Shyam Diwakar, mentored neuroscience sessions at the 7th Annual event of the Sci-ROI. Dr. Soumya Swaminathan, Chief Scientist at WHO, delivered the keynote address at the event. As a part of the event, virtual events regarding jobs were conducted for postdoctoral students and PhD students in the US and abroad helping or bridging those interested in coming back to India.

INTERNATIONAL SUMMIT ON HEALTH INNOVATION, GRAND CHALLENGES AND GLOBAL COLLABORATIONS

The three-day high-level International Summit on Health Innovation, Grand Challenges & Global Collaborations was held from August 22-24, 2022, at the Amrita Hospital, Faridabad campus (Delhi NCR). Dr. Shyam Diwakar, Dr. Anand Kumar, Head of the Department of Neurology, and

Dr. Siby Gopinath, Professor, Neurology participated at this healthcare summit and participated in collaborative synergy round tables and panel discussions on collaborations for research and education with the heads of top US universities. The summit was attended by heads of top US universities including Dr. Pradeep Khosla, President of the University of California San Diego, Dr. Satish Tripathi, President and Dr. Allison Brashear, Vice-President of the State University of New York at Buffalo, Dr. Robert Clayton Robbins, President of the University of Arizona, Dr. Prashant Mohapatra, Vice Chancellor for Research, University

of California Davis and directors, professors and department heads from Stanford University, Harvard Medical Faculty Physicians. Harvard Medical School, University of Arizona, University at Buffalo, UC Davis, and UC San Diego.

BRIDGING NEUROSCIENCE RESEARCH AND AYURVEDIC APPROACHES OF YOGA IN OPHTHALMOLOGY.

Amrita Mind Brain Center in collaboration with Amrita School of Ayurveda examines the connections between yoga, ophthalmology, and associated functional brain regions. Practitioners of eye yoga are often hoping to improve their vision, treat symptoms of dry eye, and decrease eye-strain. Its benefits are extended to strengthen, tone, and relax the musculature of the eyes and promote strength, flexibility, and resilience, reducing eye strain and associated tension prompting it as a "natural" solution to many age-related vision problems. Some techniques for improving eye health include palming, blinking, circular viewing, focus shifting, up-down viewing, Trataka Kriya, and so on. The partnership hopes to bring together the expertise of leading researchers in the fields of neuroscience and traditional Indian medicine to explore the potential benefits of yoga and Ayurveda on brain function and eye health. Soon, we hope to gain a deeper understanding of the mechanisms behind how yoga and Ayurvedic practices may impact the brain and vision and to develop evidence-based recommendations for their use in promoting overall health and well-being. This partnership may bring significant contributions to the field of brain research and Ayurveda.
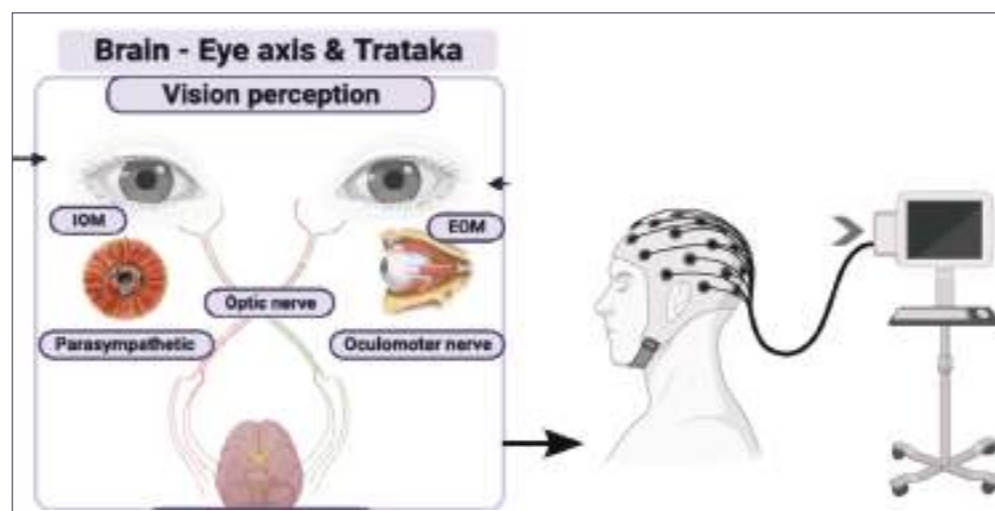
PILOT IMPLEMENTATIONS OF THE WENET PROJECT PRESENTED AT THE INTERNATIONAL MEET ORGANIZED BY THE INTERNATIONAL CENTER FOR ETHICS IN THE SCIENCES AND HUMANITIES, TÜBINGEN

On 13-15, September 2022, the International Center for Ethics in the Sciences and Humanities (IZEW) at the University of Tübingen, together with the German-American Institute Tübingen, hosted a hybrid panel discussion on "Social Innovation and AI Development in Europe" and detailed discussion on pilot implementations across the partners as part of the WeNet project activities. The panelists included Elizabeth Churchill (Google), Gi-

anluca Misuraca (Inspiring Futures, AI4GOV, InTouchAI & Re-Imagine Europa), Daniel Gatica-Perez (EPFL), and Judith Simon (University of Hamburg). The discussion was moderated by Jessica Heesen (University of Tübingen). Dr. Shyam Diwakar and Dr. Chaitanya Nutakki represented Amrita Vishwa Vidyapeetham online together with members from other universities both in person and online mode.

AMRITA VISHWA VIDYAPEETHAM AND THE UNIVERSITY OF MILAN IN ITALY JOINTLY HOSTED THE LAKE COMO SUMMER SCHOOL ON MEDICAL IMAGING.

As part of the India-Italy network of excellence project, Dr. Shyam Diwakar was a school director at the SMILE Sustainable Medical Imaging with Learning and Regularization, part of the

Lake Como School of Advanced Studies held August 28 – September 1, 2023, at Como, Italy. The school was jointly organized by Prof. Giovanni Naldi, Prof. Paola Causin from the University of Milan, Prof. Shyam Diwakar from Amrita, Prof. Marco Prato from the University of Modena, and Emilia-Romagna. The summer school had most participants in person, and a few attended online. Amrita Ph.D. students, Mr. Sreedev Radhakrishnan and Mr. Abhijith Balachandran from Amrita Mind Brain Center attended online. Dr. Shyam Diwakar gave a talk on "Telemedicine: Medical Imaging and Health" on September 1, 2023.

INTERNATIONAL VISIT

On September 14, 2022, Dr. Shyam Diwakar, visited Prof. Egidio D'Angelo's neuroscience unit and the department at the University of Pavia, Italy to expand his study on modeling multiscale brain function. This visit was part of the MSBFIINE India Italy Network of Excellence funded by DST India and MAE Italy.

Collaborators: University of Milan, University of Pavia, University of Modena, Amrita Vishwa Vidyapeetham, IIT Madras & IIT Hyderabad

VISUALIZING DEEPER INSIGHTS OF BRAIN NETWORKS THROUGH BETTER TECHNOLOGY

ANT Neuro offers high-quality, state-of-the-art products and services worldwide, providing technological solutions to leaders in the broad fields of neuroscience and neurodiagnostic applications. eego mylab provides high-density EEG/ERP experiments with a high sampling rate. It provides the highest temporal resolution with reliable results. The system is loaded with user-friendly software features for both simple and complex experiments, including step-by-step recording workflow, impedance check, subject entry management, synchronized video recording, and more. In addition, the functionality can be easily extended with EOG, ECG, EMG, real-time data access, and physiological sensors for respiration, temperature, skin conductance, acceleration, and blood oxygenation. The multi-modal system is the tool for studies seeking to determine psychophysiological correlates of mental processes, discriminate between different brain disorders, and forge the path for new pursuits in neuroscience, neurodiagnostic, and BCI.

ANNUAL CONFERENCE OF COGNITIVE SCIENCE - ACCS8.

In the last seven years, the Association for Cognitive Science (ACS) has been organizing an Annual Conference of Cognitive Science (ACCS) at some of the top universities in India including IIT Kanpur, IIT Gandhinagar, IIT Guwahati, IISc Bangalore, BITS Goa and University of Hyderabad. The 8th Annual Conference of Cognitive Science (ACCS8) was organized virtually by the Amrita Mind Brain Center, Amrita Vishwa Vidyapeetham from January 20th to 22nd, 2022, that brought together researchers from different scientific communities working on areas related to cognitive science. The ACCS conference had experts from many fields within Cognitive Science and domains such as computer science, signal processing, HCI, psychology, Linguistics, philosophy of mind, and Artificial Intelligence.

Dr, Shyam Diwakar, Director, of Amrita Mind Brain Center, commenced the event with a welcome address introduced the conference to the 698 registered participants, and invited professors to the event.

The inaugural ceremony was graced by **Sampoojya Swami Amritaswarupananda Puri,** President, Amrita Vishwa Vidyapeetham, Vice-Chairman, Mata Amritanandamayi Math, who delivered the benedictory address. Swami Amritaswarupananda told the experts and attendees "Knowledge is not objective; it is subjective. The source of information is within each of us, and it is referred to as "Vijaana", an inner revolution." He said, "When you fall in love with your work, a new dimension opens up within". He urged the scientists to in-

vestigate possibilities of bringing the wisdom of the ancient seers into modern thoughts and create a beautiful blend of science and spirituality.

Dr. Bipin Nair, Dean of Life Sciences and School of Biotechnology at Amrita Vishwa Vidyapeeth-

am, introduced the recently initiated Amrita Mind Brain Center to the conference gathering, as an initiative by the Chancellor Sri Mata Amritanandamayi Devi, for attracting the diverse scientific and research community working on various topics related to brain and mind sciences. He

addressed the multidisciplinary nature of Amrita University or Amrita Vishwa Vidyapeetham with about 20k students in 6 campuses all over India. Amrita University is one of the top 10 universities in the NIRF ranking awarded a NAAC A++ Accreditation and classified as an Institute of Eminence(IOE). He conveyed that the ACCS8 is a great opportunity for various researchers from diverse backgrounds such as computer science, signal processing, Human-Computer interactions, Psychology, and linguistics to converge on one platform and establish an understanding of the complex nature of cognitive neuroscience.

Dr. Bapi Raju S, Professor of IIIT Hyderabad, delivered the Conference Chair's address, expressing that ACCS was a platform for researchers all over the globe to share a plethora of knowledge in computational neuroscience and cognitive neuroscience. In his talk, he pointed out that we always have the quest to eliminate *"How we*

function as humans?" with physical entities that collaborate to make what we are. He addressed that the three-day conference brings institutions from logic to rational thinking and to the thinking that serves our goals or desires.

Dr.Anand Kumar A, Head of Neurology at Amrita Hospital and Vice Principal, at Amrita School of Medicine, spoke on a new topic biospaciology,

and how the brain perceives sleep-wake patterns and the surroundings. He added that as cognitive and neuroscientists we need to work together "United we stand, divided we fall".

The inaugural session was concluded by Dr. Asha Vijayan, Assistant Professor, Mind Brain Center by providing a vote of thanks speech.

KEYNOTE SPEAKERS

Nandini Chatterjee Singh, UNESCO MGIEP

Game-based courses for learning – results of an online digital game-based course to build social and emotional skills in adolescents.

Claudia A.M Gandini Wheeler-Kingshott, PhD

Principles of quantitative magnetic resonance imaging and relevance to clinical applications.

Kenji Doya, Okinawa Institute of Science and Technology, Japan

Neural Circuits for Mental Simulation

Ned Block, New York University, USA

An empirical argument that perception is non-conceptual

Egidio D'angelo, University of Pavia,Italy

Bottom-up and top-down strategies for multi-scale brain modeling

Bhavani Rao, Amrita Vishwa Vidyapeetham

"Humane" Computer Interaction – The role of HCI in facilitating social and vocational empowerment

NeuroBytes

The fireside chat session "Neurobytes" was organized and hosted by Prof. Nithin Nagaraj and Prof. Veeky Baths discussing innovative ideas relating to neuroscience and Artificial intelligence.

ACCS8 EVENTS

PAPER PRESENTATIONS

ACCS8 had 500+ papers as contributions, among which 30 novel research works have been selected for oral presentations as 3 tracks at ACCS8 through Zoom link. The parallel sessions were chaired by Prof. Devpriya Kumar (IITK) Dr. Pragathi Balasubramani (IITK) and Dr. Dr. Bapi Raju S (IITH). The authors discussed their research works relating to theoretical developments in the field of cognitive sciences, practical applications, and case studies for testing the scientific approaches.

AMBC Research Highlighted @ ACCS8

Amrita Mind Brain Center's research work led by Dr. Sandeep Bodda "Decoding hand grasped movement with EEG: Characterizing gamma oscillations, temporal biomarkers, and other cortical


potentials" was highlighted in the oral presentations.

Research work by AMBC members Mr. Abhijith Balachandran and Dr. Chaitanya Nutakki, "Modeling joint torque estimations for a lower and upper limb based on accelerometer derived gait data for assistive exoskeleton" discussed sensor-based measurement techniques designed to characterize and statistically analyze a person's motor functions and skills.
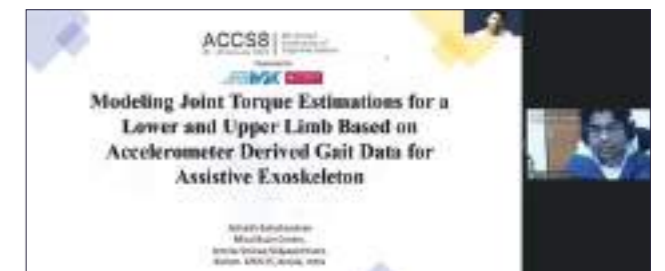
Dr. Hemalatha Sasidharakurup highlighted a Study titled "Mathematical Modelling of Biochemical Networks in Neurodegenerative Diseases"

explaining modeling of biochemical networks such as signal transduction and gene regulatory circuits are the main components of modern systems biology.
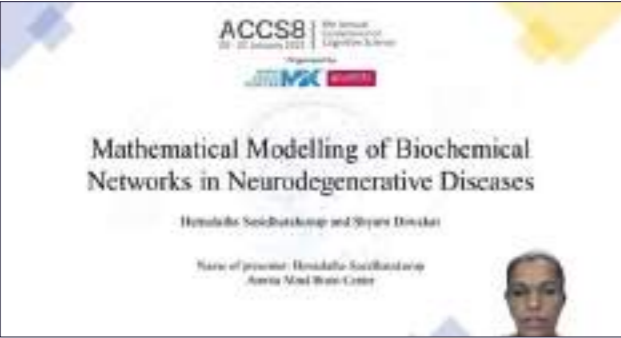

Poster Presentations

Among 500+ research work contributions, 60 research works were selected for poster presentations. The authors presented a recorded session of their work through the Zoom platform.

Highlights of AMBC at ACCS8 Poster Sessions

1. Cerebellum Model Circuitry Explaining Knockout Behaviour of Purkinje Neuron during Movement Disorder

Arathi Rajendran and Shyam Diwakar
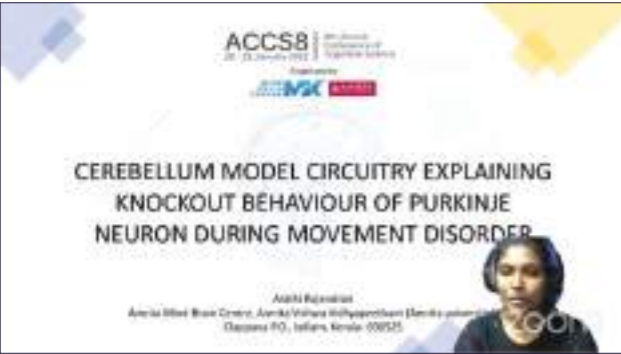
2. Implementing Web-based Bioinformatics and Biosignal Analysis Virtual Laboratories for Neuroscience Education in Universities

Dhanush Kumar, Joshy Alphonse, Krishnashree Achuthan, Bipin Nair and Shyam Diwakar

3. Learner Perception and Preferences of Using Virtual Laboratories in STEM education pre and post-COVID -19 Pandemic

Rakhi Radhamani, Anandhu Presannan, Krishnashree Achuthan, Bipin Nair, Shyam Diwakar

4. Modeling neural activity-dependent vascular changes in the cerebellar granular layer

Sreedev R, Chaitanya Nutakki and Shyam Diwakar

5. Computational Modeling of Neurovascular Coupling and fMRI BOLD Correlates of Neural Circuits using BOLDsim

The presentations by ACCS8 authors bridged the gap between the different fields of cognitive science and related neurosciences, modeling, and artificial intelligence topics, making it also possible for non-experts within an area to gain insight into new topics.

CULTURAL PROGRAMS

Getting involved in a variety of fun events and programs is a fantastic way to build intercultural skills and get engaged in activities. As we know, Kerala has a long tradition of performing arts. As a vision to transform the focus of all conference attendees from a research arena to a colorful and joyful festive mode, the center organized a cultural event through online mode that marked the second day of the conference. The talented alumni and students at the School of Biotechnology, Amritapuri Campus, added color to the conference program by entertaining the attendees with their dance and music performances. Performance of students included cultural heritages of Kerala, Kerala's dance forms such as tribal, and folk, classical and modern culture and tradition.

BRAIN ART

The brain and the mind are interconnected in complex ways. The brain and the mind play a critical role in perceiving, processing, and interpreting sensory experiences in unique and personal ways. Our mind, on the other hand, is a more abstract concept referring to the subjective experience of consciousness, thought, and emotion. It encompasses our perceptions, beliefs, desires, intentions, and other mental states that shape our experience of the world around us. As a vision to promote experiencing, sharing, learning, and getting involved, the mind-brain center is organized an art competition BRAIN ART in 2022 (Theme: Mind and Brain) and 2023 (Theme: Breaking the Stigma: Visualizing Brain Disorders), to create artworks and to merge the realms of neuroscience and art to create visually stunning and thought-provoking works that explore the complexities of the human brain and its functions. The competition was open to all ages without any socio-religious boundaries. In 2022, the event received entries of over 489 artworks in 2022 and 1089 entries in 2023 under the categories of Pencil Drawing, Painting, and Digital Drawing from amateurs to professionals, including school and college students and others from

within India. The results were announced during valedictory function of ACCS8. In 2023, the submissions were received online in various categories. The contributions were evaluated by three prominent judges in this field, winners were provided with incentive prizes, and e-certificates of participation were provided to all participants of the event.

Establishing the success stories of the event and indulging in the curiosity and engagement of participants, inspirational archives, improving skills, getting exposure, challenging individuals, and connecting with others, the Center will conduct a BRAIN ART competition annually promoting awareness of brain and mental health.
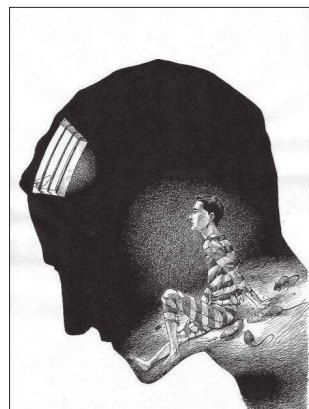
FORTY YEARS OF AMRITA YOGA: REPORT 2022

Yoga is the ideal discipline for supporting our physical and mental well-being as well as our spiritual growth. Yoga is the way to awaken our inborn capacities and attain the ultimate state of perfection. As Amma said in IDY,2021, One of the most invaluable gifts Bharat has given to the world is yoga. Amrita Vice Chancellor, Dr. Venkat Rangan, met with the President of India, Hon. Droupadi Murmu on August 24, 2022, along with some colleagues at the healthcare summit at Amrita Hospital, Faridabad and handed a copy of the "40 years of Amrita Yoga". The report covered free yoga training and outreach by the Mata Amritanandamayi Math and the organizations including yoga programs and classes at Amrita Vishwa Vidyapeetham (University campuses), Amrita Vidyalayam schools across India, other schools, and institutions, for India's armed forces and paramilitary, for corporates, yoga classes in villages, yoga camps and IDY celebrations, yoga training for the incarcerated in prisons, and yoga programs across the world since May 1980. The report endeavors to present the 40-year journey of Mata Amritanandamayi Math's efforts to spread this invaluable gift that Bharat has given to the world. "Let us all strive together to nurture and popularize yoga, which is an invaluable skill taught to us by our rishis. Let the practice of yoga benefit the entire world".

SOCIETAL OUTREACH

AMRITAVARSHAM 70

"Thank you, Amma for 70 years of torrential grace!!!"

As part of Sevanavaram (a week-long celebration of compassion and selfless service) observed in connection with Amritavarsham on September 25 – 29, 2023, the staff of Mind Brain Center organized various charitable activities. Members actively participated in a blood donation drive, 'Your Blood, Their Life', on 27 September 2023, hosted by Amrita School of Biotechnology with District Hospital Kollam.

All in the spirit of love and service inspired by Amma, members of Mind Brain Center took the initiative to visit nearby schools of Clappana, Oachira, Kulasekharapuram, Thazhava, and Karunagappally to invite the school principals to birthday program happening at the campus and to distribute tree sapling and seed balls to student coordinators of 27 schools. The aim was to promote environmental awareness and sustainability by bringing the school community together and to bring enthusiasm among students to connect to nature building a greener, healthier, and more sustainable future.

AMBC members also visited Shiva Parvati, Balika Sadanam in Pullad, Pathanamthitta District. We interacted with the 28 balikas by starting with a common prayer followed by an icebreaking session and a fun-filled activity session with games, songs, etc. Complementary gifts, sweets, and clothes were also distributed to the inmates.

INNOVATION AND DIFFUSION OF AMRITA VIRTUAL LABORATORIES

This year, Amrita Vishwa Vidyapeetham's Virtual Labs project is running a series of workshops on Virtual Labs in Physical Sciences, Chemical Sciences, Biological Sciences, Mechanical Engineering, and Computer Science. Mrs. Nijin N, Research Associate coordinated conducted Faculty and student training at different colleges and universities in India. The workshops provided a platform for learners to explore how to use virtual labs, discipline-wise hands-on training, an introduction to the Learning Managing System, and a presentation on the nodal center program, which provides a platform for everyone to contribute towards the future development of Virtual Labs.

"THE ESSENCE OF ONAM: TRADITION, UNITY, FESTIVITIES AND FAMILY FUN"

Onam is one of the grand festivals of Kerala, celebrated with intense passion and enthusiasm by Malayalis all over the world every year. As part of the university-level Onam Celebration, members of Mind Brain Center gathered with families in vibrant traditional attires marking the celebration of the grand harvest festival that embodies unity, harmony, and a deep reverence for heritage.

M.SC. IN YOGA AND COGNITIVE SCIENCES

The Amrita Mind Brain Center presents an excellent opportunity for students through its M.Sc. program in Yoga and Cognitive Science. This program is designed to provide students with a unique platform to cultivate their expertise and succeed in their desired careers. Specifically, students with a strong research interest can delve into promising career paths focused on studying the intricate relationship between yoga, meditation techniques, the brain, cognition, and related diseases. By leveraging the center's expertise and resources, including a team of highly qualified faculty members in this specialized field, students can embark on a fulfilling journey of exploration and contribute to advancing knowledge in this interdisciplinary domain.

As part of the School of Sustainable Development, the program works with the Schools of Spiritual and Cultural Studies, Biotechnology, Engineering, Computing, Ayurveda, and Social and Behavioral Sciences. The M.Sc in Yoga and Cognitive Science program is designed to provide students with an exceptional platform to cultivate their expertise and succeed in their desired careers. This is a postgraduate course provided by Amrita Vishwa Vidyapeetham at the Amritapuri Campus. Application for this course will commence on the first week of February 2024.

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- Nutakki, C., Balachandran, A., Kuchimanchi, A., Maddineni, V., Reddy, M., Avugaddi, G. and Diwakar, S., 2022, December. Towards Better Gait Predictions: Sensor-Based Detection of Flexion and Extension of Human Lower Limb Joints During Walking. In International Advanced Computing Conference (pp. 254-262). Cham: Springer Nature Switzerland.

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"Education is not only to help us live a confortable life of plenty. When our plans fall apart, when we face failure and loss, when we are knocked down, education should help us get back on our feet. Education should help us regain our mental equipoise, self-confidence and positive attitude, so that we can continue forward"

Chancellor
Sri Mata Amritanandamayi Devi (Amma)