جامعة نيويورك أبوظبي

NYU ABU DHABI

CORE TECHNOLOGY PLATFORMS

2024-2025

CORE **TECHNOLOGY PLATFORMS**

جامعة نيويورك أبوظبي

NYU ABU DHABI

A Message from the Provost

At NYU Abu Dhabi, we are deeply committed to advancing knowledge and fostering innovation across disciplines. Central to this mission are the Core Technology Platforms (CTP), which provide our faculty and researchers with the tools and expertise necessary to excel in their work. The CTPs are indispensable assets, enabling research that spans a wide array of scientific fields and addresses some of the most pressing challenges of our time.

The CTPs exemplify the collaborative spirit of NYU Abu Dhabi. They bring together scholars from diverse backgrounds, creating a dynamic environment where ideas flourish and cutting-edge research is not just supported, but actively propelled forward. The advanced technologies and expert guidance offered by the CTPs are instrumental in producing the high-impact research that positions NYU Abu Dhabi as a global higher education.

As we look to the future, the role of the CTPs will only grow in importance. They are key to our ability to innovate, to respond to emerging challenges, and to contribute to the knowledge-based economy of Abu Dhabi and the UAE. I am confident that the CTPs will continue to be a driving force behind the groundbreaking research that defines our university.

Warm regards,

Arlie Petters

A Message from the Senior Vice Provost of Research

In today's fast-paced world of scientific and engineering advancement, staying at the forefront of innovation requires more than just a vision—it demands a robust technological foundation. At NYU Abu Dhabi, the pursuit of research excellence is a fundamental pillar of our academic mission. The Core Technology Platforms (CTP) play a critical role in this endeavour, serving as the backbone of our research infrastructure. By integrating cutting-edge technologies with user-friendly interfaces and dedicated support staff, the CTPs enable our faculty and researchers to conduct ground breaking research that push the boundaries of knowledge. Indeed, the CTPs are hubs of innovation and collaboration by providing access to state-of-the-art technologies and fostering interdisciplinary research, thereby, empowering our scientists to address complex global challenges, from health sciences to environmental sustainability.

As we continue to expand our research horizons, the CTPs will remain at the forefront, driving the scientific and technological advancements that define NYU Abu Dhabi as a leading institution in the region and beyond. The continued investment in, and development of, these platforms reflect our commitment to maintaining the highest standards of research. The CTPs are not just integral to our current success but are vital to the future achievements of our academic community. I am proud to witness the extraordinary work being done and excited about the possibilities that lie ahead. Together, we are not just advancing research—we are shaping the future.

Sehamuddin Galadari

A Message from the Executive Director

The Core Technology Platforms (CTP) at NYU Abu Dhabi is the cornerstone of our research, providing exceptional support across various scientific disciplines. Our advanced technologies and skilled specialists ensure the highest standards of performance. This book highlights our diverse facilities and celebrates the groundbreaking research by our esteemed faculty.

Our mission is to foster interdisciplinary collaboration, pushing the frontiers of knowledge and addressing critical challenges. As we grow and adapt, the CTP remains committed to empowering researchers, driving innovation, and contributing to Abu Dhabi's sustainable, knowledge-based economy.

Reza Rowshan

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NYU ABU DHABI

Each Core Technology Platform (CTP) consists of a suite of research-grade equipment and are defined by the type of research they facilitate.

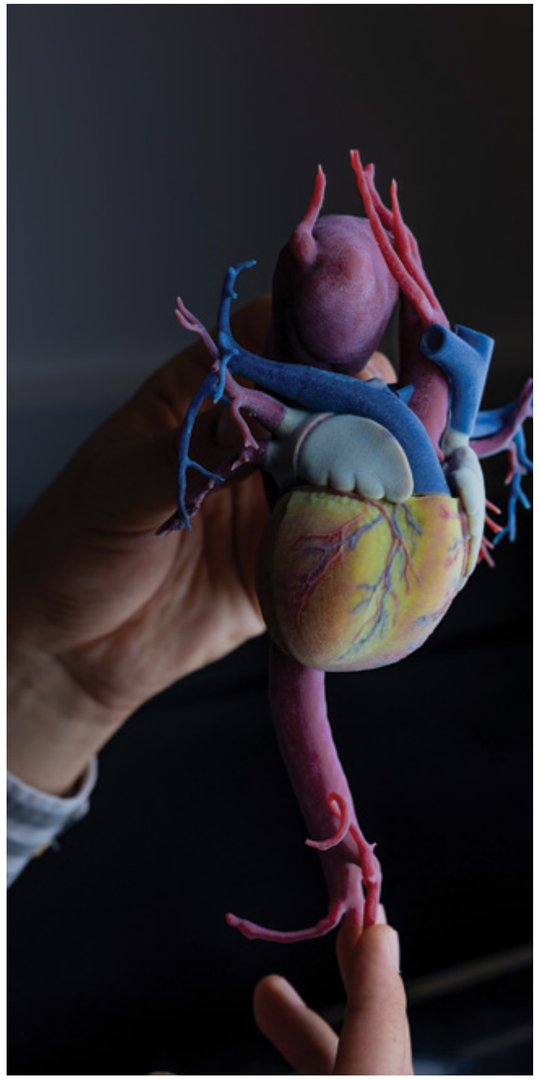
Introduction

NYU Abu Dhabi

NYU Abu Dhabi is enriched by the intellectual vitality and research opportunities of a new world-class research institute and benefits from an active connection to NYU New York and other NYU global sites. NYU Abu Dhabi provides the finest educational opportunities and supports innovative research programs that push forward the frontiers of knowledge, responding in powerful and interdisciplinary ways to vital local and global challenges. NYUAD advances NYU as a model University and contributes in multiple ways to the development of a sustainable, knowledge-based economy in Abu Dhabi. NYU Abu Dhabi has dedicated significant resources to developing one of the premier sciences and engineering research laboratories in the region. An integral component of the laboratories is the Core Technology Platforms, which are shared facilities that support research activities across disciplines.

Core Technology Platforms (CTP)

Each Core Technology Platform (CTP) consists of a suite of research-grade equipment and is defined by the type of research they facilitate. The CTPs will continue to evolve and develop as new technology is added and new areas of research are conducted at NYUAD. Support is provided by a team of highly qualified specialists who maintain and upgrade the equipment, define standards for operational performance, and provide technical and scientific assistance across the core labs.



Advanced
Manufacturing
And Electronics

Advanced Manufacturing and Electronics

The Advanced Manufacturing and Electronics Core Technology Platform supports research in the following areas:

- Mechanical design and Manufacturing of custom-made parts
- Materials imaging and Non-destructive testing
- Mechanical testing
- Advanced manufacturing techniques including 3D printing, and casting.

All activities are performed using state-of-the-art software and manufacturing equipment operated by specialized trained personnel using cutting-edge techniques. Depending on the nature of the project, a single machine or combination of machines is used. Materials used in the manufacturing of parts can range from a variety of metals, plastics, ceramics, and other materials determined by the project. The facility can produce parts accurate to the micro-scale.

Main Equipment

- 3D Stereolithography printing – Formlabs – Form 3+
- 3D Ceramic Printer - Raise 3DPro2
- 3D Printer- BMF S240
- FDM 3D Printer - F370 – Stratasys
- Polyjet 3D Printer - J750 – Stratasys
- SLS 3D Metal Printer - M270 – EOS
- SLS 3D Metal Printer - M280 – EOS
- SLS 3D Polymer Printer - EOS Formiga P110
- Ultimaker 3D Printer
- CNC turning Center - DS 30Y – HAAS
- CNC 5 Axis Milling Machine - HAAS UMC 1500 SS DUO
- Metal Surface electropolishing system - Dlyte l100- Dlyte
- Metal Surface Trough vibrator - AM-R – Rosler
- Centrifuge Casting System - Galloni – Fusus
- Metal Casting - Neutec J2R - Rio Grande
- Thermal Conductivity Analyzer - C-Therm TCI
- Tubular Furnace -Zetasinter
- Universal Testing System- 5960 series with 5KN – Instron
- Water Jet Machining - 55100 -OMAX
- Wire EDM- CUT 30P-AgieCharmilles
- X-ray Micro Computer Tomography System SkyScan 1272 Bruker

Advanced Manufacturing and Electronics

Materials used in the manufacturing of parts can range from a variety of metals, plastics, ceramics, and other materials determined by the project

Analytical and Materials Characterization

The Analytical and Materials Characterization Core Technology Platform supports scientific advancements and the development of new technologies. This facility provides state-of-the-art instrumentation with major capabilities for fundamental studies of the surface, ultrastructure and interfacial properties of materials in the following major areas:

MATERIALS CHARACTERIZATION

Characterization is used by researchers in the fields of chemistry, physics, biology, engineering, and archaeology to study the properties of samples by morphology, mechanical, chemical and crystalline properties from macro to nanometer scale. The main techniques used in this area are optical microscopy, scanning electron microscopy, transmission electron microscopy, energy-dispersive x-ray spectroscopy, x-ray fluorescence, atomic force microscopy, and mechanical testing.

ELECTRON MICROSCOPY

Scanning Electron Microscopy is a key technique within the Materials Characterization realm. By utilizing focused electron beams, SEM produces high-resolution images of material surfaces. Researchers from diverse fields such as chemistry, physics, biology, engineering, and archaeology leverage SEM to delve into the intricacies of sample morphology.

Transmission Electron Microscopy takes electron microscopy to the nanoscale, providing unparalleled insights into the ultrastructure of materials. This technique is employed across various disciplines, allowing researchers to explore the crystalline, mechanical, and chemical properties of samples with remarkable precision. TEM facilitates fundamental studies at the nanometer scale, contributing to advancements in fields such as materials science, chemistry and biology.

CRYSTALLOGRAPHIC CHARACTERIZATION

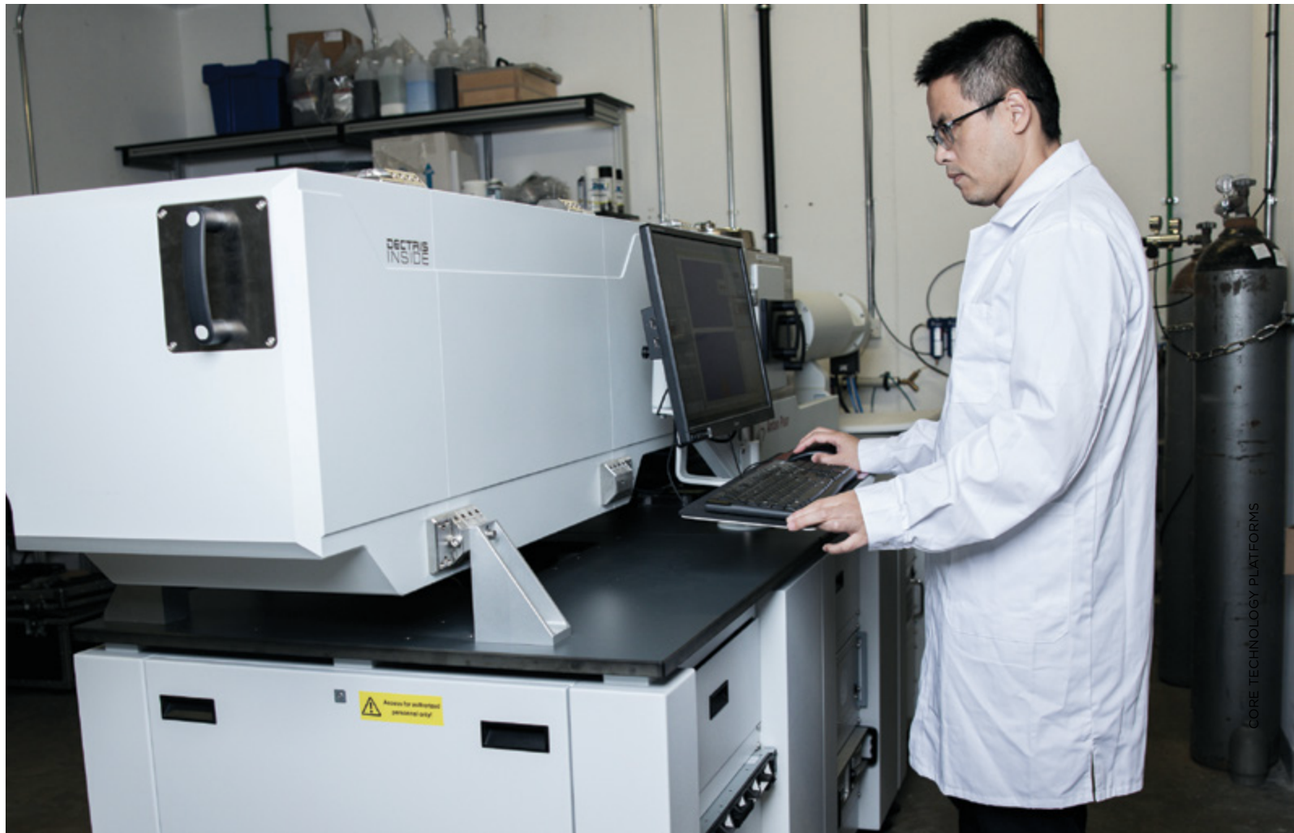
Powder, single crystal, and Small Angle Scattering (SAXS) x-ray diffractometers are available for a wide range of material identification, structural characterization, and characterization of thin films. Various sample stages are available for ambient and non-ambient characterization.

Recent research activities have included work on the structure of insect eyes, identification of diatoms on coral substrates, characterization of archaeological debris, cross-sectional imaging of integrated circuits, mechanical properties of organic crystals, X-ray tomography of organic crystals, analysis of lithographically defined materials, the structure of nano-scale scaffolds and Raman identification of olive oil adulterants, characterization of 2-D materials, and investigations of cements. Its ability to capture surface details with exceptional clarity makes it an indispensable tool for studying a wide range of materials, from biological specimens to engineered structures.

Main Equipment

- Potentiostat / Galvanostat Biologic SP-300
- Pycnometer - Micromeritics Accupyc 1340
- Surface Characterization- Micromeritics 3Flex
- Surface Tensiometer - Biolin Sigma 701
- Tensile stage - MTI Instruments MTEST
- Thermal Analysis F1 209 Libra
- Thermal Analysis-TGA - TA Instruments Q600
- Carbon Coater- Leica ACE600
- Vacuum Evaporator Denton DV-502B
- Video-Based Optical Contact Angle - DataPhysics OCA 15EC
- Dual Beam Scanning Electron Microscope - ThermoFischer Scios
- Scanning Electron Microscope - ThermoFischer Quanta3D
- Transmission Electron Microscope - ThermoFischer Talos F200X
- Poseidon Select Liquid Cell Holder
- Cryo Ultramicrotome Leica EM UC7/FC7
- NX70 Cryostat
- Rotary Microtome (100 microns sections) - Leica RM2265
- Cryostat Leica CM1950
- Freeze Substitution system - Leica AFS2
- High-Pressure Freezer Leica EM ICE
- Vitrobot FEI Mark IV
- Critical Point Dryer - Leica CPD300
- Protochips Atmosphere- TEM Environmental Gas Cell
- Target sample Preparation Device - Leica EM-TXP

- AFM - Agilent 5500
- AFM - Bruker Dimension Icon
- Nanowizard 4XP Atomic Force Microscope
- Metallographic Microscope - Olympus GX-53
- Microscope - Nikon LV 100 POL
- Nano Indenter Agilent G200
- Nanoindenter - KLA Nanoflip
- Raman Microscope - Witec Alpha 300
- SAXSpoint 5.0 Small Angle X-ray Scattering System - Anton Paar
- Single Crystal X-ray Diffraction System - Bruker D8
- X-ray Powder Diffractometer (Empyrean 2 and 3)
- XRF - Rigaku NEC GC
- DSC - Setaram SENSYS EVO
- DSC - TA Instruments Q2000
- Elemental Analyzer - Elementa-Vario Micro Cube
- Microcalorimeter - TA Instruments TAM IV
- Particle Sizing System - Anton Parr PSA 1190
- Petrology Saw/Grinder - Bueller Petrothin
- Plasma Processor- Femto Science Cute



Brain Imaging

The Brain Imaging Core Technology Platform performs cutting-edge, non-invasive examination of the brain's structural features and functional activation, and its relation to human behavior, language, and working memory, which is observed via magnetic resonance imaging (MRI) technology. This CTP is staffed with an imaging physicist and a certified MRI technologist, and is equipped with a state-of-the-art 3T Siemens MAGNETOM Prisma MRI scanner. The latest pulse sequences such as simultaneous multi-slice (SMS) for BOLD and diffusion sequences provide unparalleled capability of acquiring high spatial and temporal resolution images with adequate signal-to-noise ratio in shorter scan times. Several RF coils are available with the Prisma such as 20, 32, and 64 Channels head "TIM" RF receiver in addition to the RF body coils.

Furthermore, the Brain Imaging Core incorporates an advanced superconducting magnetoencephalography (MEG) system from Kyoto Institute of Technology (KIT). This state-of-the-art, non-invasive functional imaging technology enables researchers to directly record in real-time local electrical activity using approximately 160 axial gradiometers (recording electrodes) uniformly distributed across the brain with exceptional spatio-temporal resolution. This brain mapping capability empowers comprehensive investigations into cognitive functions, facilitating the examination of the brain's reactions to specific tasks or stimuli.

Last, the Brain Imaging Core integrates the Small Animal Imaging platform, offering advanced in vivo and ex vivo multimodality imaging for preclinical models. This capability empowers researchers to conduct comprehensive and non-invasive longitudinal assessments across various dimensions, including animal anatomy, physiology, metabolism, gene expression, and disease progression.

The facility plays a pivotal role in research, facilitating the evaluation of potential drug efficacy, gaining a non-invasive molecular understanding of disease processes in animal models, assessing therapeutic responses, and contributing to the development of novel imaging contrast agents. At the core of its capabilities is the state-of-the-art IVIS Spectrum optical imaging system from Revvity/Perkin Elmer. This system supports in vivo 2D and 3D bioluminescence and fluorescence imaging, accommodating a wide array of reporters. Complementing this, the facility houses a cutting-edge high-resolution, low-dose microCT scanner, the SkyScan 1276 from Bruker (X-ray Computed Tomography), enabling detailed structural and functional imaging. For direct visualization of internal organs and biopsy procedures, researchers have access to a tailored Endo-Arthroflator-Vet endoscope from Karl Storz.

Main Equipment

MRI Lab
- MRI scanner - Siemens MAGNETOM Prisma 3T
- Eye Link 1000 Eye Tracking System
- Vpixx Projector System (visual, auditory, and response boxes)
- Digital video camera MR compatible in-bore “MRC-HiSpeed”
- MRI compatible microphone

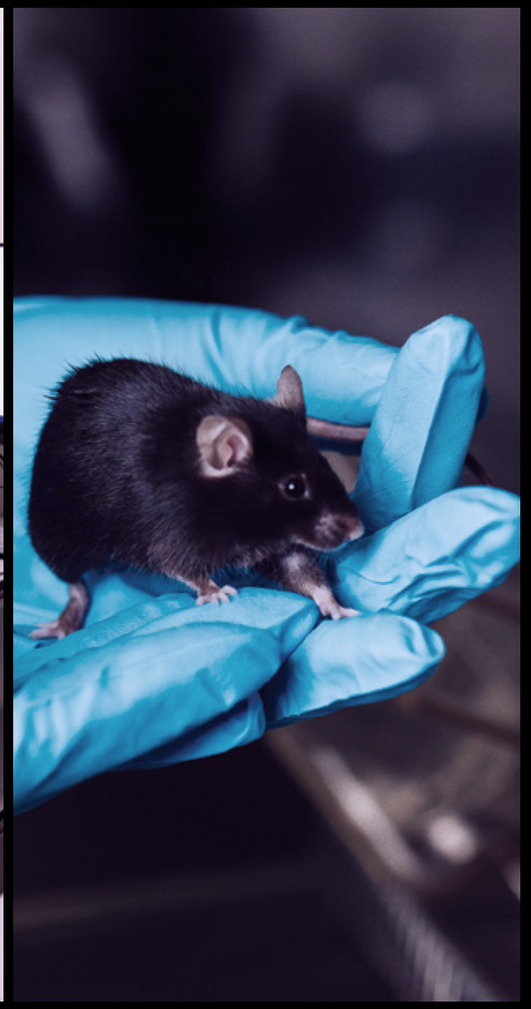
Mock Scanner Room
- Vpixx Projector System (visual, auditory, and response boxes)
- 32/64 Channel Brain Products EEG System
- Eye Link 1000 Eye Tracking System (benchtop)

MEG Lab
- 208 Channel Kit MEG System
- Vpixx Projector System (visual, auditory, and response boxes)
- Eye Link 1000 Eye Tracking System
- Helium Recovery System (purification and liquification)
- FastSCAN Laser Scanner

Small Animal Imaging Lab
- PerkinElmer IVIS Spectrum Imaging 220V
- SKYSCAN 1276 -High-resolution desktop in vivo micro-CT system
- Anesthesia Machine
- Rodent Endoscope System Karl Storz

Computing Resources
- Dell PowerEdge Server (4xA100 GPU Data Center)

Brain Imaging



Small Animal Imaging Lab

High-Throughput Screening

High-Throughput Screening

The High-Throughput Screening (HTS) Core Technology Platform, managed by the Center of Genomics and Systems Biology team, allows researchers to rapidly automate thousands of chemical and biological assays. It is used by biologists and chemists to screen large libraries of chemical and biological reagents for bioactive compound discovery, toxicity studies, and cell biology research.

This CTP is equipped with an integrated screening platform and advanced laboratory automation technology for cell-based and whole organism (e.g., microbial, worm and zebrafish) assays. This platform facilitates the automation of most steps involved in high-throughput screening of small molecule or genomic (e.g., RNAi, CRISPR) libraries. These steps include mixing reagents with cells or whole organisms, sample incubation in controlled environments, and high-content imaging at multiple levels of magnification in both bright-field and multi-channel fluorescence modes.

Main Equipment

- Agilent Bravo Automated Liquid Handling Platform
- High-throughput Screen System
- Honeybee Crystallization Robot
- Microplate Dispenser

Kinesis

The Kinesis Lab is a shared multi-space laboratory for design, exploration, and experimentation, related movement by utilizing Robotics, Artificial intelligence, and Automation technologies.This cutting-edge laboratory is meticulously outfitted with state-of-the-art technology in the realms of Robotics and Artificial Intelligence, like Mobile Robots, Drones, Robotic arms, Motion capture system, etc, that NYUAD Researchers and collaborators are using to perform their research activities in a very broad spectrum of applications. The lab's design fosters an environment of innovation, where researchers can push the boundaries of what's possible in their research field, creating a hub of technological advancement and scientific inquiry.

Arena

The Arena is the dedicated area for motion experimentation. The Arena is a 17m x 6.4m x 8m space constructed from adaptable truss structures with surrounding nets for safety and can be reconfigured accordingly. The lighting system is controllable for colors and intensity, and removable protective mattresses cover the ground area. The Arena is equipped with a local position tracking system, a 2 kW sound system, a projection system, and a high-speed ethernet and wireless network.

Workspace

The Workspace houses workstations for eight scientists with a high-speed local network and controllable lighting system. The Workspace is also home to a high-performance GPU unit and a safe charging station for LiPo batteries.

Equipment

The lab's equipment focuses on facilitating motion experimentation. At its core are the Motion Capture System, a Robotic Arm, linear and Rotary stages, VR equipment, Unmanned Aerial Vehicles (Drones) and Mobile Robots, and a plethora of Payloads such as 3D Scanners, Visible - Thermal - Hyperspectral cameras, Communication Modules, etc.

Applications and Research

The Kinesis laboratory can be instrumental in the realization of projects in a wide range of fields, such as:

Biomechanical
- Gait Analysis and Rehabilitation
- Posture, Balance, and Motor Control
- Athletics (sports performance, movement evaluation)
- Animal biomechanics and science
- Psychology and Neurology research

Engineering
- Robotics (UAV, industrial robots, robots localization, movement analysis, trajectory generation)
- Product design and evaluation (Car production industry, Aerospace, etc.)
- Virtual Reality, Immersive Reality, and Augmented Reality (Subject localization, gesture recognition)
- Aerodynamics research
- Control systems
- Artificial Intelligence and Machine learning (Artificial Neural Networks, Deep Learning, Deep Reinforcement Learning, etc)

Entertainment
- Video game development (Character animation, object animation, effects generation)
- Film production (Character animation, Object movement and animation, Computer-Generated Imagery (CGI) .
- Sound and motion application and research (Music performance and pedagogy,
- Neuroscience, Music psychology research)

Services

Users of the Kinesis Lab can receive highly specialized support in all aspects of the lab. This includes:
- Project-specific consultations
- Project execution support
- Operation of the equipment
- Training on the equipment

Main Equipment

- 3D Scanner - Faro Focus 350s plus
- Drone - Custom made
- Drone - DJI Mavic Pro 2
- Drone -Matrice 300 RTK
- Ground Robot - Boston Dynamics Spot
- Ground Robot with Robotic Arm Boston Dynamics Spot
- Motion Capture System - Vicon Vantage V16
- Object 3d Scanner- Creaform GO! SCAN 3D
- Robotic Arm - KUKA LBR iiwa 14 R820
- Robotic Gripper – Robotiq 3- Finger Adaptive Robot Gripper
- Thermal / Visual Zoom Camera - Workswell Wiris ProSc
- Wireless Network Transceivers - Persistent Systems MPU5

Light
Microscopy

Light Microscopy

The Light Microscopy Core Technology Platform provides access to several state-of-the-art microscopes and aids in the following research activities:

Confocal and super-resolution imaging:

The microscopy facility applications include molecular motor transport studies, 3D neuronal network imaging and nanoparticle testing and cell screening. The facility also can perform imaging of fluorescently labeled samples including drosophila brains, mouse brain sections and cultured cells.

Widefield microscopy:

Various imaging techniques are used in widefield microscopy which include epifluorescence, phase contract, and differential contrast microscopy. These are used in the core facility in various projects such as cell growth and proliferation regulation studies, actin reprogramming and C. elegans embryogenesis.

Sample preparation:

The facility supports researchers in experimental design and suggests different labeling techniques and microscopes setups for the various applications.

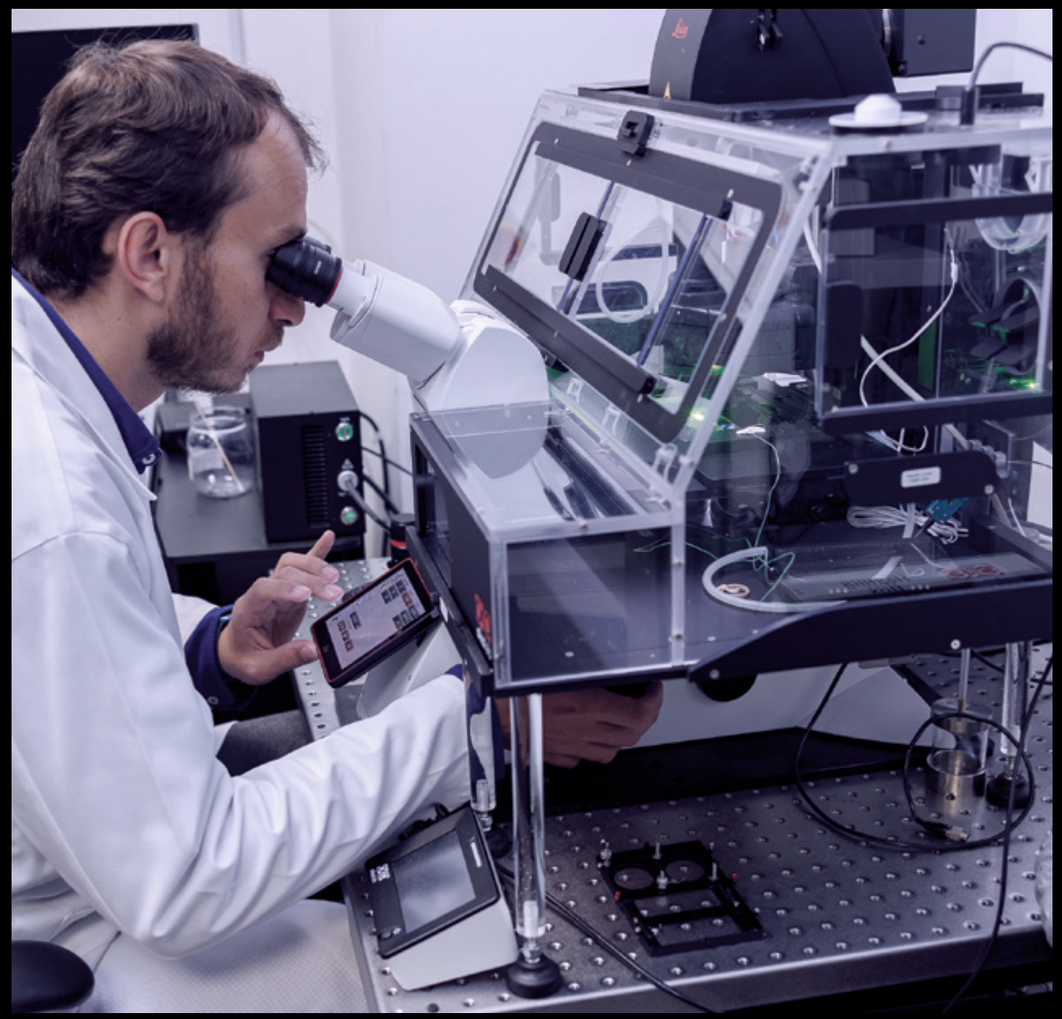
Data Analysis:

Various software programs are available for the post processing of the images on a processing workstation (Autoquant, Imaris, Matlab, LasX offline license).

Main Equipment

- Biotek Instrument- LionHeart LLX
- Metallurgical Microscope - Nikon LV-Dia
- Confocal Fluorescence Microscope Stellaris
- Confocal Microscope - Leica SP8
- Confocal Two-Photon Microscope (Inverted) - Olympus FV1000
- Confocal Two-Photon Microscope (Upright) - Olympus FV1000
- EVOS FL Auto Imaging System
- EVOS FL Cell Imaging System
- Fluorescence Lifetime Microscope MicroTime100 Picoquant
- Holographic Microscope - Nanolive 3D Cell Explorer
- Microscope Acoustic easySAM Research 2000 Kibero
- Microscopy Processing Station II – SuperMicro
- Nikon LV100 DIC/Fluorescence Metallurgical Microscope
- Nikon SMZ18 Stereomicroscope
- Stereo Microscope - Leica M205C
- Super Resolution Microscope - Leica STED 3X
- Widefield Microscope - Leica DMI3000
- Widefield Microscope - Leica DMI6000
- Widefield Microscope - Olympus IX83
- Optical Coherence Tomography System GANYMEDE SD-OCT
- Primo - Micropatterning system

Light Microscopy



The Light Microscopy Core Technology Platform provides access to several state of the art microscopes

Marine Sciences

The Marine Sciences Core Technology Platform equips researchers with the necessary training and tools to use the Arabian Gulf as a natural laboratory, both above and below the water surface.

Among the various research activities, scientists at NYUAD are examining how coral communities in these extreme environments respond to and recover from mass bleaching events. They are also investigating the impact of variations in environmental conditions on the biogeographic patterns of community structures among corals, fish, and other reef biota in the region. Additionally, the team is monitoring and studying the evolving soundscapes of coral reefs in the Arabian Gulf, while actively participating in studies focused on the local mangrove ecosystem.

In collaboration with the Mubadala ACCESS Center, another group is studying the hydrography of the basin and sampling the UAE waters. Their primary objectives include examining the biogeochemistry, classifying dominant species of phytoplankton and microbes, and analyzing potential contributions to recently discovered oxygen depletion zones in the Arabian Gulf. This group is also researching the sequential bloom of various phytoplankton groups within an enclosed bay, as well as the occasional appearance of potentially harmful algal bloom species.

The Marine Sciences facility is equipped with the latest technology and tools to facilitate cutting-edge research in this field.

Main Equipment

Research Vehicles
- Thuraya- Ribcraft 8m
- NYUAD- Arabiancraft 10m

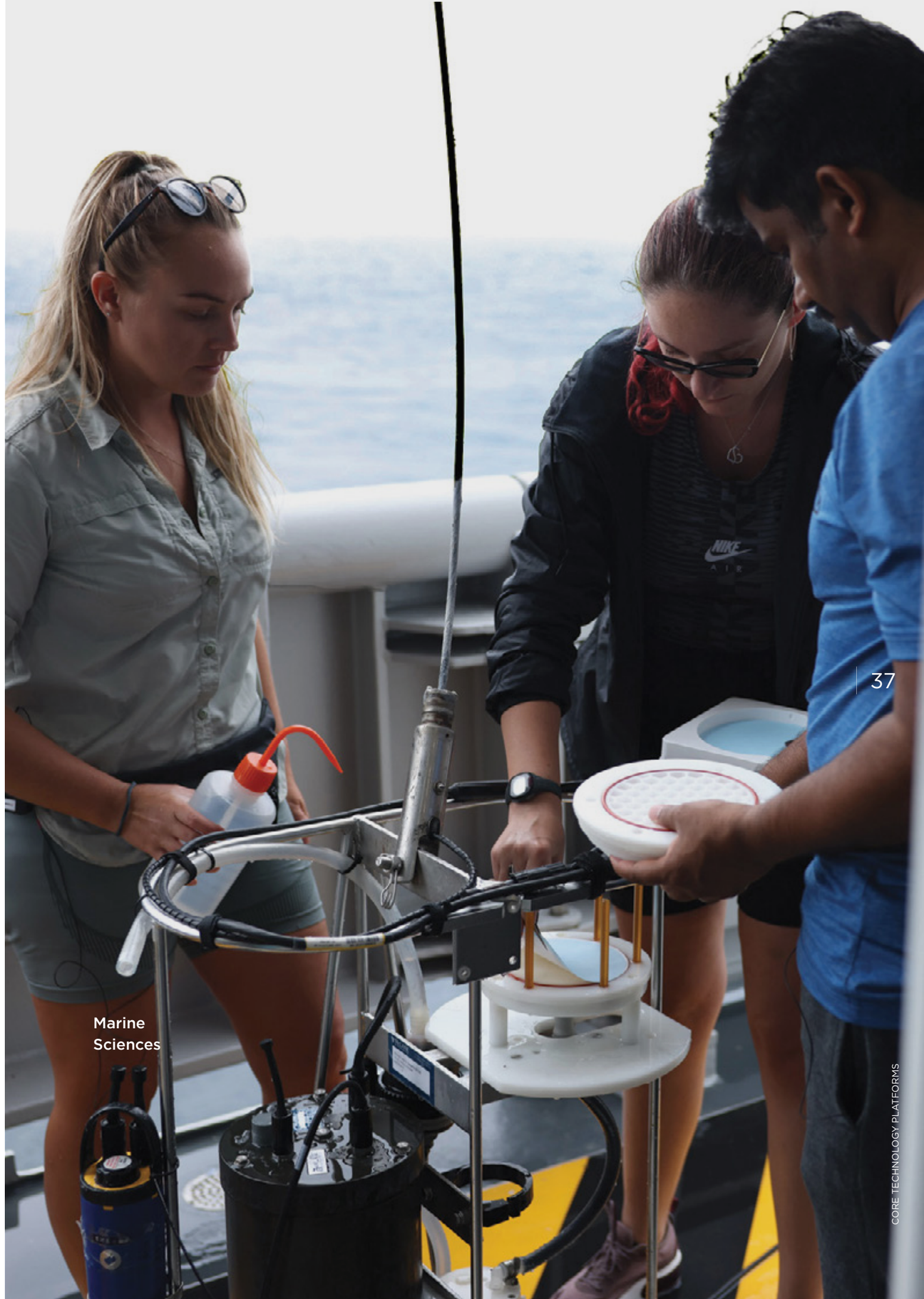
Water Quality Sampling and Monitoring
- YSI PRO DSS - Handheld Multimeter with 4 port bulkhead
- YSI Exo2 Sonde

Acoustic Doppler Current Profiler
- Teledyne Sentinel V ADCP

Diving
- Breathing Air Compressor - Bauer Mini Verticus III
- Closed Circuit Rebreather AP
- Diving Propulsion Vehicles
- Scuba Equipment

Vehicle
- Dodge Ram
- GMC Truck

Training for Operation and Instruments
- Open Circuit Scuba Diving Training (All Levels and Specialties)
- Closed Circuit Rebreather Training
- Diving Propulsion Vehicle Training
- Scientific Diver Training
- DAN training (AED, BLS, Oxygen provider, First Aid)
- Boat Driving Orientation
- Truck Driving Orientation
- Breathing Air Compressor Orientation
- YSI EXOs Sondes
- YSI ProDSS - Handheld Multimeter



Micro
Fabrication

Micro Fabrication

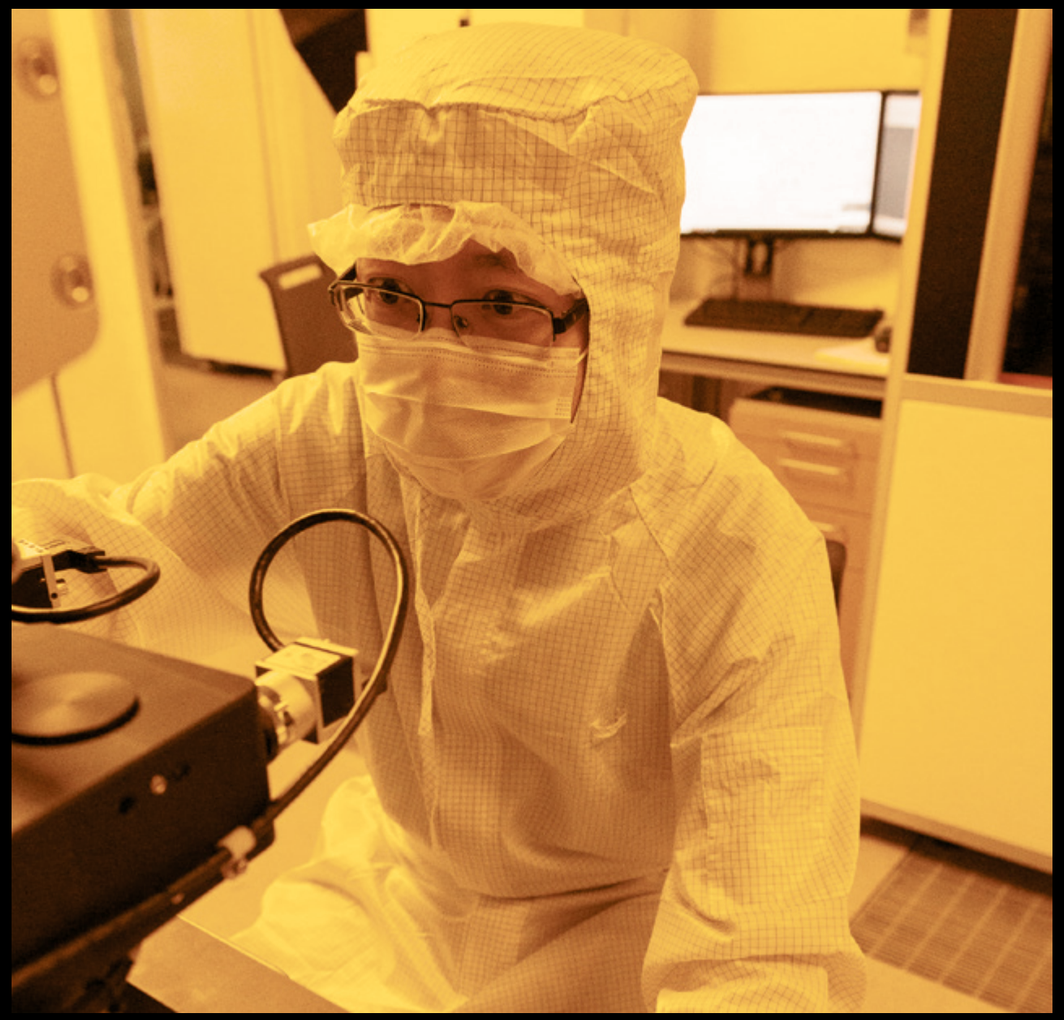
The Micro Fabrication Core Technology Platform has the equipment necessary to perform lithography for microelectromechanical systems (MEMS) and microfabrication.

Researchers are utilizing this CTP to build microfluidic platforms for high-throughput drug screening, develop ultrasensitive point-of-care diagnostic chips for early detection of cancer and other diseases, design chips to isolate fetal cells from maternal blood and create portable platforms for monitoring the quality of water in developing and developed countries.

Main Equipment

- 3D Nano Printer - Nanoscribe Photonic Professional GT
- Atomic Layer Deposition (NLD-3500)
- Magnetron Sputter- ATC Orion Series UHV Sputtering System
- Spin Coater - Laurell WS650
- Mask Aligner - Karl Suss MA8
- Mask Writer- Heidelberg Instruments DWL66+
- Micro Dispensing System - M24You Two-200
- Microplotter system - SonoPlot GIX II
- Physical Property Measurement System (PPMS) Quantum Design DynaCool 9T
- Physical Vapor Deposition - Lesker Proline PVD 75
- Plasma Processor - Femtoscience COVANCE
- QCMD- Biolin QSense Analyzer
- QSense Analyzer -Biolin QCM-D
- Rapid thermal processing - Jipelec JetFirst 200C
- Reactive Ion Etcher - Advanced Vacuum Vision 320
- SDS PDS 2010 Labcoater 2 Parylene Deposition System
- Spectroscopic Imaging Nulling Ellipsometer Accurion EP4
- Surface Profiler Bruker Dektek XT-A
- Thermal Evaporator – Angstrom Engineering Nexdep 400
- Vertisis Technology – MagVision Kerr System

The Micro Fabrication



The Micro Fabrication Core Technology Platform has the equipment necessary to perform lithography for microelectromechanical systems (MEMS) and microfabrication.

Molecular and
Cell Biology

Molecular and Cell Biology

The Molecular and Cell Biology Core Technology Platform provides a broad range of services and expertise that aid scientists in performing research at the molecular, single cell, and tissue culture level. Research activities carried out at NYUAD in this core include:

Gene Editing and Molecular Cloning:
- Genome editing services for targeted gene knockout, knock-in, and gene modifications
- Molecular cloning techniques for gene insertion, deletion, and manipulation
- Recombinant DNA technology for constructing expression vectors and genetic engineering

Protein Expression and Purification:
- Recombinant protein expression in bacterial, yeast, insect, or mammalian cell
- Protein purification using chromatography techniques such as affinity chromatography, ion exchange chromatography, and size exclusion chromatography
- Characterization of protein structure, function, and interactions

Cell Culture and Functional Assays:
- Cell culture services for maintaining and propagating cell lines, primary cells, and stem cells
- Functional assays to study cell proliferation, viability, apoptosis, migration, and differentiation
- High-content screening (HCS) and automated microscopy (Brightfield and Fluorescence) for analyzing cellular phenotypes and responses
- Live-cell imaging to track dynamic processes and monitor cellular behavior in real-time

Flow Cytometry and Cell Sorting:
- Flow cytometry analysis for quantifying and characterizing cells based on surface markers, intracellular proteins, and DNA content
- Fluorescence-activated cell sorting (FACS) for isolating specific cell populations based on their phenotypic properties

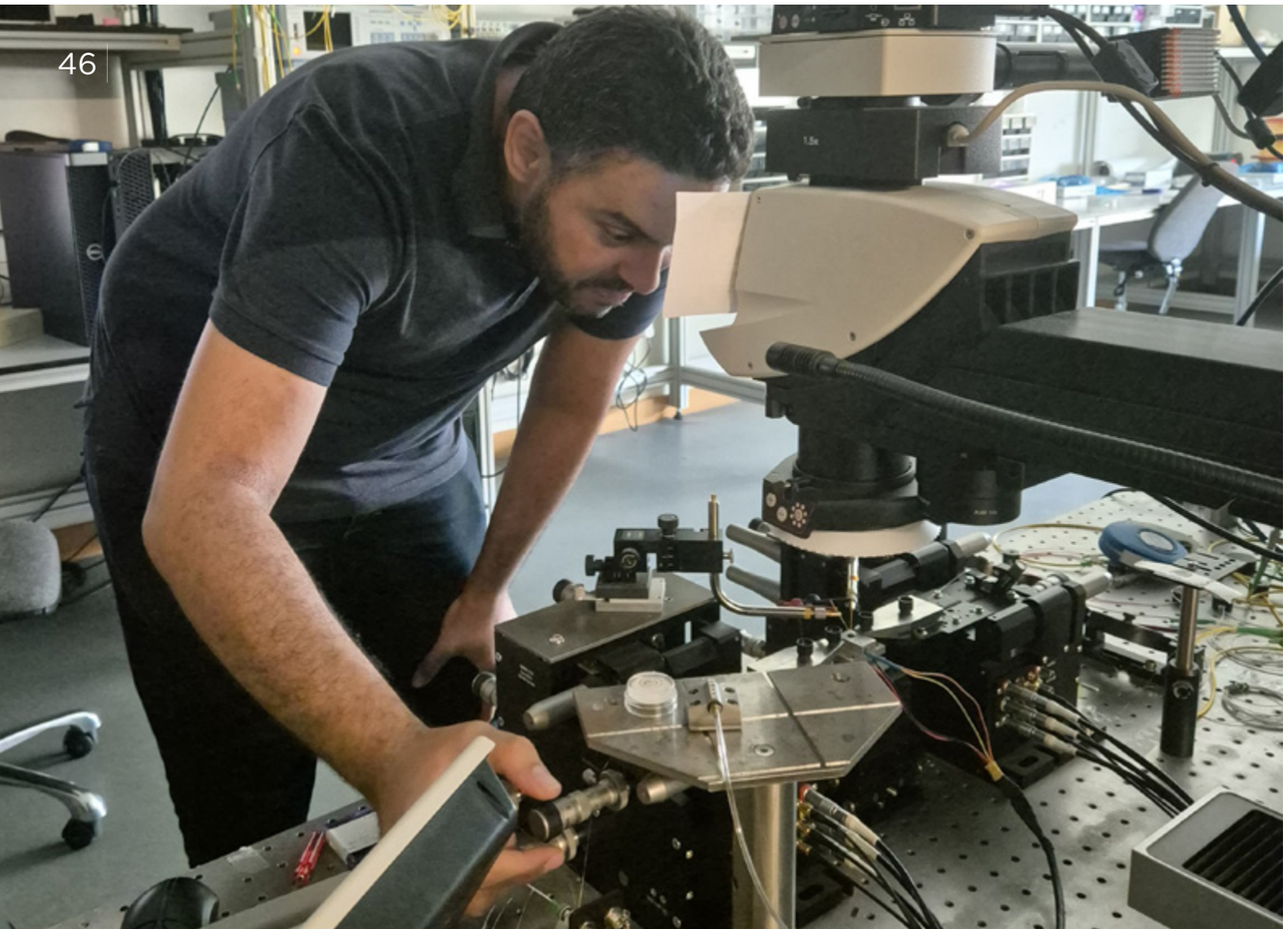
Biochemical Assays and Enzymology:
- Enzyme assays to measure enzyme activity, substrate specificity, and kinetics
- Biochemical analysis of proteins, nucleic acids, lipids, and metabolites
- Assay development and optimization for drug discovery, biomarker identification, and pathway analysis

Main Equipment

- AKTA pure 25 M
- Arpege40 Cryotanks
- Autoclave - Hirayama Hiclave HV-110
- Autoclave - Rodwell Sapphire 660
- Classic Prestige Medical Autoclaves
- Automated Microscope - Biotek LionHeart FX
- Binder CO2 Incubator
- Shaker - New Brunswick Scientific Excella E24
- Shaker - New Brunswick Scientific I26
- Shaker - New Brunswick Scientific Innova 4
- Panasonic Heated Incubator
- Biorad Zoe Imager
- Bioreactor system-Epiphyte3 LEX-48
- Class II Type A2 biological safety cabinets
- Centrifuge - Beckman Coulter Allegra X12
- Centrifuge - Beckman Coulter Avanti J26XPI
- Microfuge 22R Beckman Coulter
- Super Speed Centrifuge - Thermo Scientific Lynx 6000
- Ultracentrifuge - Beckman Coulter XPN 90
- Chemagic 360-D
- ChemiDoc MP Imaging System
- EVOS FL Auto Imaging System
- EVOS Floid Imaging System
- Circular Dichroism Spectrometer - Applied Photophysics Chirascan plus
- Countess II cell counter
- Differential Scanning Calorimetry - TA instruments Nano DSC
- Isothermal Calorimetry - TA instruments Nano ITC
- Flow Cytometer - BD Biosciences Accuri C6
- Flow Cytometer - ThermoFisher Attune NxT
- Flow Cytometer, Cytek Aurora
- High Throughput qPCR - Fluidigm Biomark HD
- Mastercycler Pro PCR
- Multigene Optimax PCR
- QPCR - Agilent Technologies Stratagene Mx3005P
- qPCR- Applied Biosystems QS5
- Mediaclave 10 and Mediajet Vario
- Metabolic Analyzer-Agilent Seahorse XFe96
- Microplate reader - Biotek Cytation 5
- Microplate Reader - Biotek Synergy H1
- Mini Protean Tetra Cell and Trans-Blot Electrophoresis Kits
- Multi-Mode Dispenser -Biotek MultiFlo FX
- Nanometers
- Pathogenic Bacterial Lab
- Pro250 Cell Homogenizer
- Qubit 2.0 Fluorometer
- Refeyn 2MP Mass Photometer
- Rheometer - Rheolution Elastosens Bio2
- Sonics Vibra Cell Sonicators (VCXX130, VCX750)
- Tecan Spark Multimode Microplate Reader
- Tube Luminometer-Lumat 3
- Uvitec Transilluminator
- UV-VIS Spectrophotometer - Shimadzu UV-2700

Tissue Culture

- Tissue Culture 1- 7
- BSL-2 Pathogenic Bacterial Lab
- Biorad Zoe Imager



Photonics and Telecommunications

The Photonics Core Technology Platform is an advanced facility that has been exclusively established to address the current and future research activities in the field of Telecommunications.
The instruments in this laboratory work in synergy to perform advanced characterizations necessary to support research theories and for the evaluation and certification of Optical and Electronic Telecommunication devices. The latest research on data telecommunication channels uses a combination of optical and electrical components. The combination of instruments is essential in the field of telecommunication. Individually, the same instruments can be utilized for research in physics, chemistry, engineering, computer science, and much more.

Some of the measurements that can be conducted in this core are as follows:

- Bit error rate testing
- Coherent detection
- Vector signal analysis
- S-Parameters evaluation
- Insertion loss (IL) / Polarization dependent loss (PDL)
- Spectral measurements
- Polarization analysis
- Swept-wavelength measurement
- Frequency domain / Time domain response
- Various modulation formats analysis
- Fast spectral measurements
- Signal integrity
- Small signal and large signal analysis

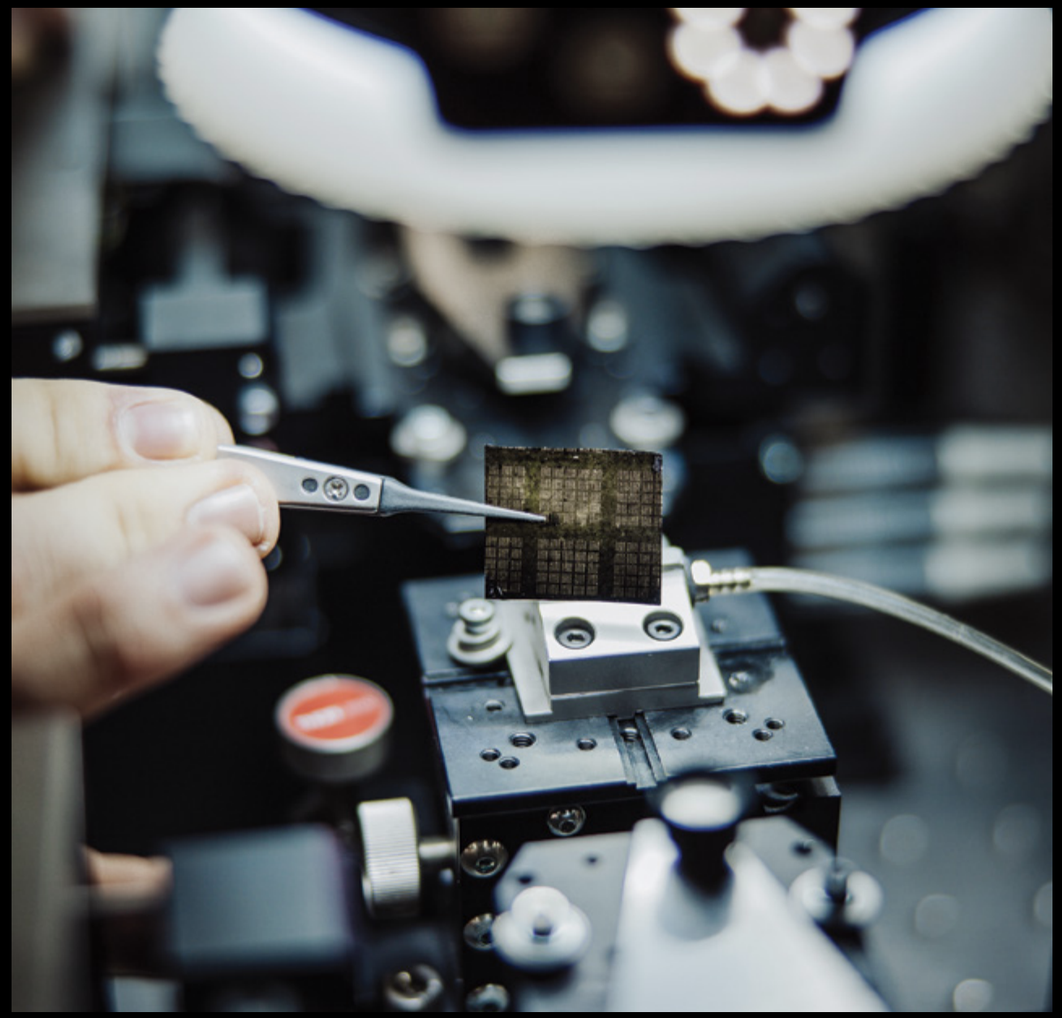
Applications and Research

- The Photonics laboratory can be instrumental in the realization of a wide range of projects, including:
- Silicon Photonics and monolithic photonics-electronics integration
- Process technology for low-temperature germanium photodetectors and modulators
- Energy-efficient Photonic sensors, Opto-MEMS
- Cybersecurity
- Microwave Photonics
- Plasmonics
- Free-space optical communication (FSO)
- Integrated Sensing and Communication
- Waveform Design
- Physical Layer Security

Main Equipment

- 2D Transfer System Microscope
- Amplitude Modulators
- Arbitrary Waveform Generators
- Bit Error Rate Tester (BERT)
- LCR Meter
- Lightwave Component Analyzer
- Lock-in Amplifier
- Optical Amplifiers
- Optical Attenuators
- Optical Multi-Format Transmitter
- Optical Switches
- Optical/Electrical Clock Recovery
- Polarization Synthesizers
- Optical Power Meters
- Real-Time Oscilloscope
- Sample Oscilloscope
- Return Loss Meter
- RF Amplifiers
- RF Power Meters
- RF Spectrum Analyser
- Sampling Oscilloscope
- SHF RF Amplifiers
- Source/Measure Unit
- Stereo Microscope - Visible / IR
- Tunable Laser Sources
- Variable Delay Line
- Variable Optical Attenuators

Photonics and Telecommunications



The Photonics Core Technology Platform is an advanced facility that has been exclusively established to address the current and future research activities in the field of Telecommunications.

Spectrometry and
Spectroscopy

Spectrometry and Spectroscopy

The Spectroscopy and Spectrometry Core Technology Platforms assists researchers in the following applications:

Chemical discovery, synthesis, and characterization:
This facility maintains and operates a wide range of tools for separation, characterization, and even automated synthesis of compounds which aids in the synthesis and discovery of chemical compounds.The chemspeed isynth automation platform is a system at NYUAD that aids in streamlining and automating synthetic chemistry reactions and throughput. For molecular characterization and identification, this core facility has a general use Q-TOF (Agilent 6538) and 500 MHz NMR. For more custom characterization, we also have a fleet of mass spectrometers including: Impact II QTOF, EVOQ QQQ, Solarix FT-ICR, Fusion Lumos and Q-extractive to perform. This facility is equipped with an FT-IR, UV-VIS-NIR, and fluorescence for photophysical analysis and HPLCs (prep, semi-prep, and analytical) to aid in precision separation. The platform offers a broad array of equipment that facilitates the synthesis and isolation of chemical compounds. Furthermore, this core is equipped with a higher field 600 MHz NMR including a cryoprobe and the first wide bore solid state 600 MHz NMR (with DNP) spectrometer in the UAE.

Metabolomics, Proteomics and petroleomics:
Metabolomics is a term used for the characterizing and understanding of all metabolites present in living organisms. The metabolome can help us understand biochemical processes, diseases, and biodiversity by using spectroscopic and spectrometric techniques to characterize and quantify complex biological mixtures. Proteomics and petroleomics similarity attempt to analyze the complex features of proteome and petroleum samples. Our fleet of aforementioned Mass Spectrometers (Agilent 6538, Impact II QTOF, EVOQ QQQ, Solarix FT-ICR, Fusion Lumos and Q-extractive) is fully equipped to characterize complex mixtures.

Protein structure:
As proteins are large molecules, the same spectroscopic techniques can be used to characterize and validate these compounds, only with additional time, care, and data handling. The 600 MHz NMR with cryoprobe is a common tool utilized to understand the dynamic structure proteins in solutions. We also have an HDX platform coupled with the IMPACT II to do hydrogen deuterium exchange experiments as well as Q-Extractive configured for nanoflow proteomics analysis.

Main Equipment

- 500 MHz NMR Spectrometer - Bruker 500 MHz Avance
- 600 MHz NMR Spectrometer - Bruker 600 MHz Ascend UHD
- 600 MHz wide-bore NMR Spectrometer - Bruker 600 MHz Aeon
- Agilent-LCMS-6125B with Prep System
- Agilent GCSMS 700 D Gerstel
- Agilent 7800/ICP-MS
- EVOQ Tandem Quad LC-MS
- LC/HDX -MSMS - Bruker Impact II
- LC-MSMS - Agilent 6538
- LC-MS Orbitrap Fusion Lumos
- LC/MALDI/NanoMate Mass Spectrometry - Bruker 7T solariX2xR
- Thermo EASY-nLC Q-Executive HF Orbitrap MS
- Thermo System Base Vanquish - Analytical grade
- Accelerated Solvent Extractor -Thermofisher Dionex ASE 350
- Alpha 3-4 LSC basic lyophilizer
- Certus Flex Liquid Dispenser
- Chemspeed
- Discover 2.0 Microwave Synthesizer
- EPR/ESR spectrometer - Bruker EMXnano
- Fluorescence Spectrometer - Perkin Elmer LS 55
- Fluoromax 4: Spectrofluorometer
- Fourier Transform Infrared Spectrometer - Agilent FT-IR 670/630
- Shimadzu UV- Visible Spectrophotometer UV 2600i
- Spectrophotometer UV-VIS-NIR UV-3600i Shimadzu
- Ultraviolet-Vis Spectrophometer - Perkin Elmer Lambda 25
- Ultraviolet-visible-near-infrared spectrophotometer - Agilent Cary 5000
- FT-IR microscope, Lumos II
- Invenio- S Fourier Transform Infrared Spectrometer
- Genevac Evaporator HT- 12 31
- Glovebox - Innovative Technology PL-HE-2GB
- HPLC (analytical scale) - Agilent 1260
- HPLC (semi-prep) - Agilent 1260
- Infinicon MicroGC Fusion Analyzer
- Lyophilizer - Christ Alpha 1-2 LD plus
- MCP 5100 Modular Circular Polarimeter
- SEAL AutoAnalyzer 3 HR
- Metrohm Professional IC Vario
- Particle Sizing System - Malvern Spraytec
- Zetasizer - Malvern Nano
- Vacuum Evaporation System-RapidVap 230V

Spectrometry and Spectroscopy

Sequencing

Sequencing

The sequencing facility enables researchers to rapidly collect large amounts of data on DNA and RNA sequences. Researchers are using the latest Illumina and Oxford Nanopore sequencing technology to sequence samples from humans, model organisms, and non-model organisms to characterize their genomes (DNA), transcriptomes (RNA), and genetic diversity in populations (sequence variants). In addition, the 10X Genomics platform facilitates various downstream analysis at single-cell resolution in fields such as developmental biology, cancer research, and immunology. Other applications include investigating interactions between proteins and nucleic acids (e.g., using ChIP-seq or PAR-CLIP) and analyzing samples collected from the environment (metagenomics).

Upon reception of DNA or RNA samples, a team of highly skilled specialists will proceed with library preparation either manually or with automation solutions and ensure the highest quality and the best reproducibility rates are met. Sequencing data will then be processed on the HPC and results delivered to the researchers.

Main Equipment

- Agilent 4200 TapeStation
- Agilent Bioanalyzer 2100
- Automated Liquid Handling - BMS Myra
- Covaris E220 Focused-Ultrasonicator
- 10x Genomics Chromium Controller
- Illumina MiSeq
- Ilumina NextSeq 550
- Illumina NovaSeq 6000
- SeqStudio Genetic Analyzer
- Oxford Nanopore Technologies MinION Mk1C
- Juno System
- StepOne Plus Real-Time PCR System

Faculty Pioneering Research

At the core of our academic community lies Faculty Research, where esteemed faculty members lead innovation. Supported by cutting-edge equipment and the expertise of Core Technology Platforms' Research Instrumentation Scientists and Specialists, they embark on groundbreaking research journeys fueled by curiosity and a commitment to excellence.

where esteemed faculty members lead innovation.

RECENT INNOVATIVE RESEARCH

1. HEALTH SCIENCES
2. INNOVATIONS IN MATERIALS AND ENGINEERING
3. SUSTAINABILITY AND ENVIRONMENTAL PRESERVATION
4. INSIGHT INTO THE HUMAN BRAIN

1

HEALTH SCIENCES

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Overview of the Research Group

A fundamental quest in neuroscience is to understand the spatio-temporal development of neural diversity as well as the mechanisms leading to neuronal connections. Achieving a thorough understanding of these processes is of crucial importance to gain insight into how a complex brain is built, and how these could be compromised in disease and neurodegenerative disorders. Drosophila is a prime model system that is extensively used because of the powerful genetic toolkit available, which allowed countless discoveries that have shaped our knowledge in various fields of Biology. Our lab studies the visual system of Drosophila which provides a powerful model for studying diverse aspects of neural circuit development, organization, and disease. This is due to the relative simplicity of this brain structure that still allows sophisticated behaviors and acrobatic flying at high speed.

The Desplan lab has contributed significantly to understanding the mechanisms controlling how the division of neural stem cells and gene regulation establish complex functional neural networks. More recently, the Desplan lab started studying the red palm weevil, a severe pest worldwide that attacks 40 palm tree species, including date palms, which are the most commercially important species in the UAE.

Key Research Utilizing CTP Facilities

The main questions of the Desplan lab are:

- What are the mechanisms involved in neural stem cell division to produce the vast diversity of neurons?
- How are the highly specific connections between different populations of neurons formed during development to generate functional neural circuits?

To address these questions, we employ an array of the latest technology provided by the CTP such as: Confocal Microscopy, Live Imaging, Transcriptome Analysis and Genetic Manipulations.

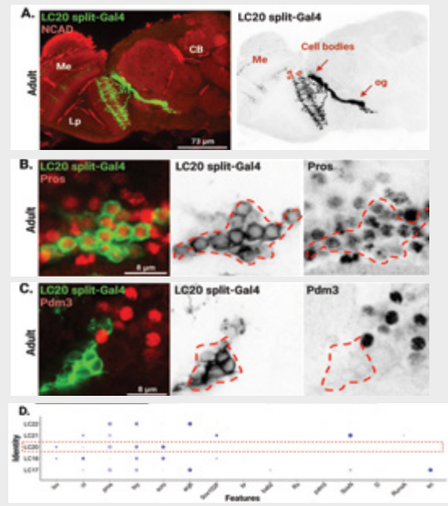
Major Publications Leveraging CTP Equipment

Morphological and functional convergence of visual projections neurons from diverse neurogenic origins in Drosophila
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5849253/

The Drosophila visual system is a powerful model to study the development of neural circuits. Projection neurons that relay visual information from the lobula part of the optic lobe to the central brain (lobula columnar neurons-LCNs), are thought to integrate different visual cues controlling specific behavioral outputs in response to these stimuli. There are ~20 classes of LCNs whose projections form highly specific, non-overlapping synaptic domains in the brain called optic glomeruli. Although functional investigations of several LCN circuits have been carried out, very little is known about their developmental origin and the neural stem cell lineages that generate the LCN subtypes. We show that LCNs originate from neural stem cells in four distinct regions in the fly brain that exhibit different modes of neurogenesis. This convergence of similar neurons illustrates the complexity of generating neuronal diversity in the brain and likely reflects the evolutionary origin of each LCN.

Collaborations Utilizing CTP Facilities

The study relied in big part on the extensive use of the Confocal microscopes provided by the CTP, more specifically the Leica SP8 confocal microscope and the Leica Stellaris-8 microscope. We used 3 dimensional rendering of Drosophila brain tissue at different life stages to identify the developmental patterns of different subtypes of Lobula Columnar Neurons (LCNs) (an essential neuronal subtypes for the survival of the Drosophila fruit fly). Additionally, we used the confocal microscopes to screen for the presence of multiple proteins in the brain. In combination with single cell RNA sequencing, these images allowed us to identify the cluster identities of each LCN during development. These results will likely be of big interest in the field.



Using the Leica Stellaris-8 microscope, we were able to identify different marker proteins that are specifically expressed in this cell type (B-C), which allowed us to pinpoint its cluster identity using single cell RNA sequencing (D).

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Website

Overview of the Research

Date palms (Phoenix dactylifera) are the major food crop of the UAE, and plays a critical role in the food security of the arid lands of the MENA region. Our group is focused on studying the genomic diversity of date palms to trace its origin and evolution, and develop genomic resources that can be used to aid the development of improved date palm varieties. Our work also looks at the relationship between genome sequences and key functional traits in date palms, including fruit color, sugar content and sex determination.

Key Research Utilizing CTP Facilities

A cornerstone of our research is high-throughput re-sequencing of the genomes of date palms from across the world, using the short-real NovaSeq sequencers at CTP. To date, using the sequencing capabilities of NYUAD CTP, we have sequenced the genomes of >700 date palm varieties, including wild relatives in the genus Phoenix. We have also obtained data to construct reference genomes for 10 date palm varieties from the Middle East and North Africa, as well as wild relatives of the cultivated palm.

Major Publications Leveraging CTP Equipment

The genomes of ancient date palms germinated from 2,000-year-old seeds
Gros-Balthazard, M., J. M. Flowers, K. M. Hazzouri, S. Ferrand, F. Aberlenc, Sarah Sallon and M. D. Purugganan* (2021) https://www.pnas.org/doi/10.1073/pnas.2025337118

The genomes of ancient date palms germinated from 2,000-year-old seeds. Proc. Natl. Acad. Sci. USA 118: e20 25337118 [Note: This was widely covered in the news, including Haaretz and Al Arabiya]. Summary: Seven date palm seeds (Phoenix dactylifera L.), radiocarbon dated from the fourth century BCE to the second century CE, were recovered from archaeological sites in the Southern Levant and germinated to yield viable plants. We conducted whole-genome sequencing of these germinated ancient samples and used single-nucleotide polymorphism data to examine the genetics of these previously extinct Judean date palms. We find that the oldest seeds from the fourth to first century BCE are related to modern West Asian date varieties, but later material from the second century BCE to second century CE showed increasing genetic affinities to present-day North African date palms.

Genome-wide association mapping of date palm fruit traits
https://www.nature.com/articles/s41467-019-12604-9

Fresquez, U. Rosas, J. Zhang, J. Talag, S. Lee, D. Kudrna, R. Powell, I. Leitch, R. Krueger, R. Wing, K. M. Amiri and M. D. Purugganan* (2019)

Genome-wide association mapping of date palm fruit traits. Nature Communications 10: 4680 Summary: Here we report an improved long-read genome assembly for P. dactylifera that is 772.3 Mb in length, with contig N50 of 897.2 Kb, and use this to perform genome-wide association studies (GWAS) of the sex determining region and 21 fruit traits. We find a fruit color GWAS at the R2R3-MYB transcription factor VIRESCENS gene and identify functional alleles that include a retrotransposon insertion and start codon mutation. We also find a GWAS peak for sugar composition spanning deletion polymorphisms in multiple linked invertase genes.

Collaborations Utilizing CTP Facilities

Khalifa Center for Genetic Engineering and Biotechnology (Al-Ain, UAE), Center for Research in Agricultural Genomics (Barcelona, Spain), KAUST (Thuwail, Saudi Arabia), Mediterranean Agronomic Institute-Chania (Crete, Greece), IRD (Montpellier, France), Royal Botanic Gardens (Kew, UK), Chinese Academy of Agricultural Sciences (Beijing, China), International Rice Research Institute (Los Banos, Philippines), De La Salle University (Manila, Philippines), Arizona Genomics Institute (Tucson, Arizona), HudsonAlpha Genome Institute (Huntsville, Alabama).

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Overview of the Research Group

Around one million cells die every second in our body due to a finely orchestrated biological process called programmed cell death (PCD). This mechanism is crucial for various biological processes, from embryonic development to immune system maintenance, ensuring our overall health and biological balance. However, disruptions in PCD are closely linked to numerous diseases, including cancer, diabetes, autoimmune, and neurodegenerative diseases. Extensive research over several decades has revealed different forms of cell death, such as apoptosis, autophagy, and necroptosis, along with their morphological features and underlying signaling mechanisms. But the field of PCD continues to evolve with the discovery of novel cell death pathways like ferroptosis and oxeiptosis. Understanding the intricate signaling pathways of PCD holds significant promise for therapeutic interventions. By deciphering these pathways, researchers aim to develop innovative drugs that can manipulate cell death processes effectively. At the Cell Death Signaling Laboratory, we focus on exploring the mechanism and communication involved in various PCD pathways, employing state-of-the-art biochemical, molecular, genetic, and cell biological techniques. Most notably, we investigate how regulatory networks in PCD can be targeted to develop new anticancer drugs.

Key Research Utilizing CTP Facilities

In modern scientific research, access to state-of-the-art equipment and facilities is paramount for groundbreaking discoveries. We have had enormous support provided by the CTP in advancing our investigations. We have been receiving CTP support for the following:

1. Confocal Microscopy: For visualizing protein post-translational modifications and nuclear localization dynamics.
2. Next-Generation Sequencing (NGS): For analyzing gene expression patterns in response to novel anticancer drugs.
3. Electron Microscopy: For unraveling structural characteristics of novel cell death pathways induced by an anticancer drug.
4. Reverse Transcription Polymerase Chain Reaction (RT-PCR): To quantify changes in target gene expression during anticancer treatment.
5. Fluorescence-Activated Cell Sorting (FACS) Analysis: To understand diverse modes of cell death induced by different agents and to elucidate the signaling pathway involved in the cell death.

Major Publications Leveraging CTP Equipment

Targeting oxeiptosis-mediated tumor suppression: a novel approach to treat colorectal cancers by sanguinarine.

Cell Death Discov . 2023 Mar 13;9(1):94. Oxeiptosis is a recently identified reactive oxygen species (ROS)-sensitive, caspase independent, non-inflammatory regulated cell death pathway. This process is activated by a specific pathway involving molecules called KEAP1, PGAM5, and AIFM1. In this particular study, we found that anticancer drug sanguinarine triggers oxeiptosis in colorectal cancer cells by activating KEAP1-PGAM5-AIFM1 axis in ROS-dependent manner. When we blocked these signals, the cell's response to sanguinarine weakened, showing how important this pathway is for the sanguinarine's effect. Testing in mice, we found that sanguinarine reduced tumor growth, suggesting that sanguinarine-induced oxeiptosis could be a promising way to fight cancer. In this particular study, we have received CTP support for analyzing differential gene expression patterns in response to sanguinarine.

Caspase cleavage and nuclear retention of the energy sensor AMPK-α1 during apoptosis

Cell Rep . 2022 May 3;39(5):110761. AMPK coordinates energy homeostasis during metabolic and energy stress. In this article, we found that during apoptosis, a specific isoform of AMPK subunit (AMPK-α1) is cleaved by an enzyme called caspase-3. AMPK-α1 cleavage is characterized by precise excision of the nuclear export sequence (NES) from the C-terminal end. This resulted in nuclear retention of cleaved AMPK-α1 and its activation within the nucleus during anticancer treatment. In this particular study, we have received CTP support for confocal microscopy to understand if the cleaved AMPK-α1 is translocated to the nucleus.

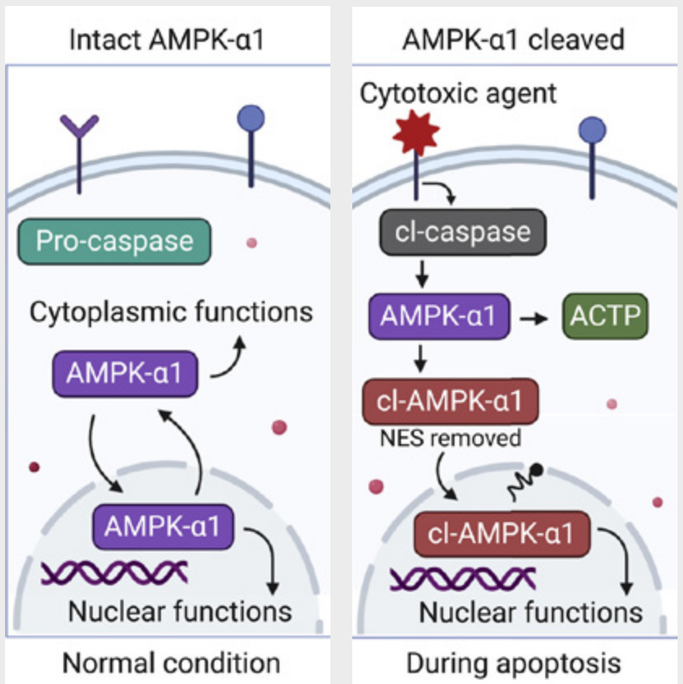

Figure 1 caption. Mechanisms of caspase cleavage and nuclear retention of the energy sensor AMPK-α1 during apoptosis

Collaborations Utilizing CTP Facilities

Collaboration between our lab and the CTP exemplifies the ethos of collective endeavor in scientific exploration. Through the convergence of expertise and resources, we have yielded invaluable insights, advancing our understanding of complex biological phenomena and paving the way for future discoveries. Two of our collaborative research are listed below.

1. Exploring Post-translational Modifications with Confocal Microscopy: We have utilized cutting-edge confocal microscopy to investigate the impact of cleavage on nuclear localization of AMPK protein. Leveraging the sophisticated capabilities of confocal microscopy housed within the CTP, we were able to study intricate interplay between molecular alterations and subcellular dynamics. The findings of this collaborative effort were published in Cell Report (Cell Press; Cell Rep. 2022 May 3;39:110761)
2. Unraveling Molecular Landscapes with Next-generation Sequencing: In collaboration with the CTP, we employed next-generation sequencing to uncover the differential gene expression patterns influenced by our anticancer drug of interest, sanguinarine. This collaborative effort, supported by CTP's infrastructure, propelled the project forward, leading to significant findings published in Cell Death and Discovery (Nature Publishing; Cell Death Discov. 2023 Mar 13;9).

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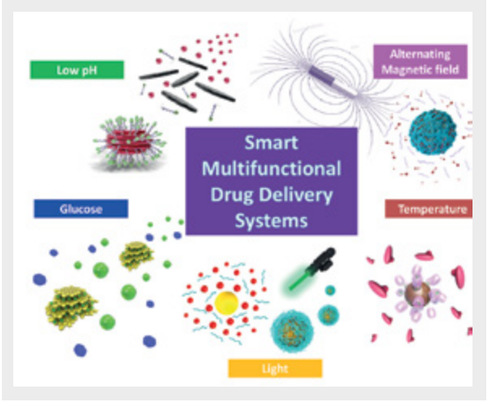
Website

Overview of the Research Group

The Trabolsi Research Group at NYU Abu Dhabi specializes in molecular topology, supramolecular chemistry and materials chemistry, focusing on innovative health solutions and environmental sustainability. The group has significantly advanced nanomedicine over the past decade by leveraging molecular and ionic recognition with self-assembly to develop multifunctional materials for therapeutic and diagnostic purposes. This includes breakthroughs in multiple drug delivery systems and smart materials that improve treatment efficacy. In the field of environmental science, the group has innovated in water purification and desalination, particularly through the creation of covalent organic frameworks (COFs) used in applications such as capacitive deionization, solar water evaporation and nanofiltration. They also focus on the removal of toxic contaminants and combat global water scarcity and pollution.



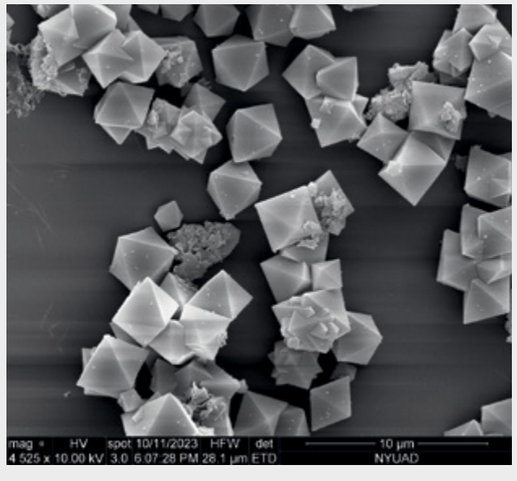
Overview of the research interests of the Trabolsi group related to the development of Smart Multifunctional Drug Delivery Systems (SMDDS). The Trabolsi group focused on the development of smart stimulus-responsive nanoparticles for biomedical applications.

Key Research Utilizing CTP Facilities

The focus of our research is on the development of covalent organic frameworks (COFs) as functional porous materials for various advanced applications. The development of such materials requires comprehensive characterization techniques. CTP instruments are very helpful in the synthesis and characterization of these novel materials. The main instruments we use for our research include:

- **Synthesis:**
  - Microwave reactors
- **Material Characterization Expertise**
  - FT-IR, NMR, EPR, Absorption and Emission spectrometer
  - Powder X-ray diffractometer (PXRD) and thermogravimetric Analyzer (TGA)
  - Chromatographies: Gas and Liquid (GCMS, HPLC)
  - Porosimetry (BET), Dynamic-Light Scattering, and Magnetic Measurements (VSM)
  - Scanning Electron Microscopy, Energy-Dispersive X-ray Spectroscopy (SEM and EDX), and Transmission Electron Microscopy (TEM)
- **Biology and Biomedical Techniques**
  - In vivo Experimentation: Mouse and rat models with a focus on diabetes and cancer. IVIS Spectrum optical imaging system
  - In vitro Experimentation: Cell Culture a, Flow Cytometry, Seahorse, Confocal and Optical Microscopies
  - Bacterial Experimentation

Representation of a COF based drug delivery vehicle in action.



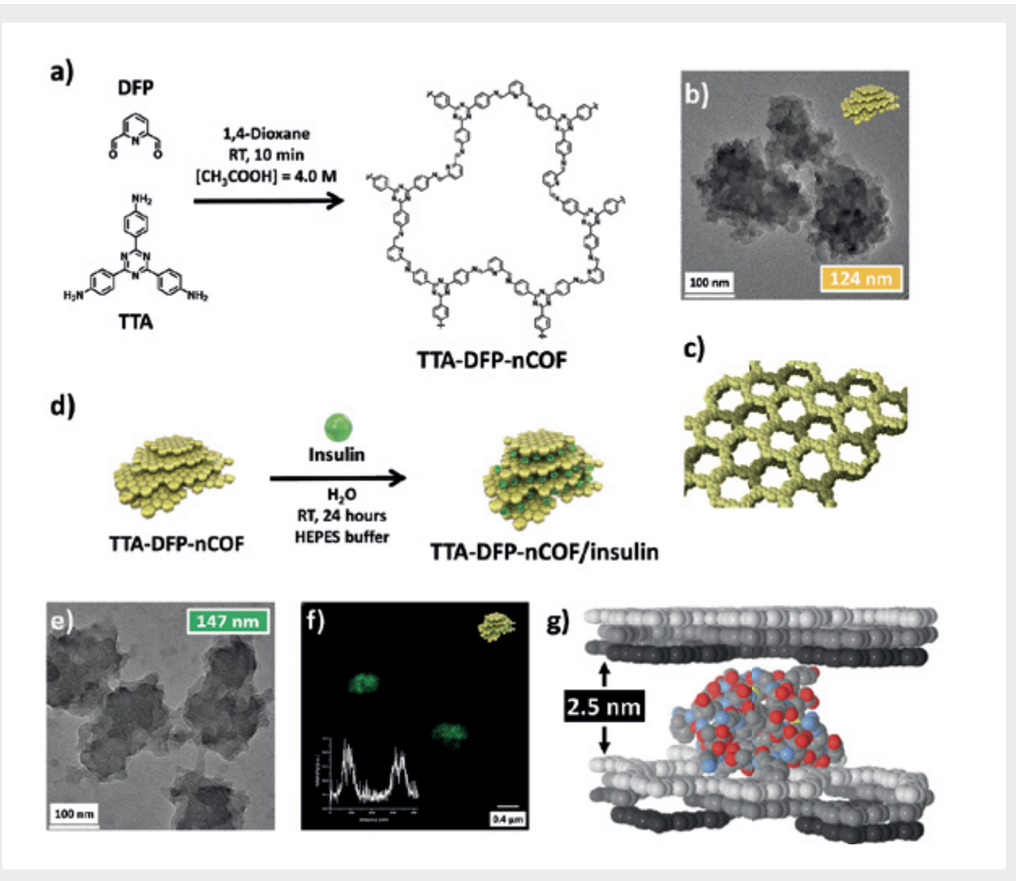
SEM images of a macrocycle based COF material.

Major Publications using CTP equipment

In Vivo Oral Insulin Delivery via Covalent Organic Frameworks

Authors: F. Benyettou, N. Kaddour, T. Prakasam, G. Das, S. K. Sharma, S. A. Thomas, F. Bekhti-Sari, J. Whelan, M. A. Alkhalifah, M. Khair, H. Traboulsi, R. Pasricha, R. Jagannathan, N. Mokhtari-Soulimane, F. Gándara, A. Trabolsi Journal details: Chem. Sci. 2021, 12, 6037-6047; DOI: 10.1039/D0SC05328G

This publication acknowledges CTP for providing the facility of FTIR, PXRD, NMR, Porosity analyzer, and collaboration for in-vitro and in-vivo biological studies and TEM imaging.

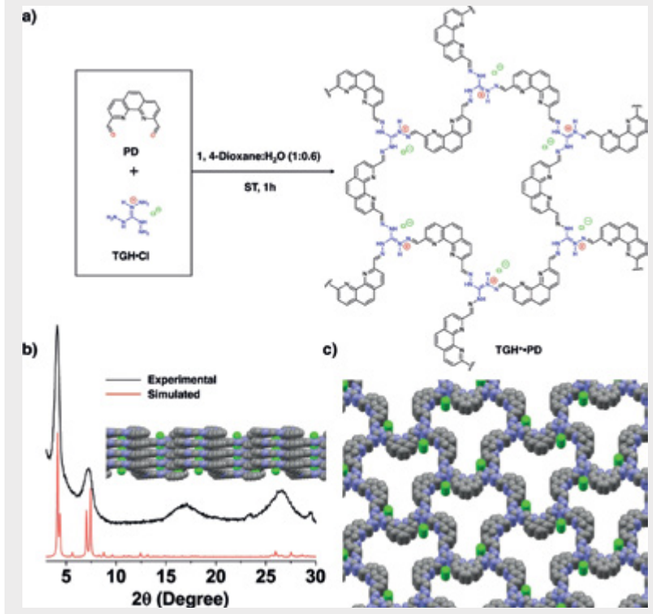


Insulin is intercalated between TTA-DFP-nCOF layers. a) Chemical structure and synthetic route of TTA-DFP-nCOF. b) HR-TEM image of TTA-DFP-nCOF. Cartoon representation (yellow nanoparticles) illustrates the shape of TTA-DFP-nCOF. c) Structural model of TTA-DFP-nCOF, consisting of hcb layers that are disposed in abc sequence, generating hexagonal channels along the stacking direction. d) Schematic representation of the encapsulation of insulin between the layers of TTA-DFP-nCOF. Cartoon representation (green spheres) illustrates the insulin. e) HR-TEM image of TTA-DFP-nCOF/insulin. f) Confocal microscopy image of TTA-DFP-nCOF/insulin-FITC; inset: fluorescence intensity. g) Van der Waals representation of the optimized location of an insulin monomer molecule intercalated between TTA-DFP-nCOF layers. Atoms belonging to COF layers are displayed in white, grey, and black color, for each individual layer. For insulin molecules, C, N, O, and S atoms are grey, blue, red, and yellow, respectively. H atoms are omitted for clarity.

Fluorescence Turn on Amine Detection in a Cationic Covalent Organic Framework

Authors: G. Das, B. Garai, T. Prakasam, F. Benyettou, S. Varghese, S. K. Sharma, F. Gándara, R. Pasricha, M. Baias, R. Jagannathan, N. Saleh, M. Elhabiri, M. A. Olson, A. Trabolsi Journal details: Nat. Commun. 2022, 13, 3904; DOI: 10.1038/s41467-022-31393-2

This publication acknowledges CTP for providing the facility of FTIR, PXRD, SEM, UV-vis spectrometer, Fluorometer, Porosity analyzer, Zetasizer, and collaboration for solid state NMR spectroscopy and TEM imaging.



Synthesis scheme for a phenanthroline based 2-dimensional covalent organic framework from the chemical precursor under solvothermal condition. b) Experimentally observed PXRD profile used to model the structure of the COF, and c) representation of TGH+•PD COF.

Collaborations Utilizing CTP Facilities (please check)

We have active collaboration with CTP team for measurement and analysis of various studies such as:

- Mostafa Khair (Biological Assessment)
- Sabu Varghese (Solid-state NMR)
- Renu Pasricha (TEM)
- James Weston (SEM)
- Osama Abdullah (MRI)
- Matthew J O'Connor (Spectroscopy)
- Maylis Boitet (IVIS)
- Sneha A. Thomas
- Haidee Paterson

Kirsten Sadler Edepli
Sadler Edepli Lab | Science/ Biology
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Website

Overview of Research Group

Our research uses whole animal models to study fundamental processes related to development, regeneration, cancer and the response to toxicants. We integrate genomic and imaging approaches to study how the epigenome regulates these processes.

Key Research Utilizing CTP Facilities

We take advantage of the small size and transparency of zebrafish embryos and larvae to image a wide range of developmental and disease relevant processes. The imaging facility is critical to this research as it has enabled us to develop new approaches for live imaging immune cell interaction with cancer cells, the dynamic properties of lipid droplets in zebrafish models of fatty liver and quantitative imaging approaches to generate detailed information about cell number, size shape and other features of cells that are influenced by toxicants or by perturbations of development.

The genomics facility is absolutely essential for all our research. As epigeneticists, we use the genomics facility regularly to define the epigenetic landscape of the liver, to develop novel approaches to investigate the epigenome of tiny zebrafish embryonic livers, to carry out single cell analysis of tumor initiation and progression and to determine cell identity in regenerating octopus arms.

Major Publications Leveraging CTP Equipment

DNA hypomethylation activates Cdk4/6 and Atr to induce DNA replication and cell cycle arrest to constrain liver outgrowth in zebrafish
Madakashira, B.P., Magnani, E., Ranjan, S. and Sadler, K.C. (2024)
Nucleic Acids Res
https://pubmed.ncbi.nlm.nih.gov/38321933/

A permissive epigenetic landscape facilitates distinct transcriptional signatures of activating transcription factor 6 in the liver
Ramdas Nair, A., Lakhiani, P., Zhang, C., Macchi, F. and Sadler, K.C. (2022
Genomics, 114, 107-124
https://pubmed.ncbi.nlm.nih.gov/34863900/

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Major Publications Leveraging CTP Equipment

Genomic analysis reveals association of ASIP with a recurrently evolving color pattern in frogs
S. Goutte, I. Hariyani, K.D. Utzinger, Y. Bourgeois, and S. Boissinot (2022)
https://europepmc.org/article/med/36317199

We investigated the evolution of a color pattern that has evolved recurrently in frogs. Using a resequencing approach on a large sample of frogs of the species Ptychadena robeensis that differ in their color pattern, we identified that the gene ASIP is responsible for the presence of a dorsal band in frogs. RNAseq and real-time quantitative PCR revealed that differential expression of the gene and an adjacent long non-coding RNA is linked to the patterning in this species. Surprisingly, and although the stripe phenotypes are shared with closely related species, we found that the P. robeensis alleles are private to the species and unlikely to evolve under long-term balancing selection, thus indicating that the vertebral stripe phenotypes result from parallel evolution within the group. Our findings demonstrate that this cryptic color pattern evolved rapidly and recurrently in terrestrial anurans, and therefore constitutes an ideal system to study repeated evolution.

Overview of Research Group

The evolutionary genomics laboratory at NYUAD is using the tools and concepts of population genetics and comparative genomics to address a number of fundamental biological questions. Our research is focused around three main directions: (1) understanding why vertebrate genomes differ in size and structure and the impact repetitive sequences have on genome evolution; (2) deciphering the genomic architecture underlying visible phenotypes and the evolutionary processes driving the evolution of these phenotypes; (3) understanding the mechanisms of local adaptation, in particular in invasive species.

Key Research Utilizing CTP Facilities

Our research combines multiple -omics approaches including genomics and transcriptomics. The evolutionary genomics laboratory is using the sequencing services of the CTP extensively. We are generating large population-level genomic datasets, we are conducting de novo genome sequencing and we analyze gene expression. We are also making occasional use of the microscopy service.

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Overview of the Research Group

The lab's research focus is three-fold: the development of novel therapeutics for cancer and amyloid diseases; the development of novel systems for the delivery of cancer and amyloid therapeutics; and the development of novel biophysical methods for assessing the efficacy of our therapeutics and delivery systems. The active projects in the lab currently include the following:

1. Design and synthesis of small molecule and peptide-based inhibitors of the aggregation and cytotoxicity of the amyloid-beta (Aβ) peptide, which is implicated in Alzheimer's disease.
2. Protein mimetic-based approaches to abrogate cancer-associated mutant p53 aggregation and restore tumor suppressor function.
3. Engineering pH-responsive nanoparticles for combined multimodal diagnostic imaging and targeted photodynamic and photothermal cancer therapy.

Key Research Utilizing CTP Facilities

All of the research in the lab involves experiments that use CTP equipment. These experiments include imaging (Confocal laser scanning microscopy, in vivo IVIS imaging, transmission electron microscopy (TEM), magnetic resonance imaging (MRI)) and nuclear magnetic resonance (NMR) spectroscopy, circular dichroism (CD) spectroscopy, quantitative proteomics analysis, inductively coupled plasma mass spectrometry (ICP-MS), Zetasizer measurements.

Major Publications Leveraging CTP Equipment

Protein mimetic amyloid inhibitor potently abrogates cancer-associated mutant p53 aggregation and restores tumor suppressor function
https://www.nature.com/articles/s41467-021-23985-1

Mutations in p53 occur in over 50% of all human cancers. The majority of these mutations are located in the inherently unstable DNA-binding domain (DBD), many of which destabilize the domain further and expose its aggregation-prone hydrophobic core, prompting the self-assembly of mutant p53 into inactive cytosolic amyloid-like aggregates. Screening an oligo pyridyl amide library, previously shown to inhibit amyloid formation associated with Alzheimer's disease and type II diabetes, identified a tripyridyl amide, ADH-6, that abrogates self-assembly of the aggregation-nucleating subdomain of mutant p53 DBD. Moreover, ADH-6 targets and dissociates mutant p53 aggregates in human cancer cells, which restores p53's transcriptional activity, leading to cell cycle arrest and apoptosis. Notably, ADH-6 treatment effectively shrinks xenografts harboring mutant p53, while exhibiting no toxicity to healthy tissue.

pH-Responsive Upconversion Mesoporous Silica Nanospheres for Combined Multimodal Diagnostic Imaging and Targeted Photodynamic and Photothermal Cancer Therapy
https://pubs.acs.org/doi/10.1021/acsnano.3c04564

Photodynamic therapy (PDT) and photothermal therapy (PTT) have gained considerable attention as potential alternatives to conventional cancer treatments. However, these approaches remain limited by low solubility, poor stability, and inefficient targeting of many common photosensitizers (PSs) and photothermal agents (PTAs). To overcome the aforementioned limitations, we have engineered biocompatible and biodegradable tumor-targeted upconversion nanospheres with imaging capabilities. The nanospheres facilitated tumor magnetic resonance and thermal and fluorescence imaging and exhibited potent near-infrared (NIR) laser light-induced anticancer effects in vitro and in vivo via combined cytotoxic reactive oxygen species (ROS) production and localized hyperthermia, with negligible toxicity to healthy tissue, hence markedly extending survival.

Collaborations Utilizing CTP Facilities

Many of the projects in the lab involve collaborations with colleagues at NYU Abu Dhabi, NYU and international institutions. Among the groups we are collaborating with are:

- Andrew Hamilton (NYU)
- Astrid Graslund (Stockholm University)
- Francisco N. Barrera (University of Tennessee Knoxville)
- Rihab Nasr (American University of Beirut)
- Piergiorgio Percipalle (NYU Abu Dhabi)
- Ramesh Jagannathan (NYU Abu Dhabi)
- Sehamuddin Galadari (NYU Abu Dhabi)
- Sunil Kumar (University of Denver)

All of the collaborations involve extensive use of CTP equipment as outlined above.

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Overview of the Research Group

Cells of the body are subjected to external loading as well as inherent physiological forces and they respond to these biomechanical cues. Cells of the immune system are not spared from being exposed to such biomechanical forces that can come in the manner of cell-cell interaction, interstitial fluid shear forces, resistance during migration within tissues. In fact, such biomechanical forces are present and enable the healthy workings of our body, and during disease there is a disturbance in the force. LIBRA's overarching goal is to decipher the effects of these forces in both physiological and pathological scenarios using basic science, by reconstructing the immune microenvironment from its basic building blocks. We analyze immune response to biomechanical forces at the genetic-, protein-, and functional-levels, collectively facilitating the understanding and contributing to the field of immune mechanobiology. We translate our findings to real-world applications, with the aim of improving the quality of life and health of humankind.

Key Research Utilizing CTP Facilities

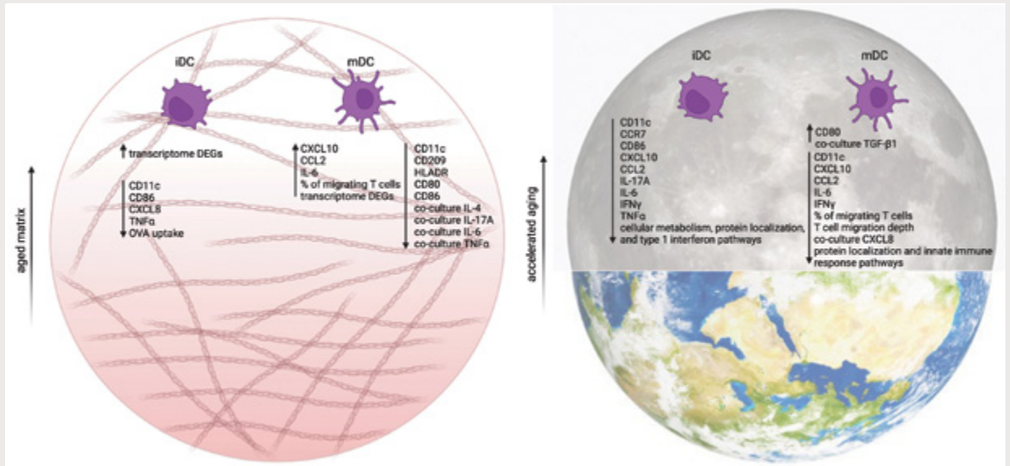
For us to achieve comprehensive investigative science, we thoroughly make use of the generous equipment from Core Technology Platforms. We currently have several main focus in LIBRA:

1. Onco-immune in vitro modeling for understanding immune cancer cross talk
2. Biomimetic platform development for improving cell-based immunotherapy outcomes
3. Tissue engineering of lymphoid tissues / niches for discovery of potential new therapeutic angles
4. Space-immunobiology to contribute to medical science support for long duration/ distant space travel and potentially new therapeutics on Earth

All our research engages the CTP.

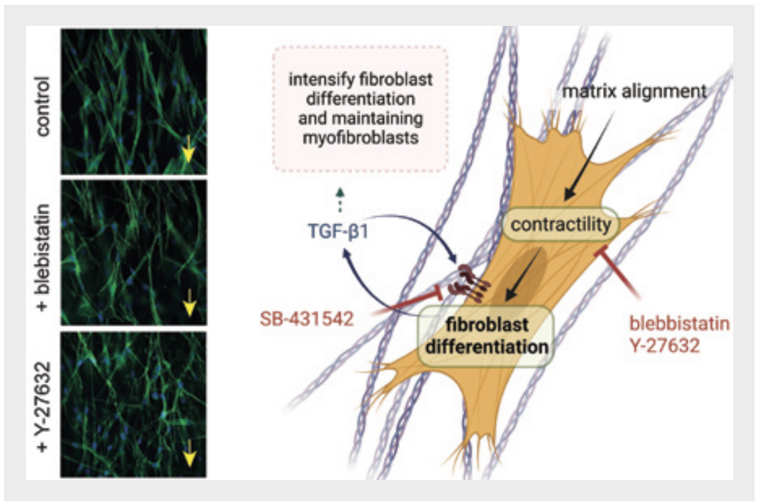
Major Publications Leveraging CTP Equipment

Effects of an aged tissue niche on the immune potency of dendritic cells using simulated microgravity
https://pubmed.ncbi.nlm.nih.gov/37249413/



Microgravity accelerates the aging of various physiological systems, and it is well acknowledged that aged individuals and astronauts both have increased susceptibility to infections and poor response to vaccination. Immunologically, dendritic cells (DCs) are the key players in linking innate and adaptive immune responses. Their distinct and optimized differentiation and maturation phases play a critical role in presenting antigens and mounting effective lymphocyte responses for long-term immunity. Despite their importance, no studies to date have effectively investigated the effects of microgravity on DCs in their native microenvironment, which is primarily located within tissues. Here, we address a significantly outstanding research gap by examining the effects of simulated microgravity via a random positioning machine on both immature and mature DCs cultured in biomimetic collagen hydrogels, a surrogate for tissue matrices.

Collagen Fibril Orientation Instructs Fibroblast Differentiation Via Cell Contractility
https://pubmed.ncbi.nlm.nih.gov/37249413/



Collagen alignment is one of the key microarchitectural signatures of many pathological conditions, including scarring and fibrosis. Investigating how collagen alignment modulates cellular functions will pave the way for understanding tissue scarring and regeneration and new therapeutic strategies. However, current approaches for the fabrication of three-dimensional (3D) aligned collagen matrices are low-throughput and require special devices.

To overcome these limitations, a simple approach to reconstitute homogeneous 3D collagen matrices with adjustable degree of fibril alignment using 3D printed inclined surfaces is developed. By characterizing the mechanical properties of reconstituted matrices, it is found that the elastic modulus of collagen matrices is enhanced with an increase in the alignment degree. The reconstituted matrices are used to study fibroblast behavior to reveal the progression of scar formation where a gradual enhancement of collagen alignment can be observed.

Collaborations Utilizing CTP Facilities

We have been and fill continue collaborate with CTP, in particular, the cell and molecular biology (Cell culture, FACs, Lionheart Imager, SeaHorse), light microscopy (Confocal imaging), sequencing (RNA-seq). All these cores help us to perform comprehensive investigative immunomechanobiology studies, from which we have produced many publications in high impact journals, presented our work at conferences, and have a patent filed. Further more, we have also engaged the Advanced Manufacturing and Electronics (various 3D printing and CNC-machined parts) and currently started to engage with micro-fabrication cores.

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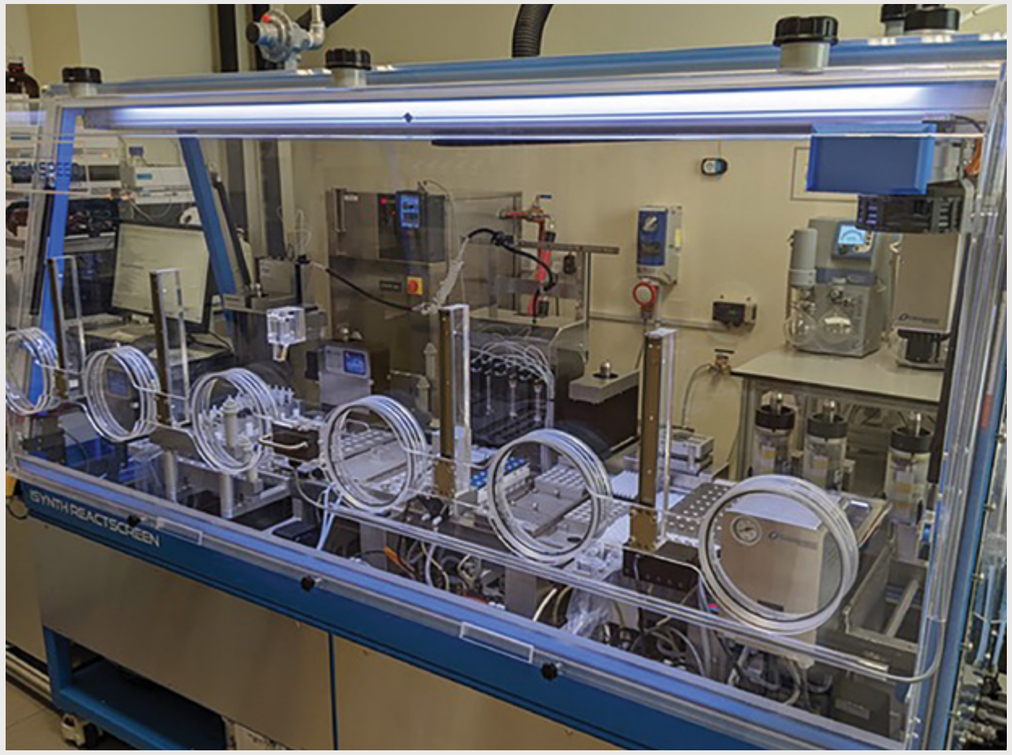
Overview of Research Group

The Healy lab started in 2019 intending to develop an automated assembly line synthesis of bioactive polyketides and related natural products. Our mission is to harness the tools of bioinformatics, automated synthesis and high-throughput screening to streamline the process from natural product gene cluster to preclinical drug candidate. We are equipped with state-of-the-art instrumentation for the automation of synthetic chemistry. Our motivation is to develop an efficient and reproducible synthetic strategy to access natural products using commercially available equipment. The ultimate goal is to provide a platform that can be adopted by researchers around the globe including non-specialists to gain access to this treasure trove of bioactive molecules.

Key Research Utilizing CTP Facilities

The implementing automation in the synthesis of novel chemical entities, from new materials to therapeutic agents, can result in a dramatic step-change in the efficiency and scalability of the process. The Chemspeed automation system enables us to run high-throughput experimentations (HTE) in quick succession. From reagent addition to simple workup after a completed reaction, the system can be used to generate necessary reaction data efficiently to optimize conditions or synthesize a variety of molecules. The Chemspeed is also connected to an LCMS/SFC instrument to create a closed-loop cycle of synthesis and analysis to further improve the synthetic workflow.

Additional CTP analytical instruments used by our groups are the HPLC, NMR and HRMS instruments.



Major Publications Leveraging CTP Equipment

A Catalytic Enantioselective Stereodivergent Aldol Reaction
https://www.science.org/doi/10.1126/sciadv.adg8776#acknowledgments

The aldol reaction is a key carbon-carbon bond forming process in organic chemistry. It is widely applied in the synthesis of complex molecules, and as a consequence it has been the focus of much study. In this work, we developed a new catalytic aldol reaction that makes all possible versions of the product from the same starting materials in just one step. It is a mild process, easily scalable, and produces carbon dioxide as the only waste product. This method is versatile, compatible with a wide range of substances, and yields valuable chiral β-hydroxy thioesters. Using CTP analytical instruments - HPLC, NMR and HRMS instruments.

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Overview of Research Group

The research activity of the NMR Group has been long focused on the application of high resolution NMR methods to proteins.The group determined the first NMR structure in UAE (Percipalle M, Hunashal Y, Steyaert J, Fogolari F, Esposito G, Molecules 26, 3567, 2021).

In addition, over the last years, the NMR Group has thoroughly been involved in C.elegans targeted and untargeted metabolomics, in the context of the research projects of prof. Fabio Piano's laboratory. This activity also involves other analytical techniques such as mass spectrometry and chromatography.

Besides the acivity in prof. Piano's projects, numerous collaborations have also been established with other NYUAD scientists, namely prof. Magzoub (amyloidogenic protein and peptides), prof. Percipalle (nanobodies against SARS-CoV-2 Nsp9, organoids), prof. Idaghdour (targeted metabolomics), prof. Trabolsi (supramolecular compound characterization), prof. Naumov (QCMD applications). The NMR Group was established in 2014 and is currently formed by the leader, Rino Esposito, his associate collaborator, Yamanappa Hunashal, and Gennaro Battaglia, visiting PhD student from Naples University. Over the past years, other researchers gave their contribution to the research activity, namely, Maurizio Ballico, Stefano Zanini, Cristina Camtarutti, and Mathias Percipalle.

Key Research Utilizing CTP Facilities

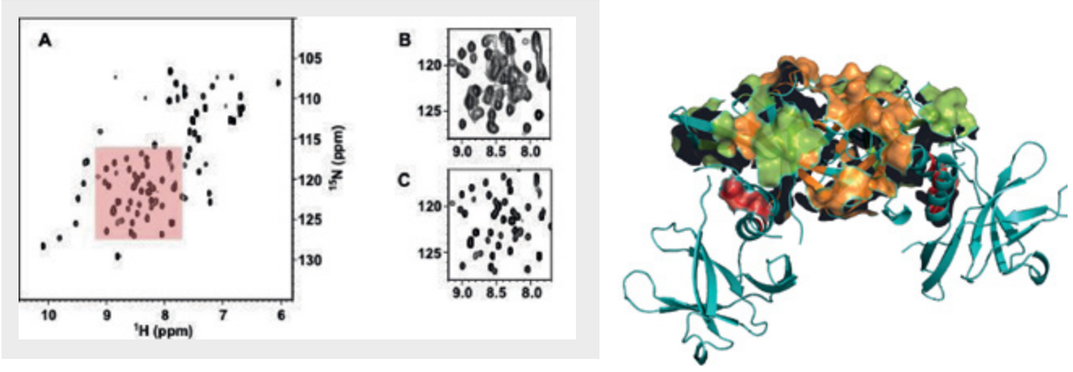
Protein NMR Amyloid protein interactions studies by NMR and QCMD NMR characterization of metallo-organic complexes Targeted and untargeted NMR metabolomics in liquid and semi-solid state (HRMAS) using also mass spectrometry and chromatography.

Major Publications Leveraging CTP Equipment

NMR-based analysis of nanobodies to SARS-CoV-2 Nsp9 reveals a possible antiviral strategy against COVID-19
Esposito G., Hunashal Y. , Percipalle M., Venit T., Dieng M. M., Fogolari F., Hassanzadeh G., Piano F., Gunsalus K. C., Idaghdour Y., Percipalle P. NMR-based analysis of nanobodies to SARS-CoV-2 Nsp9 reveals a possible antiviral strategy against COVID-19 Adv. Biology, 5, 2101113, 2021
https://pubmed.ncbi.nlm.nih.gov/34705339/

Nanobodies are domains, i.e. structurally autonomous regions, of single-chain antibodies, a class of antibodies occurring in camelids and sharks. In this research the scientists of the groups headed by P. Percipalle and G. Esposito studied the interaction of an essential component of SARS-CoV-2 replication complex named Nsp9, with the two most promising species of a nanobody library, obtained from the immune response of lamas against Nsp9 (1). First, the two nanobodies were shown to be capable of binding to Nsp9 in biological samples, namely with purified recombinantly-expressed Nsp9 and with endogenous Nsp9 in the saliva of patients infected with COVID-19. Further, using NMR spectroscopy, it was shown that the two selected nanobodies bind Nsp9 and perturb the monomer–dimer–tetramer equilibrium toward the induction of a tetramer. Besides the development of highly sensitive, cost-effective diagnostic tools, the two discovered nanobodies could therefore represent the basis of an antiviral drug since the promoted Nsp9 oligomerization is incompatible with the formation of the virus replication and transcription complex, which requires the Nsp9 monomer for the propagation mechanism. Further studies are underway to define the antiviral efficacy of the nanobodies and to formulate a diagnostic kit for a rapid salivary test.

(1) Esposito G., Hunashal Y. , Percipalle M., Venit T., Dieng M. M., Fogolari F., Hassanzadeh G., Piano F., Gunsalus K. C., Idaghdour Y., Percipalle P., Adv. Biology, 5, 2101113, 2021

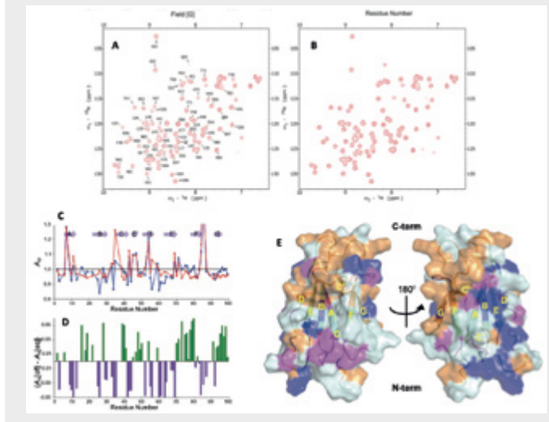


A-C: 15N-1H HSCQ of SARS-CoV-2 Nsp9 with highlights showing the row (in B) and resolution enhanced (in C) region to stress the oligomerization effect on the peak widths. D: NMR-based mapping of the nanobody contacts (green surfaces) on the Nsp9 tetramer with the dimer-dimer and monomer-monomer interfaces highlighted in orange and red, respectively.

Approaching protein aggregation and structural dynamics by equilibrium and non-equilibrium paramagnetic perturbation
Hunashal Y., Percipalle M., Molnar T., Kardos J., Percipalle P., Esposito G. Approaching protein aggregation and structural dynamics by equilibrium and non-equilibrium paramagnetic perturbation
Analytical Chemistry, 94, 10949-10958, 2022
https://pubmed.ncbi.nlm.nih.gov/35877130/

PENELOP (Paramagnetic Equilibrium vs. Non-equilibrium magnetization Enhancement or LOss Perturbation) is a method based on the paramagnetic perturbation of equilibrium and non-equilibrium NMR spectra to identify at once the location of proteins' exposed surface, hindered accessibility, and exchange processes occurring on a μs-ms time scale (1,2). Besides mapping the protein surface accessibility, the application of this method under specific conditions makes it possible to distinguish conformational mobility and chemical exchange processes, thereby providing an alternative to characterization by more demanding techniques (transverse relaxation dispersion, saturation transfer, high-pressure NMR). Moreover, its high sensitivity enables studying samples at low, physiologically more relevant concentrations.

1. Hunashal Y., Cantarutti C., Giorgetti S., Marchese L., Molinari H., Niccolai N., Fogolari F., Esposito G. Phys. Chem. Chem.l Phys., 22, 6247-6259, 2020
2. Hunashal Y., Percipalle M., Molnar T., Kardos J., Percipalle P., Esposito G. Anal. Chem., 94, 10949-10958, 2022



1H-15N HSQC spectra D76N b2m in the absence (in A) and presence (in B) of Tempol. C: Equilibrium, AN[eq], (red) and off-equilibrium, AN[off], (blue) Tempol-induced attenuations,. D: {AN[off] – AN[eq]} differences highlighting the locations of Type I (green bars) and Type II (purple bars) patterns. E: Tempol-perturbed surface of D76N b2m. Hindered or buried surface in orange, exchange sites in blue, and exposed exchange sites in magenta.

Collaborations Utilizing CTP Facilities

NMR Characterization of polysaccharides in collaboration with M. Ayyash, Al Ain University

2

INNOVATIONS IN MATERIALS AND ENGINEERING

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Overview of the Research Group

Our vibrant research team at the Smart Materials Lab works at the interface of science and engineering to explore new materials for applications in the energy, water, and health sectors. Our research's core is the design, assessment, and application of a broad range of smart materials with extraordinary properties, such as capabilities for reshaping, memorizing, moving, programming, self-repairing, and healing. We are particularly interested in materials that hold the potential for efficient and controllable energy transduction in the form of light or heat into work that can be used in various devices. Over the past decade, we have pioneered the new research field of crystal adaptronics, which explores the dynamic aspects of ordered organic solid states and related methodologies, specifically the emerging class of adaptive molecular crystals, where molecular-scale perturbations are amplified to a response on a macroscopic scale. Aside from contributing to the fundamental understanding of the performance limits of organic materials, the underlying phenomena are also the foundational basis for all-organic optics and electronics, organic emissive devices, smart membranes for separation, organic biomedical materials, and soft robots. We are proud that the SML generates about 40-60% of the impactful chemistry in the UAE each year.

Key Research Utilizing CTP Facilities

The research conducted in the Smart Materials Lab is diverse and varied, with a central focus on creating new and responsive materials. As such, a majority of the research utilizes equipment in the CTP equipment. For projects that focus on characterizing surface science, such as monitoring water collection using microscopic channels, we use atomic force microscopes and confocal Raman spectroscopy for chemical analysis. Other projects focusing on identifying trace components of pigments and dyes in van Dyke crystals have heavily relied upon chemical analysis tools such as NMR, liquid chromatography-mass spectrometry, and infrared spectroscopy. Several other projects that characterize crystalline actors use diffraction-based equipment such as the single crystal and powder X-ray diffractometers and the small angle X-ray scattering diffractometer. Other instruments used for visualization, such as optical, confocal, and scanning electron microscopy, are used ubiquitously for all projects, as imaging material is the first step in the long journey of completing the projects.

Major Publications Leveraging CTP Equipment

Autonomous and directional flow of water and transport of particles across a subliming dynamic crystal surface
https://www.nature.com/articles/s41557-023-01158-5

The transport of microscopic amounts of water over a substrate is the cornerstone of microfluidics principles. In microfluidics, one of the most intriguing phenomena is the autonomous transport of water without external intervention. In nature, the autonomous motion of water is usually facilitated by a unique surface shape that creates a Laplace pressure gradient. These natural water-transducing surfaces are static, and the water is driven by the increasing size of the droplet and its contact with the surface. In our article, we report the first instance of the flow of water that was condensed from the air and moved the water along the microchannels on a dynamic crystal surface that changes over time by sublimation. Moreover, the water moving across the surface can also passively transport nanoparticles and dust over macroscopically measurable distances ranging from 5.9 to 54.9 μm. The results showed that even at RH 11%, the autonomous transport phenomena of surface water were substantial.

Collaborations Utilizing CTP Facilities

The CTP equipment is extensively utilized to develop collaborations with other institutions, such as:

1. Max Planck Institute for Solid State Research, Stuttgart 70569, Germany
2. SESAME Synchrotron, As- Salt 19252, Jordan
3. University of California Los Angeles, California USA.
4. Bruker Biospin K.K.3–9,Moriya, Kanagawa,Yokohama, Kanagawa221-0022, Japan
5. Laboratoire de Bioimagerie et Pathologies, UMR 7021 CNRS Université de Strasbourg 74 route du Rhin, 67401 Illkirch, France
6. State Key Laboratory of Supramolecular Structure and Materials College of Chemistry Jilin University Changchun 130012, P. R. China

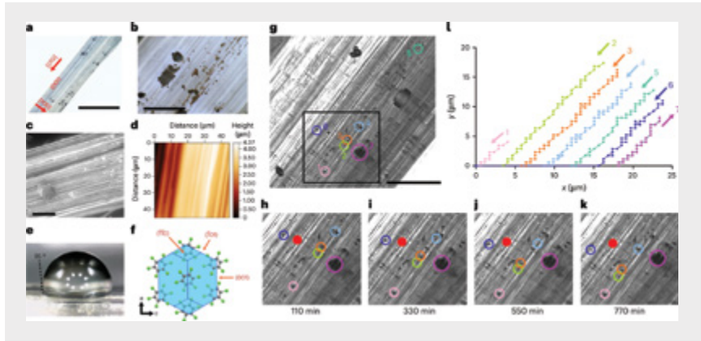

Fig. 1 | Topology and transport of AgMPs across the (001) surface of a naturally grown crystal of HCB. a,b, Optical microscopy of the channels on the surface of HCB crystals with AgMPs on them. Scale bars, 500 μm (a) and 50 μm (b). c,d, Scanning electron micrograph (c) and AFM image (d) showing the corrugated surface of HCB. Scale bar, 100 μm. e, A droplet of water on the surface of HCB with a static contact angle of the HCB of 95°, showing that it is mildly hydrophobic. f, the Crystal structure of HCB and face indexing. The data on the crystal structure of HCB were retrieved from a crystal structure in the Cambridge Structural Database 47 (reference code: 1029022). g–k, Greyscale brightfield images of the (001) facet of an HCB crystal with AgMPs scattered on the surface, seen as dark spots, monitored at 21 °C and 55% relative humidity at 0 (g), 110 (h), 330 (i), 550 (j) and 770 min (k). Seven nanoparticles (highlighted with color-coded circles) were tracked and shown to move along the crystal channels at fairly consistent rates. A red circle is placed over a stationary location in the images in h–k as a reference point. Scale bar in g, 100 μm. l, the Tracked path of each AgMP in g, plotted in Cartesian coordinates. The colors correspond to the respective particles in g. The relative positions of the particles on this plot were adjusted to end their travel at y = 0 for particles 1–6 and to start at y = 0 for particle 7, and the respective x-axis values were uniformly offset for ease of comparison.

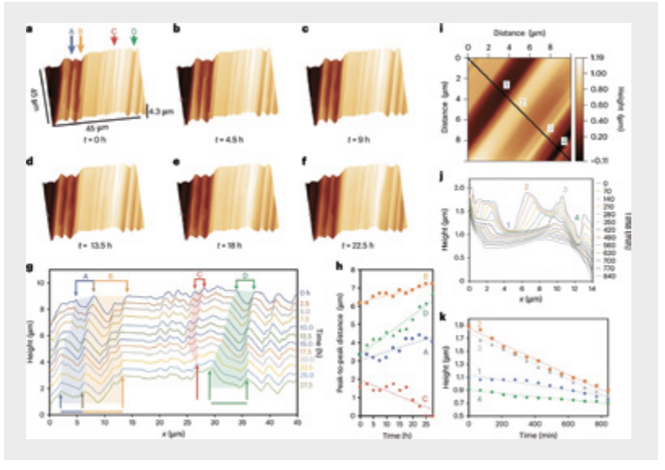

Fig. 2 | Dynamics of the surface topology of an HCB crystal at 21 °C and 55% relative humidity over time. a–f, Three-dimensional AFM topography images at t = 0 (a), 4.5 (b), 9 (c), 13.5 (d), 18 (e) and 22.5 h (f), with four open microchannels labelled A–D. The images show the widening and narrowing of various channels by sublimation. At t = 0 h, the surface shows several channels of varying widths and heights. After 4.5 h, the surface sublimes and channel D widens. After 9, 13.5, 18 and 22.5 h, the sublimation continues and features A, B and D widen while C narrows until it can no longer be observed. g, Peak-to-peak width changes extracted from the height profiles of the AFM surface images. A y offset was added to the height for clarity. h, Peak-to-peak distances of microchannels A, B, C and D. i,j, AFM image (i) of a different crystal monitored over 840 min and used to measure the rate of sublimation of the peak and valley features labelled as 1–4 (j). k, Height of features 1–4, measured over time to calculate their sublimation rate. The linear fits for features 1–4 were y = −0.0004x + 1.133 (R2 = 0.897), y = −0.0012x + 1.852 (R2 = 0.987), y = −0.0012x + 1.776 (R2 = 0.995) and y = −0.0002x + 0.8958 (R2 = 0.8958), respectively.

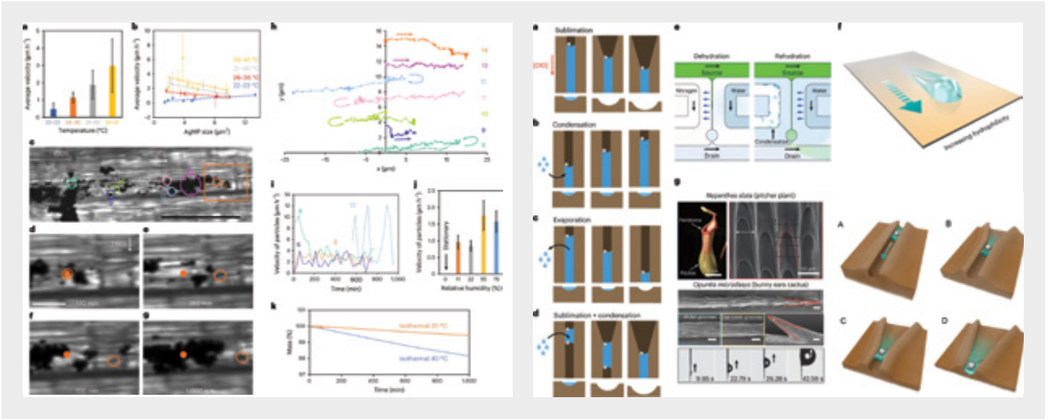

Fig. 3 | Methods for altering particle velocity. a, Histogram of the average velocity (mean ± s.d.) of AgMPs, as measured at different temperatures and 44% relative humidity (n = 7), showing that the velocity of the particles increased with temperature. b, Graph showing the negative correlation between AgMP particle size and average velocity (n = 6–12), as smaller particles move faster than larger ones. The error bars represent s.d. c, Optical confocal microscopy image of particles 8–14 at 34.7–42.5 °C and t = 0 min. The seven particles moved unpredictably across the surface. Scale bar, 50 μm. d–g, Time-lapse images of the motion of particle 14 at 170 (d), 350 (e), 700 (f) and 1,000 min (g). The current location of particle 14 is shown by an open orange circle and its original location is shown by a filled orange circle. The particle had notable motion outside of a channel. Scale bar, 10 μm. h, Motion of particles 8–14 moving backwards and forwards, plotted using Cartesian coordinates. The initial position of all particles was set to (0,0), and then a y offset was applied for ease of comparison. i, Velocity of particles 3, 6, 8 and 12, with the 21 °C particles displaying constant velocities and heated particles 8 and 12 showing varying velocities over time. j, Velocities of the particles that were monitored under controlled relative humidities. The rate increased at higher humidities. The error bars represent s.d. (n = 3). k, Isothermal thermogravimetric analysis of HCB monitored at 20 and 40 °C. Sublimation occurs 316% faster at 40 °C than at 20 °C.

Fig. 4 | Proposed mechanism of particle movement on the surface of HCB crystals and comparison with other mechanisms of passive water transport. a–d, A series of illustrations showing how water can move along the channels via sublimation (a), condensation (b), evaporation (c) and a combination of these factors (d). The particles can be pushed by an expanding water meniscus during condensation, pulled by an evaporating meniscus or moved by narrowing subliming channels. The particles can also be moved by a combination of two effects, such as water condensing in a channel while it narrows via sublimation. The cross-sectional representation of each surface is shown at the bottom. e, Schematic of a device that uses water evaporation to passively transport water. f, a Cartoon of a surface that was chemically modified to have a hydrophilicity gradient to unidirectionally propel water. g, Images of two natural systems: Opuntia microdasys (colloquially known as bunny ears cactus) needles and Nepenthes alata (one of the pitcher plant species), which transport water unidirectionally using static hierarchical structures that trap water using wedges or by propelling it using a conical surface. Scale bars, 20 μm for top, middle-left and middle-middle and 2 μm for middle-right. h–k, Dynamic sublimation-induced mechanism of transport of HCB. Water present in the valleys of the crystal (h) moves along the ridges as the valley widens (i) via sublimation. The water is then drawn down the channel via capillary forces and the silver nanoparticles are carried with the water (j,k). Panels reproduced with permission from e, ref. 9

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Overview of the Research Group

The Robotics and Intelligent Systems Control Laboratory (RISC Lab) at New York University Abu Dhabi focuses on perception, control, and planning in primarily autonomous robots. Our vision is to realize fully capable aerial workers, delivery systems, and collaborative autonomous agents as well as focus on medical and search and rescue applications. Active research areas include distributed mapping and localization for autonomous agents, cooperative area coverage and mapping, design and implementation of surgical robotic solutions, collaborative flight of physically connected aerial vehicles, cooperative aerial manipulation, and autonomous ground & aerial package transportation and delivery. RISC Lab operates in two research spaces, the office space located in A1-005, and the Kinesis laboratory in collaboration with the Core Technology Platform of NYUAD.

Key Research Utilizing CTP Facilities

The main research includes the development of heterogeneous autonomous cooperative units (drones, quadrupeds, wheeled ground robots). Unmanned aerial vehicles (UAVs) with attached manipulators, hybrid aerial/ground/vessel systems, quadrupeds, and others perform distributed simultaneous localization and mapping (SLAM), followed by path planning algorithms in a cooperative manner (leader-follower configuration). Cooperative multi-copters for payload delivery and others are deployed in a GNSS-denied, obstacle-cluttered environment. Customized mobile surgical robots, VTOLs, and other omnidirectional drones are safely controlled to assist in several tasks.

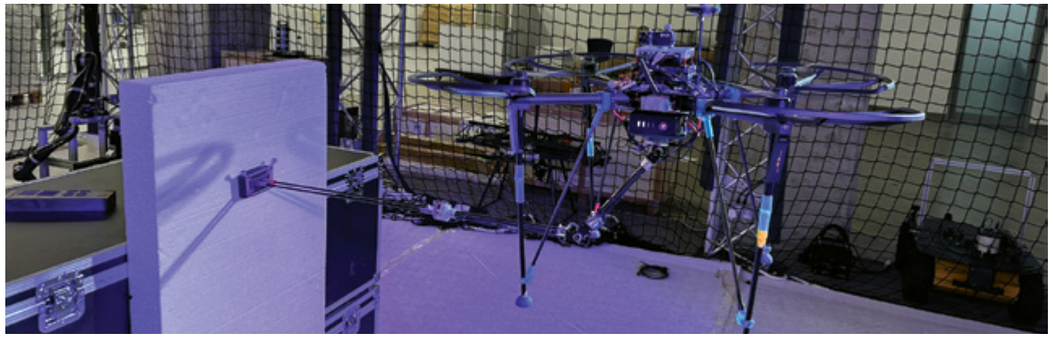
Major Publications Leveraging CTP Equipment

Modular Multi-Copter Structure Control for Cooperative Aerial Cargo Transportation

The control problem of a multi-copter swarm, mechanically coupled through a modular lattice structure of connecting rods, is considered in this article. The system's structural elasticity is considered in deriving the system's dynamics. The devised controller is robust against the induced flexibilities, while an inherent adaptation scheme allows for the control of asymmetrical configurations and the transportation of unknown payloads. Certain optimization metrics are introduced for solving the individual agent thrust allocation problem while achieving maximum system flight time, resulting in a platform-independent control implementation. Experimental studies are offered to illustrate the efficiency of the suggested controller under typical flight conditions, increased rod elasticities and payload transportation.

Mechatronic Design and Control of a Hybrid Ground-Air-Water Autonomous Vehicle

This article describes the development of a hybrid autonomous vehicle capable of flying and navigating on ground terrain and water surface. This is achieved by combination of a typical coaxial tricopter with a flotation device, coupled with omni wheels and water propellers. The mechatronic design is presented, starting with the hardware component description, the supervisory control architecture and the redesign based on the hardware-in-the-loop simulation. The water-resistant autonomous vehicle uses one autopilot copter-component and another one for the vehicle/vessel. The supervising computer switches between these autopilots depending on the needed mode of operation using alterations in the firmware in designing the control effort. Simulation and experimental studies are offered to highlight the efficiency of the developed system.



Collaborations Utilizing CTP Facilities

NYU Abu Dhabi and the Abu Dhabi Airport Commission worked together to protect and ensure the safety of infrastructure at the city's new international airport, as well as ensuring the safety of workers. The aerodynamic design of the airport roof is a high risk environment for humans to work in. Engineers at NYU Abu Dhabi built a drone with a robotic arm to do the work instead, minimizing the risks and hazards of using humans in difficult tasks.

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Overview of the Research Group

Laboratory of Applied Nonlinear Dynamics (L.A.N.D.) focuses on understanding various nonlinear phenomena and applying this understanding to resolve issues related to power generation, manufacturing, microelectromechanical systems, and origami structures. The research currently performed at L.A.N.D. is focused on the following topics:

- Improving performance of energy harvesters in stochastic environments
- Exploiting nonlinearities and non-traditional design concepts to improve the performance of flow energy harvesters
- Exploiting liquid-state transduction materials for energy harvesting
- Studying the mechanics and dynamics of origami-based structures
- Employing origami-based structures in energy absorption and energy harvesting applications
- Structural morphing using dynamic instabilities
- Developing broadband wave energy converters

Key Research Utilizing CTP Facilities

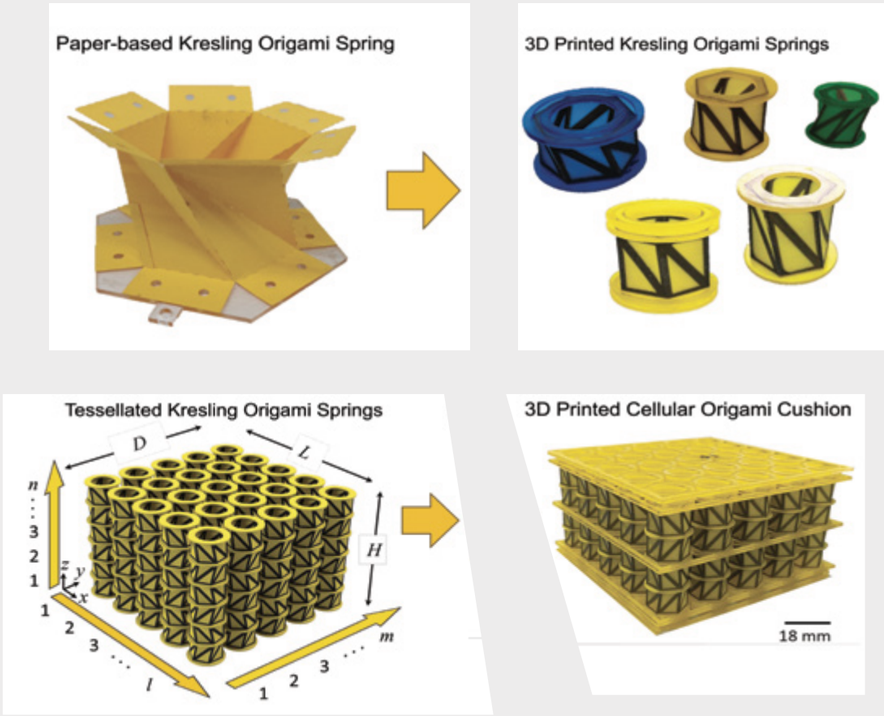
One of our research goals focused on developing a fabrication process for a certain type of origami-inspired structures called the Kresling origami springs. These springs have several unique properties that are desirable in many engineering applications, but they are conventionally fabricated using paper-folding methods, which lack repeatability and durability. We have utilized CTP's multi material polyjet 3D printer (Stratasys J750) and were able to successfully fabricate functional, durable, and repeatable variants of the Kresling origami springs. Moreover, we have used CTP's Instron universal testing machine to characterize these springs and demonstrate their enviable and tunable nonlinear behavior. Additionally, we were able to scale the Kresling origami springs and fabricate a three dimensional tessellation, using the same 3D printing process with few adjustments, in order to create a cellular cushion material with highly efficient impact energy absorption capability. The impact testing setup used to evaluate the performance of the cushion material was built in-house by also utilizing other FDM-based 3D printers (eg; Stratasys F370 and Ultimaker S5) available at CTP labs.

Major Publications Leveraging CTP Equipment

Combining Advanced 3D Printing Technologies with Origami Principles: A New Paradigm for the Design of Functional, Durable, and Scalable Springs
https://doi.org/10.1016/j.compositesb.2022.109811

This paper presents a novel approach for the design and 3D printing of a Kresling origami spring (KOS) which mimics the qualitative behavior of a paper-based KOS without compromising on durability, repeatability, and functionality. In the new design, each fundamental triangle in the traditional KOS is replaced by an inner central rigid core and an outer flexible rubber-like frame, which are fabricated out of different viscoelastic materials using polyjet-based 3D printing technology (Stratasys J750). The quasi-static behavior of the fabricated springs is assessed under both compressive and tensile loads using a universal testing machine (Instron 5960).

An Origami-inspired Design of Highly Efficient Cellular Cushion Materials
https://doi.org/10.1016/j.apmt.2023.101835



In this paper we combined advanced manufacturing technologies with origami principles to create a new class of architectured cellular viscoelastic cushion material which combines low weight and high energy absorption efficiency with damage resistance and full behavior customization. Each unit cell in the proposed material is inspired by the Kresling origami topology, which absorbs impact energy by gracefully folding the different interfaces forming the cell to create axial and rotational motions. A large part of the absorbed energy is then dissipated through viscoelasticity in the base constituents. The result is a nearly ideal cushion material exhibiting high energy absorbing efficiency (-70%) combined with high energy dissipation (94% of the absorbed energy). The material is also tunable for optimal performance, reliable despite successive impact events, and achieves full shape recovery.

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Overview of the Research Group

The S.M.A.R.T. Construction Research Group is an interdisciplinary team conducting world-leading research that delivers innovative frameworks, methodologies, models, and tools to improve the management of construction projects and move forward the automation and digitalization of the construction sector. We generate high-impact scholarly work while ensuring a pragmatic viewpoint to guarantee successful integration in managing the planning, design, construction, operation and maintenance, inspection, retrofit, and repair of the built environment and communities of the future.

Key Research Utilizing CTP Facilities

Automated Building Exterior Crack Inspection Software (ABECIS): This research proposes an open-source software to autonomously detect and label cracks on the surface of facades. An Artificial Intelligence (AI) algorithm identifies and labels cracks from images, providing qualitative and quantitative information such as the direction of the crack and the relationship between the width and the length of the crack. A DJI Matrice 300 RTK was used to collect images from concrete surfaces.
In addition, tests were performed with pictures taken from a consumer-grade smartphone to show that the proposed software successfully behaves independently of the platform used to collect the images. Multi-agent robotic system: This research involves robot and human agents working collaboratively for the reality capture of a construction site. The methodology was tested in a case study that involved 3D digitization of a small, occluded space using two robots and one human agent. A Boston Dynamics Spot quadruped robot and a Robotnik SUMMIT-XL holonomic robot with different payloads were used. A human in the loop was included for verification and support. The findings from these research projects have been disseminated at international conferences and published in journals.

Major Publications Leveraging CTP Equipment

Developing a Free and Open-source Semi-automated Building Exterior Crack Inspection Software for Construction and Facility Managers
https://doi.org/10.1016/j.compositesb.2022.109811

Inspection of cracks is an important process for properly monitoring and maintaining a building. However, manual crack inspection is time-consuming, inconsistent, and dangerous (e.g., in tall buildings). Due to the development of open-source AI technologies, the increase in available Unmanned Aerial Vehicles (UAVs) and the availability of smartphone cameras, it has become possible to automate the building crack inspection process. This study presents the development of an easy-to-use, free and open-source Automated Building Exterior Crack Inspection Software (ABECIS) for construction and facility managers, using state-of-the-art segmentation algorithms to identify concrete cracks and generate a quantitative and qualitative report. ABECIS was tested using images collected from a UAV and smartphone cameras in real-world conditions and a controlled laboratory environment.

AutoCIS: An Automated Construction Inspection System for Quality Inspection of Buildings
https://www.iaarc.org/publications/2021_proceedings_of_the_38th_isarc/autocis-an_automated_construction_inspection_system_for_quality_inspection_of_buildings.html

Quality inspection of existing buildings is a task currently performed by human inspectors. In general, these inspections consist of assessing the different elements of a building as they are being constructed, checking that they are within acceptable tolerances and meeting industry standards. Typically, this process is carried out by doing a visual inspection, taking photographs, and using measuring tools to identify deficiencies for further comparison with the BIM model. The acquired data must be analyzed by different specialists such as civil, electrical, and mechanical engineers, looking for defects or substandard installations. This process is time-consuming and dependent on the human factor, leading to errors and inconsistencies. To counteract that, we propose a methodology based on a multi-robot system that works synergistically to automatically collect data and analyze it for the further generation of a quality report.

Collaborations Utilizing CTP Facilities

- Matrice 300 RTK
- Various DJI Payload (LiDAR + IR Camera + RGB Camera)
- Boston Dynamics Spot quadruped robots
- Wireless communication system from Persistent System
- Hovermap ST LiDAR

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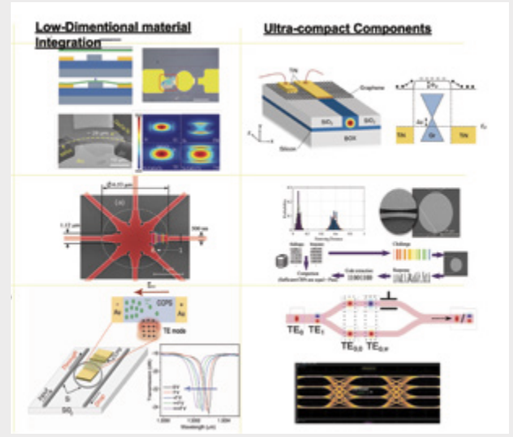
Key Research Utilizing CTP Facilities



The main research area is optical communications, with a particular focus on integrating optical and electrical components to achieve high data rates. This involves designing, testing, and certifying various telecommunications devices and systems, emphasizing reliable and high-speed data transmission. Testing includes designing and characterizing components such as photodetectors, modulators, optical sensors, and integrated photonics circuits, with a focus on overcoming bandwidth limitations through silicon photonics. Another main research area encompasses applications in fields such as cybersecurity, artificial intelligence, healthcare, and environmental monitoring, where compact, high-sensitivity, and cost-effective optical solutions are crucial for applications in 6G wireless communications, Visible Light Communication, and Microwave Photonics.

Major Publications Leveraging CTP Equipment

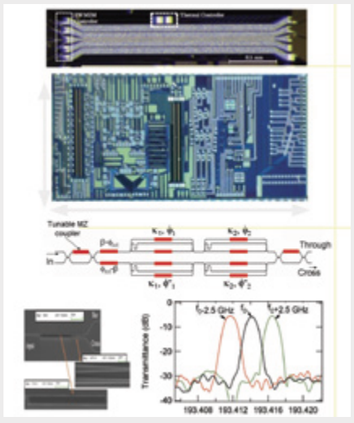
Electro-optic Tuning in Composite Silicon Photonics based on Ferroionic 2D Materials

Dushaq, G., Serunjogi, S., Tamalampudi, S.R. et al. Electro-optic tuning in composite silicon photonics based on ferroionic 2D materials. (Nature) Light Sci Appl 13, 92 (2024). https://doi.org/10.1038/s41377-024-01432-2. Summary: Tunable optical materials, crucial in integrated photonics, pose challenges in achieving precise control. Multilayer ferroionic CCPS unveils robust electro-refractive response, enhancing Silicon photonics circuits tunability Results surpass TMD-based phase shifters, promising diverse applications from optical switching to neuromorphic systems.

Ultra-Compact Ultra-Broadband Two-Mode Transverse-Electric Based SWG Multiplexer Demonstrated at 64 Gbps

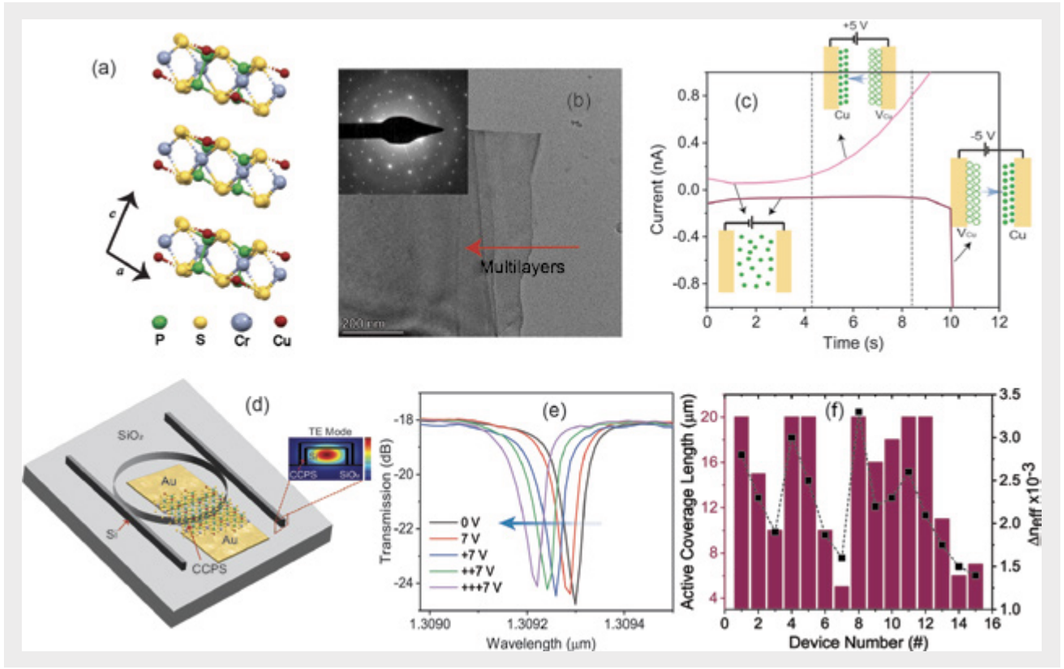
Bruna Paredes, Zakriya Mohammed, Juan Esteban Villegas, and Mahmoud Rasras, “Ultra-Compact Ultra-Broadband Two-Mode Transverse-Electric Based SWG Multiplexer Demonstrated at 64 Gbps,” J. Lightwave Technol. 41, 5412-5417 (2023) Summary: This work presents an ultra-compact, ultra-broadband two-mode de-multiplexer on an SOI platform, employing an SWG asymmetrical coupler. The device operates at 64 Gbit/s and it achieves high fabrication tolerance and operates across S-, C-, and L-bands.

Overview of the Research Group



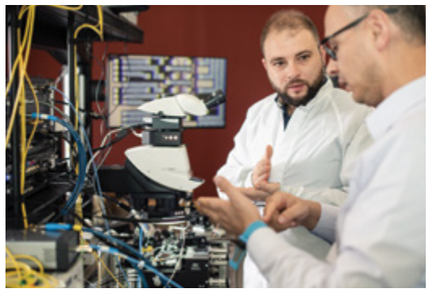
The Photonics Research Lab is dedicated to developing novel Photonic/Optoelectronic components for advanced optical and data communication networks, with a specific focus on overcoming bandwidth limitations through silicon photonics. Present endeavors include the design of 2D material-based photodetectors and modulators in CMOS-compatible platforms. Furthermore, the lab explores optical sensor applications in cybersecurity, artificial intelligence, healthcare, and environmental monitoring, providing compact, high-sensitivity, and cost-effective solutions. Leveraging expertise in Silicon Photonics, monolithic photonics-electronics integration, and access to advanced characterization facilities, the lab also aims to advance energy-efficient optical components for other applications, including 6G wireless communications, Visible Light Communication, and Microwave Photonics.

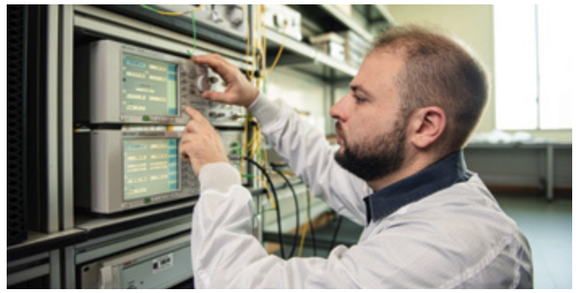
By combining cutting-edge research with state-of-the-art facilities, the lab endeavors to contribute significantly to the development of next-generation optical and data communication technologies, addressing the growing demands for high-speed, reliable, and energy-efficient communication systems in various domain.



Collaborations Utilizing CTP Facilities

We have a fruitful research collaboration with the science division within the Center of Smart Engineering Materials. Additional external collaborations are anticipated with the TII Institute, Khalifa University, and Cambridge University, working on 2D materials for next-generation photonics and high-speed component development.





3

SUSTAINABILITY AND ENVIRONMENTAL PRESERVATION

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Overview of the Research Group

The Marine Biology lab at NYU Abu Dhabi uses the Arabian Gulf as a natural laboratory to study coral reef ecology in extreme environments and to understand how these reef communities may serve as a model for the possible impacts of future climate change on reefs elsewhere. Current research explores how reef fauna in the Arabian Gulf can cope with extreme environments (e.g. temperature and salinity) using a suite of genomic, molecular, physiological and ecological approaches. Projects include understanding the role of adaptation versus acclimation in the high thermal tolerance of corals and their symbionts, the biogeographic patterns of the genetic structure of coral and their symbionts across environmental gradients in the region, and large-scale changes in regional coral reef ecosystems as a result of recurrent bleaching and other disturbances, among other projects. Other ongoing projects include an intensive study of the ecophysiology of reef fishes living in this extreme environment to understand the role that thermal stress plays in ecological performance from the molecular/cellular to population scales, as well as studies of population genetics and genomic signatures of adaptation in commercial fish species.

The lab has also recently completed a three-year project on mangrove genomics.

Key Research Utilizing CTP Facilities

- Open Circuit Scuba Diving Equipment, tanks and compressor - Coral reef surveys and monitoring, sea-urchin monitoring (Collaboration with Florida), water sampling, coral sampling, fish collection, seagrass areas monitoring
- Exo Sondes - Water physical/chemical data collection - water columns profiling - fixed stations on reefs and crucial locations for water monitoring
- ProDSS - Water physical/chemical data collection - water columns profiling - Aquarium water monitoring
- NYUAD/Thuraya vessels - Fieldwork activities (all above)
- GMC Sierra/Dodge RAM - Material transportation for fieldwork activities - Water collection for Aquarium - Transportation to Atlantis/Seaworld/ Fujairah

Major Publications Leveraging CTP Equipment

Signatures of selection underpinning rapid coral adaptation to the world's warmest reefs
https://www.science.org/doi/10.1126/sciadv.abl7287

Smith, E. G., Hazzouri, K. M., Choi, J. Y., Delaney, P., Al-Kharafi, M., Howells, E. J., Aranda, M., & Burt, J. A. (2022). Signatures of selection underpinning rapid coral adaptation to the world's warmest reefs. Science Advances, 8(2), eabl7287

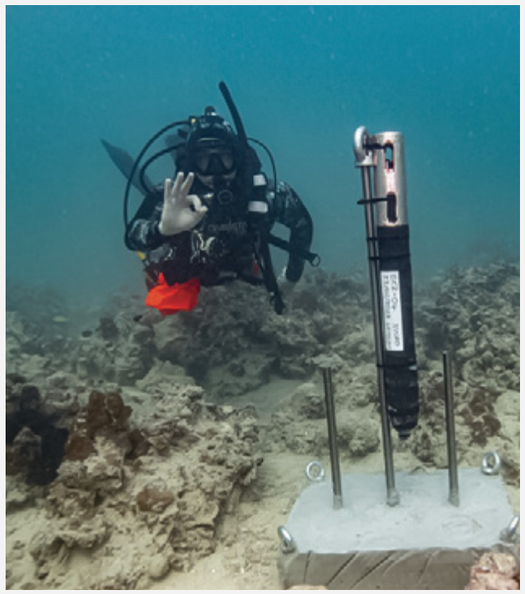
A high-quality genome assembly and annotation of the gray mangrove
https://academic.oup.com/g3journal/article/11/1/jkaa025/6026961

Friis, G., Vizueta, J., Smith, E. G., Nelson, D. R., Khraiwesh, B., Qudeimat, E., Salehi-Ashtiani, K., Ortega, A., Marshell, A., Duarte, C. M., & Burt, J. A. (2021) A high-quality genome assembly and annotation of the gray mangrove, Avicennia marina. G3 Genes|Genomes|Genetics, 11(1)

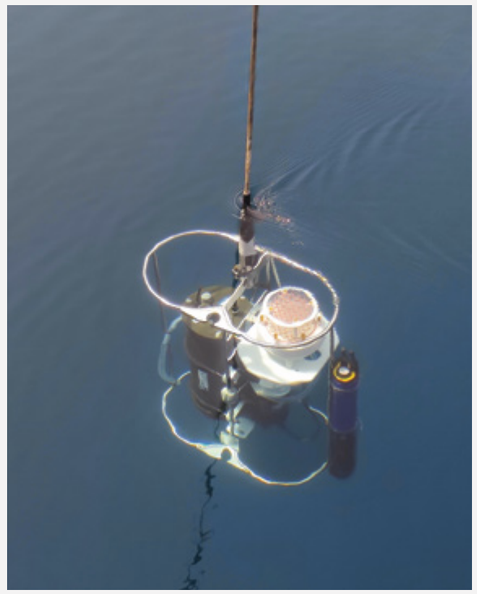
Collaborations Utilizing CTP Facilities

The Marine Biology Lab and the Marine Microbiomics Lab have embarked on an innovative collaboration aimed at unraveling the intricate relationship between coral reef ecosystems and their resident microbiomes. Focused on the Arabian Gulf, a region characterized by extreme thermal conditions, this partnership seeks to illuminate the fascinating mechanisms behind the high thermal tolerance exhibited by Gulf corals.

By combining the Marine Biology Lab's expertise in coral physiology and ecological dynamics with the Marine Microbiomics Lab's cutting-edge genomic and metagenomic techniques, the researchers are delving into the microbial communities that inhabit these unique coral environments. This interdisciplinary effort not only promises insights into the adaptive strategies of Arabian Gulf corals but also holds the potential to inform broader strategies for coral conservation in the face of escalating global climate challenges. To effectively execute their ambitious research goals, the collaboration between the Marine Biology Lab and the Marine Microbiomics Lab, CTP has seamlessly integrated vital resources. CTPs state-of-the-art boats and diving equipment are playing a pivotal role in facilitating comprehensive fieldwork and data collection in the challenging Arabian Gulf Environment.



CTP has several YSI Exo Multiparameter meters that have seven universal ports that allow for any combination of smart sensors to record several critical parameters including dissolved oxygen, turbidity, pH, conductivity, salinity, depth and temperature. The instruments can be deployed underwater for extended periods of time to collect continuous in-situ environmental data.



The in-situ McLane pump is used to simultaneously size-fractionated and filter large volumes of sea water for DNA/RNA and metabolite extractions across several depths.

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Overview of the Research Group

The Marine Microbiomics Lab studies the role microbiomes play in the adaptation and evolution of important marine eukaryotes, particularly microalgae and corals. Using multiomics and physiological and phenotypic techniques, we examine how these microbiomes influence their hosts' physiology, evolution, response to the environment, and the effects of climate change and anthropogenic influences on these host-microbiome relationships.

Our lab is also extensively using cutting-edge techniques to study microbial ecology and beyond. We use microfluidics to study microbiomes of unicellular eukaryotes at the single-cell level. We also use and develop metabolomics techniques to study a wide range of questions, including host-microbiome interactions, saliva metabolomics, drug metabolism in the human gut and model system metabolomics.

Key Research Utilizing CTP Facilities

Our research utilizes the Leica DMI6000 widefield microscope to investigate bacterial attachment to microalgae and characterize the biodiversity of microalgae in the Arabian Gulf. Additionally, we employ the Quanta 450 FEG field emission scanning electron microscope to study bacterial phenotypes.

We employ shakers for bacterial culture maintenance, and the SeqStudio Genetic Analyzer for 16S rRNA bacterial identification.

FlowCam imaging Flow Cytometer is used for screening and real-time imaging of phytoplankton species from the UAE coast. BD Accuri c6 flow cytometer is used for enumeration of HNA/LNA bacteria and picophytoplankton.

To investigate metabolomics samples of bacteria, algae and multicellular organisms like corals we utilize liquid chromatography mass spectrometry (LCMS) instruments like the Bruker Impact HD Q-ToF system and Thermofisher Orbitrap Fusion Lumos instruments. Further, intra- and extracellular isotope labeled (13C, 15N) samples with high chemical complexity are analyzed using a Bruker Solarix XR FT-ICR-7T system by direct infusion from an Advion
TriVersa Nanomate.

Nutrient levels of seawater in the Arabian Gulf, in aquaria, culture and aquaculture samples are determined using a SEAL-analytical AA3 HR autoanalyzer.

NYU Boat is used for all fieldwork in the Arabian Gulf.

Major Publications Leveraging CTP Equipment

Endozoicomonas provides corals with steroid hormones during thermal stress
https://www.biorxiv.org/content/10.1101/2023.09.19.558257v1

One of the keystone coral-associated bacteria is Endozoicomonas, an enigmatic bacterium ubiquitously associated with corals globally and hypothesized to be a beneficial symbiont. Through genomic predictions, Endozoicomonas is believed to help the coral host though the nature of the relationship is unknown. In this paper, we analyzed metagenomics and metabolomics data collected from wild corals in the Arabian Gulf during a natural thermal stress event and subsequent recovery to unravel the specific role Endozoicomonas play in response to rising ocean temperatures. We showed that under thermal stress, Endozoicomonas partially utilizes coral-derived cholesterol as a carbon source while simultaneously converting it to testosterone and progesterone hormones. Both steroids prime the innate immune system and inhibit pathogenic microbes. These findings highlight a novel interaction between corals and their microbiome that may be critical to coral health in a warming ocean.

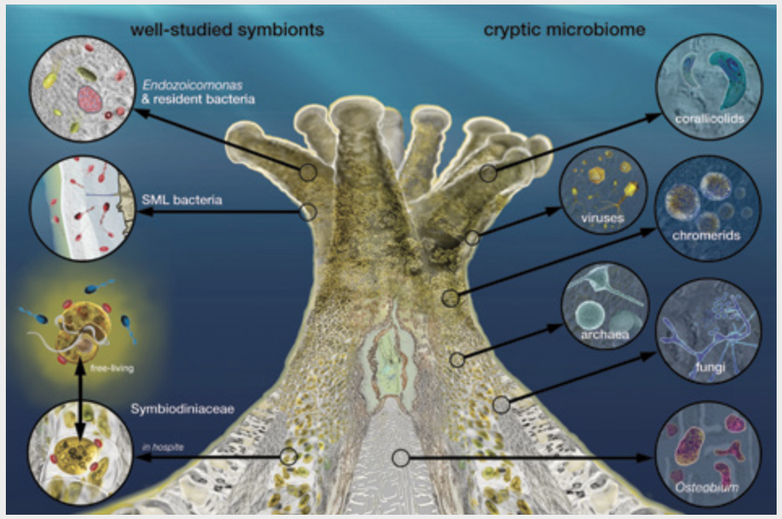
Molecular mechanisms of microbiome modulation by the eukaryotic secondary metabolite azelaic acid
https://elifesciences.org/articles/88525

Photosynthetic organisms, like plants and microalgae, foster fundamentally important relationships with their microbiome through the reciprocal exchange of chemical currencies. Among these, azelaic acid (Aze) is important for promoting the growth of bacterial symbionts while simultaneously inhibiting harmful bacteria of such hosts. Its potent effects against harmful bacteria is evident in being the major active ingredient in most acne-treatment creams. However, the ability of Aze to promote or inhibit bacterial growth and its uptake and assimilation mechanisms into bacterial cells are mostly unknown. In this paper, we identified a putative Aze transporter in symbiotic bacteria that assimilates this important molecule and showed that Aze is assimilated through the fatty acid degradation pathway. On the other hand, Aze inhibits the ribosome and/or protein synthesis of harmful bacteria. These findings unravel the role of a key chemical currency in Modulating host-microbiome interactions.

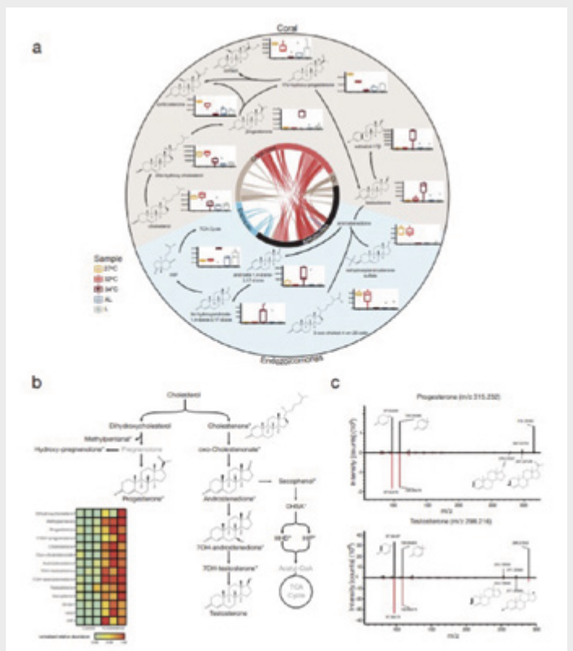
Collaborations Utilizing CTP Facilities

Collaboration with PHRC: The global prevalence of obesity has been steadily increasing over the last decades, making it a major short- and long-term public health concern. Untargeted metabolomics using LCMS (Thermofisher Orbitrap Fusion Lumos mass spectrometer) was performed on a large set of oral mouthwash extracts from obese and non-obese members of the Emirati population to investigate the metabolic profiles of their oral microbiome. This study provided evidence that the oral microbiome was different between obese compared to non-obese individuals and potentially shed light on the role of the oral microbiome in obesity.

Collaboration with Prof. Walla Mousa at Al Ain University: Understanding how drugs are metabolized or degraded by the human gut microbiota is one of the key elements in predicting their bioavailability and potential side effects. Microbiota can modify or degrade pharmaceutical drugs and produce metabolites that might be beneficial or harmful to patients. In this study, the Thermofisher Orbitrap Fusion Lumos mass spectrometer was used to investigate and identify different drug metabolites and degradation products by probiotics. This study indicates that the administration of probiotics along with some drugs may lead to changes in drug activity and provides an insight into the fate of these drugs by the gut microbiome.



The complex coral microbiome. Recent evidence points to the importance of the coral microbiome to adaptation to thermal stress.



Steroid hormone biosynthesis and degradation in the coral holobiont. a, Steroid biosynthesis and degradation pathways based on coral and Endozoicomonas genes. Metabolite relative abundance is shown for each detected steroid-related metabolite. Colors indicate different pathways (brown=steroid biosynthesis, red=steroid hormone biosynthesis, blue=steroid degradation, black=metabolites). b, Proposed cholesterol transformation pathway by Endozoicomonas inferred from metabolomics analysis of E. acroporae with or without cholesterol. c, Fragmentation spectra spectra for progesterone (96% match) and testosterone (99.3% match).

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Overview of the Research Group

Prof. Paparella's research focuses on developing and studying mathematical models of Earth-system processes, with particular attention to processes relevant to the Gulf region.

Key Research Utilizing CTP Facilities

Measurement of the main hydrographical and biogeochemical parameters in the Southern Gulf waters. The marine science research vessel is the primary asset.

Major Publications Leveraging CTP Equipment

Long-term, basin-scale salinity impacts from desalination in the Arabian/ Persian Gulf
https://www.nature.com/articles/s41598-022-25167-5

Paparella, F., D'Agostino, D. & A. Burt, J. Long-term, basin-scale salinity impacts from desalination in the Arabian/Persian Gulf. Sci Rep 12, 20549 (2022)

Recent expansion and intensification of hypoxia in the Arabian Gulf and its drivers
https://www.frontiersin.org/articles/10.3389/fmars.2022.891378/full

Lachkar, Z., Mehari, M., Levy, M., Paparella, F., & Burt, J. A. (2022). Recent expansion and intensification of hypoxia in the Arabian Gulf and its drivers. Frontiers in Marine Science, 9, 891378

4

INSIGHT INTO THE HUMAN BRAIN

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Overview of the Research Group

Researchers in the Rokers Vision Laboratory use motion perception as a model system in which to explore the relationship between sensory input, neural activity, and visual perception. Our work answers fundamental questions on the nature of neural computation, lays the foundation for novel treatments of visual disorders, and informs technological innovation in domains such as virtual and augmented reality.

Key Research Utilizing CTP Facilities

A major goal of our research is to advance the understanding of brain function in health and disease, with a particular emphasis on prevalent disorders in the UAE. Our group has co-founded NYUAD's Center for Brain and Health which has built upon CTP's Imaging Facility to jumpstart interdisciplinary research programs at the nexus of NYUAD's strengths in Brain, Health, and Data Science, and by pursuing translational and commercialization opportunities with its clinical and industry partners.

Major Publications Leveraging CTP Equipment

Proceedings of the National Academy of Sciences
Pedersini, C. A., Miller, N. P., Gandhi, T. K., Gilad-Gutnick, S., Mahajan, V., Sinha, P., & Rokers, B. (2023). White matter plasticity following cataract surgery in congenitally blind patients. Proceedings of the National Academy of Sciences, 120(19), e2207025120

NeuroImage
B. (2023). Identifying cortical areas underlie the transformation from 2D retinal to 3D head-centric motion signals. NeuroImage, 270, 119909

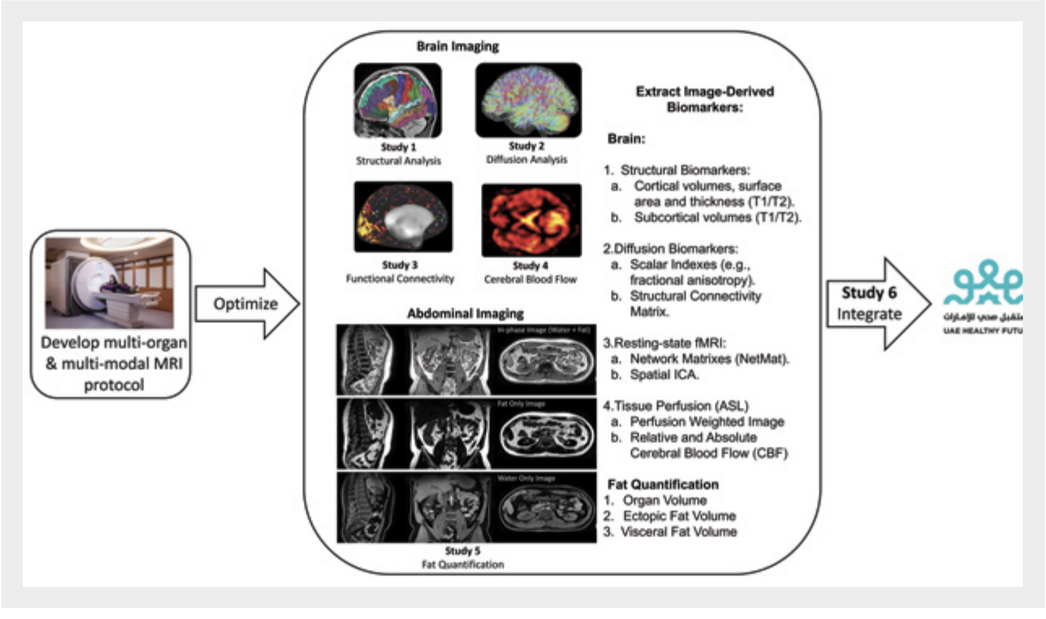
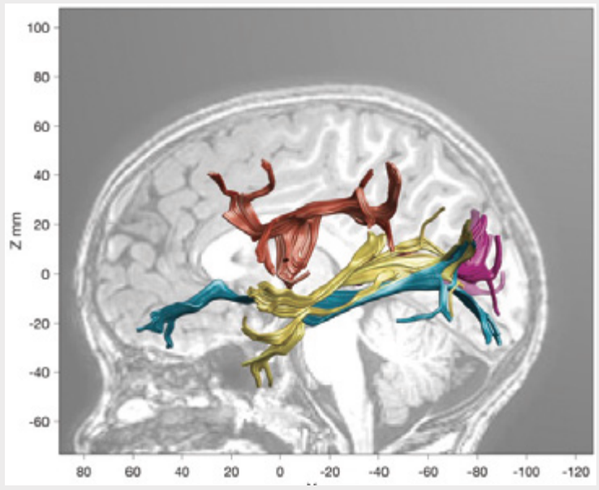


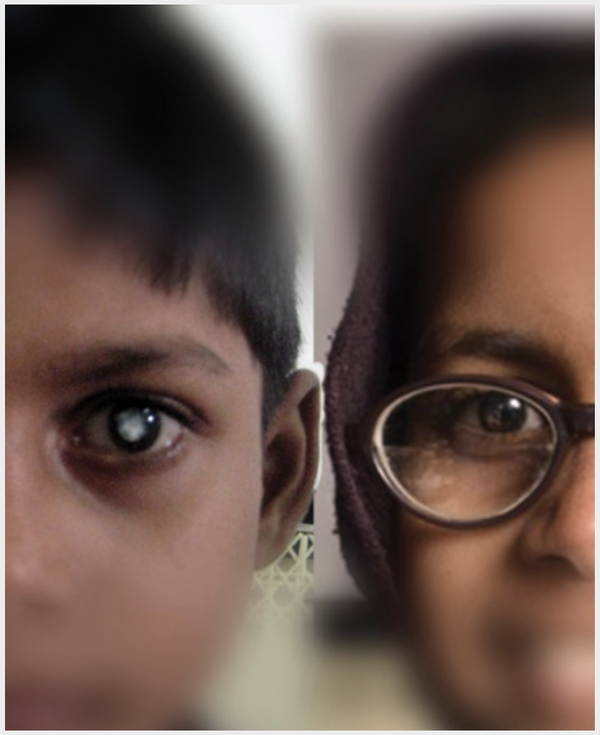
Figure 1. Overview of the proposed pipeline. We will develop, optimize, and integrate advanced multi-organ and multi-modal MRI acquisition in 5 pilot Studies. Total scan time for all modalities will be less than 60 minutes per subject. Image-derived biomarkers will be subsequently extracted using advanced post-processing tools. The full pipeline will be used to scan UAE nationals and integrated with the existing UAE Healthy Future Study Database (Study 6).

Collaborations Utilizing CTP Facilities

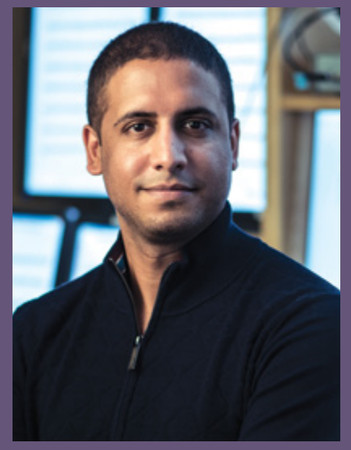
The CTP Imaging Facility is an essential part of the ASPIRE Precision Medicine Research Institute Abu Dhabi. The Institute combines the expertise of 5 Universities in the UAE to conduct fundamental and applied research in support of a lasting, direct impact on the health and healthcare of the people of Abu Dhabi, increasing the quality and length of life.



Major white matter pathways identified in a patient with congenital cataracts, using diffusion magnetic resonance imaging (dMRI). Identification of these pathways relied critically on the imaging resources provided by NYUAD's Core Technology Platform.



Anonymized photographs of two adolescent congenital cataract patients from Uttar Pradesh, India, before (left) and after (right) surgery. Surgery involves the placement of an artificial lens in the eye that restores sight.



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Overview of the Research Group

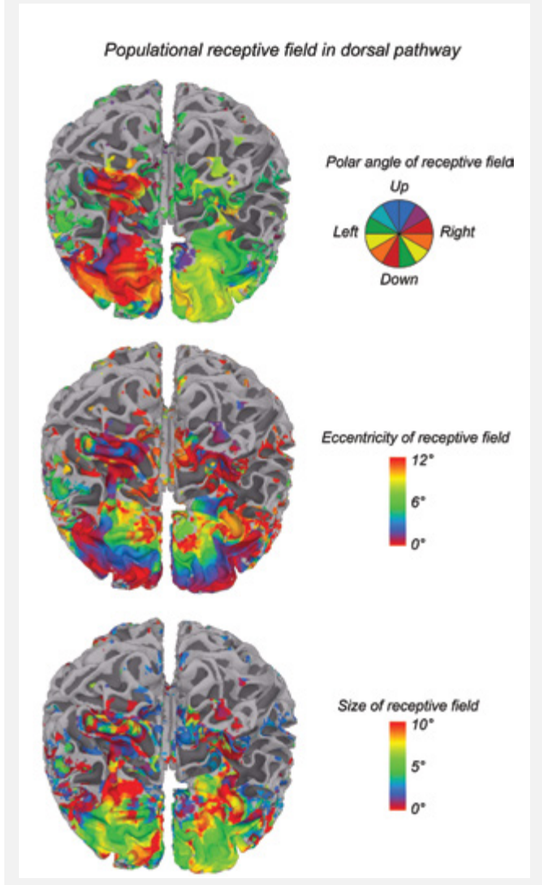
The Sreenivasan Lab is interested in how the brain forms and implements goals. Our primary focus is the neurobiological basis of working memory, which is the process that allows us to actively hold on to information over brief periods. Working memory underlies our ability to communicate, problem-solve, and think abstractly. In the lab, we combine neuroimaging and behavioural studies in healthy and patient populations to gain insight into how working memory and other elements of goal-directed behaviour are implemented in the human brain.

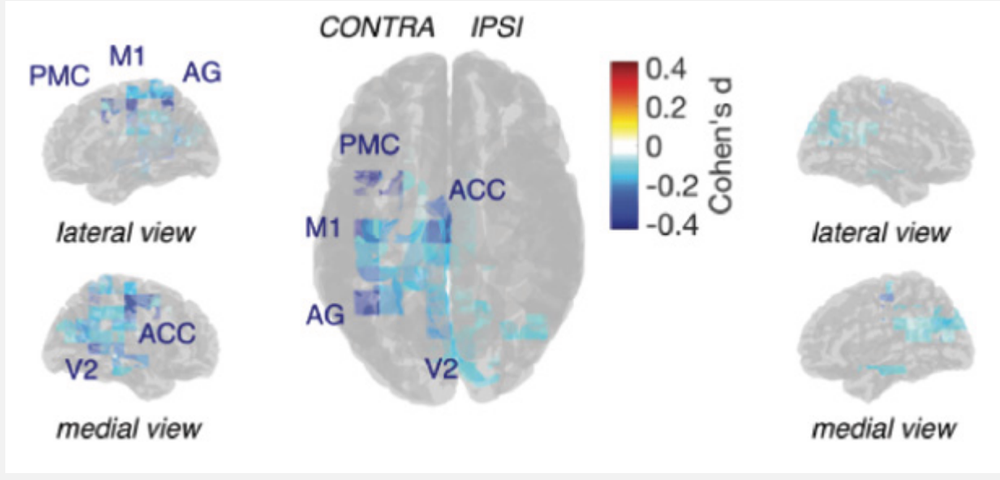
Research areas include:

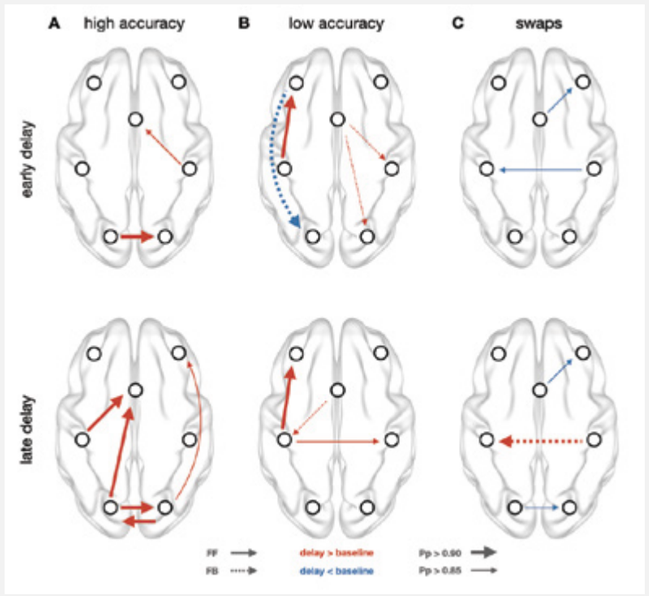
1. How are multiple working memory representations organized in parallel? Working memory likely involves multiple parallel representations distributed across the brain, but it is not clear what the purpose of this organization is. We aim to uncover the joint and unique contributions of parallel working memory representations to behaviour as well as understand how they interact.
2. How are memories converted into a coherent behavioural response? Working memories are richer than previously imagined. Converting these representations into a simple (e.g., match/non-match) behavioural response is not a trivial feat. We aim to elucidate the processes and brain mechanisms by which rich working memories are converted to point estimates in response space.

Key Research Utilizing CTP Facilities

Our work uses magnetoencephalography (MEG) and magnetic resonance imaging (MRI). The MEG and the MRI are part of the CTP equipment located in the Computational Research Building. Both of these techniques allow us to image the human brain noninvasively and are the first research-dedicated equipment of their kind in the Gulf region. Using MEG, we can measure the electrical signals generated by the brain's billions of neurons. We use MEG to understand how (1) brain regions communicate with each other during memory; (2) how the brain binds information together to form coherent memories; and (3) how the geometry of brain representations changes over time. We can indirectly measure activation across the entire brain using MRI with millimeter spatial resolution. We use MRI to reconstruct individual memories and understand how the properties of how memories are encoded in the brain are related to human behaviour. We also use MRI to understand the different properties of memory encoding and storage across the brain.







Major Publications Leveraging CTP Equipment

Performance-dependent reconfiguration of effective connectivity supporting working memory: a dynamic causal modeling study of MEG data

Santo-Angles A, Temudo A, Babushkin V, and Sreenivasan KK (submitted). Performance-dependent reconfiguration of effective connectivity supporting working memory: a dynamic causal modeling study of MEG data

Alpha phase-coding supports feature binding in working memory

Pagnotta M, Santo-Angles A, Temudo A, Babushkin V, Barbosa J, D'Esposito M, Compte A, and Sreenivasan KK (submitted). Alpha phase-coding supports feature binding in working memory.

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