TITOLO E ABSTRACT TEMI DI RICERCA DOTTORANDI DEL CORSO DI DOTTORATO DI RICERCA IN SCIENZE E TECNOLOGIE PER L'INNOVAZIONE

XL ciclo

Alfonso Emmanuel Castaneda Serrano

Tema di ricerca:
Development, manufacturing, and characterization of a Three-Layers Vascular Graft exploiting the microgravity potential to obtain a functional vessel surrogate

Abstract:
Considering the state of the art, culturing a cell seeded bioprinted 3 Layered Vascular Graft in microgravity has never been attempted before. This proposed project will address an important science question: "Does microgravity facilitate vascular tissue surrogate constructive remodeling", and if yes: "Can this mechanism be scaled up and translated to address a major unmet clinical need in cardiovascular applications?". In literature, several studies proposed large strain mechanical stimuli and mesoscopic topological cues to enhance ECM remodeling to obtain a functional construct on Earth. Yet, while these notions have been initially explored for bone and cartilage engineering, they have never been tested in microgravity for cardiovascular tissue engineering. Moreover, cell proliferation, migration and neotissue development have been insufficiently investigated under purely mechanical isotropic conditions. In this project, assessing the notion of micro-gravity, not only may lead to a breakthrough in engineered vascular grafts compared to the in vivo study but will also address a strong science gap: "Is Earth's gravity a limiting factor for the elaboration of neo-tissue in a seeded scaffold?"

Manuela Cherchi

Tema di ricerca:
In-hospital and Out-hospital connections in the Multidisciplinary Management of Peripheral Arterial Disease (PAD) in Sardinia

Abstract:
Peripheral artery disease is a major cause of death worldwide. Integrated healthcare strategies for the management of PAD are to be focusing on primary and secondary prevention, through multidisciplinary approach, in order to reduce morbidity and mortality. PAD-affected patients will be enrolled in a project that includes health promotion and integrated home care. This process starts by contacting (general practitioners) GPs to

identify patients at risk and schedule vascular surgery consultations. Remote-medicine and remote-consultation will be offered to facilitate communication between healthcare professionals and ensure prompt, efficient care.
The study aims to create a regional network between hospitals, GPs, specialists, and local services to improve patient management. This network's goal is to optimize care, reduce hospital stays, prevent major amputations, and provide faster access to treatments for PAD patients, especially in rural areas.
A digital patient record system will be implemented, allowing seamless sharing of clinical data among all involved parties. This system will on the one hand reduce unnecessary examinations and on the other had guaranteed prompt interventions when needed.
The expected results in the long-term include reduced hospitalization times, decreased waiting lists, and better prevention of amputations. Furthermore, the project follows the ambitious goals of optimizing regional healthcare resources and ensuring equal access to care across the Sardinian region, despite living in remote areas. The enhancement of remote-medicine will disrupt geographical barriers, ensuring PAD patients receive prompt and appropriate care regardless of their location.
The ultimate goal is to generate a sustainable, duplicable model for PAD management that could be of use as a reference for other regions, improving both the quality of care and the overall efficiency of the healthcare system.

Laura Nonnis

Tema di ricerca:
Digital Pathology e Intelligenza Artificiale: addestramento in Machine Learning come supporto alla diagnosi istopatologica

Abstract:
Negli ultimi anni stiamo affrontando un momento di crisi poiché, a fronte di un peggioramento nella carenza di anatomopatologi a livello mondiale, il carico di lavoro degli stessi è aumentato esponenzialmente, questo a causa dell'incremento nel numero di casi e per la richiesta da parte dei clinici di diagnosi sempre più complete e precise per andare a identificare le terapie più ottimali per i pazienti.
Lo sviluppo di mezzi che possano rendere la vita del patologo più semplice e veloce perciò sono, non solo da prendere in considerazione, ma da incentivare.
Ogni giorno I patologi si ritrovano a dover effettuare operazioni routinarie, fondamentali al clinico, e l'utilizzo dell'intelligenza artificiale in questi casi aiuterebbe a ridurre I tempi di analisi da parte del patologo, assicurando, da una parte dei risultati più veloci e dall'altro più tempo per espletare la sempre maggiore mole di lavoro che ci si ritrova ad affrontare e che al giorno d'oggi non è possibile delegare ad una macchina.
La Digital Pathology nella sua interezza però non si limita solo all'analisi dei vetrini da parte di un programma di intelligenza artificiale, ma facilita anche la consultazione tra patologi in tutto il mondo con la condivisione delle immagini o del vetrino stesso, velocizzando il

processo e che fino a qualche tempo fa (ma in alcuni posti ancora ora) veniva effettuato tramite servizio di posta con tutti i ritardi nelle risposte legate alla procedura.
La visione del vetrino attraverso uno schermo e non più attraverso gli oculari di un microscopio può richiedere un po' di tempo prima di abituarcisi, ma con una formazione appropriata e i giusti strumenti i patologi possono diventare più accurati e/o efficienti nel loro lavoro di tutti i giorni.
Un altro strumento che potrà aiutare e facilitare la vita del patologo è la possibilità tramite i programmi di visualizzazione dei vetrini di poter visualizzare vetrini diversi contemporaneamente sullo stesso schermo, facilitando la comparazione degli stessi.
I sistemi di digitalizzazione interfacciati con i sistemi di archiviazione e di registrazione dei casi forniscono inoltre un accesso istantaneo a vecchie immagini digitali riducendo tempo e costi nell'andare a ricercare ogni volta vecchi casi dall'archivio.
In definitiva l'applicazione e l'utilizzo della Digital Pathology nel lavoro quotidiano di un reparto di Anatomia Patologica può non solo diminuire il carico di lavoro di patologi, ma anche essere un buon strumento di risparmio monetario da parte dell'azienda.
L'ecosistema della digital pathology è composto da tre componenti principali: un sistema informatico che gestisca le informazioni dei pazienti; i sistemi della digital pathology, costituiti da scanner dei vetrini, una stazione di lavoro con un programma di visualizzazione delle immagini e un digital storage; programma di machine learning per l'analisi dei dati.
Con questo studio ci si prepone all'applicazione della Digital Pathology nel lavoro quotidiano. L'utilizzo di sistemi di intelligenza artificiale come QuPath si sta rivelando di grandissima importanza a livello mondiale per quanto riguarda la ricerca, ma ancora pochi centri lo utilizzano come sistema di aiuto e appoggio nella refertazione.
L'integrazione di questo programma presso il nostro istituto di Anatomia Patologica aiuterà a ridurre notevolmente i tempi di analisi e di refertazione da parte dei patologi.
Ci si aspetta che nel giro di pochi anni, prima di iniziare ad analizzare il caso (per esempio di campioni provenienti da screening), il patologo potrà usufruire già di un'analisi preliminare da parte del sistema di Intelligenza Artificiale. Si potranno poi fare delle richieste di elaborazione secondaria al programma una volta che il patologo abbia analizzato il caso.
Nel caso di tumori, inoltre, il programma sarà capace di analizzare tutta una serie di caratteristiche dello stesso necessarie per il suo inquadramento clinico (come l'indice mitotico, l'indice di proliferazione, il grado tumorale, presenza e grado di linfociti infiltranti il tumore, espressione di antigeni utili per la programmazione di terapie personalizzate come PDL-1, HER-2, MMR, ROS ecc.) supportando il patologo nella diagnosi e migliorando la tempistica di refertazione con notevole risparmio di risorse (vedi IIC e Biologia Molecolare).
Infatti, una delle aree più promettenti che circondano i modelli di machine learning è proprio del supporto alla diagnosi e al superamento della variabilità diagnostica inter e intraoperatoria. Queste scoperte possono essere fatte tramite il riconoscimento da parte della macchina di pattern associati a diversi dati multimodali come possono essere la morfologia istopatologica, la genomica, la proteomica e i dati clinici. Si arriva quindi a programmi che possono facilmente predire l'origine di carcinomi con sede primitiva ignota o virtualmente predire l'espressione cellulare di determinate proteine e le aberrazioni molecolari dalla sola analisi della sezione in Ematossilina/Eosina.

Uno studio ha mostrato che l'utilizzo di un'intelligenza artificiale diminuisce di circa il 47% il tempo impiegato nel rilevamento di metastasi di carcinoma della mammella e del 19% il tempo impiegato nell'analisi di linfonodi benigni. L'utilizzo quindi di questi programmi, finalizzati non solo all'analisi di carcinoma della mammella, ma di tutta una serie di patologie porterà ad un netto miglioramento della gestione del proprio tempo da parte di tutto il personale del reparto di Anatomia Patologica.
Lo sviluppo di un'interfaccia di facile comprensione e interfacciata al sistema di refertazione in uso aiuterebbe inoltre nella difficile transizione da un metodo di refertazione analogico a quello digitale.

Martina Tetti

Tema di ricerca:
Sviluppo di materiali amorfi e nano-cristallini a base di fosfati di calcio (CaPs) per l'ingegneria tissutale

Abstract:
I fosfati di calcio (CaPs) sono ampiamente riconosciuti come materiali innovativi nel campo dell'ingegneria tissutale grazie alla loro eccellente biocompatibilità, osteoconduttività e bioattività. Questi materiali sono in grado di mimare la fase minerale dell'osso umano, favorendo la rigenerazione e l'integrazione dei tessuti ossei. Tuttavia, la produzione di CaPs con caratteristiche morfologiche e strutturali ottimali rappresenta ancora una sfida significativa.
Il presente progetto di ricerca si propone di sviluppare materiali amorfi e nanocristallini a base di fosfati di calcio, la cui sintesi verrà effettuata utilizzando la tecnica nota come Solution Combustion (SCS). Questa metodologia permette di ottenere polveri di diverse tipologie con elevata purezza e controllo delle particelle, tipicamente di dimensioni nanometriche. I materiali prodotti verranno sottoposti a una caratterizzazione approfondita dal punto di vista morfologico, composizionale e strutturale, utilizzando tecniche avanzate di microscopia elettronica, diffrazione a raggi X e spettroscopia.
Al fine di ottenere prodotti massivi, il progetto prevede l'impiego della sinterizzazione a freddo (Cold Sintering, "CS") per consolidare le polveri di CaPs ottenute tramite SCS. La tecnica CS consente il consolidamento di polveri ad alta pressione (100-800 MPa) e bassa temperatura (massimo 250°C) ed è particolarmente adatta per i fosfati di calcio che tendono, soprattutto se carbonatati e/o idratati, a modificare le proprie caratteristiche iniziali qualora trattati ad alte temperature. Questo approccio innovativo mirerà pertanto a migliorare le prestazioni dei materiali a base di CaPs per applicazioni in ambito biomedico, offrendo nuove soluzioni per la rigenerazione ossea e l'ingegneria tissutale.
Nell'ambito del progetto si valuterà la combinazione dei CaPs con altri biomateriali, come i vetri bioattivi o i biopolimeri.

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Marco Alcibiade

Tema di ricerca:
Synthesis and Characterization of Metal Complexes as Active Materials for On-Chip Integrated Quantum Light Sources

Abstract:
This project focuses on the design, synthesis, and characterization of transition metal complexes with nonlinear optical (NLO) properties, intended for use in quantum light sources for applications in quantum telecommunications, sensing, computing, and metrology. The study will target homoleptic and heteroleptic nickel (Ni), palladium (Pd), and platinum (Pt) complexes with high second- and third-order NLO properties, utilizing both known ligands and newly designed ligands containing nitrogen, sulfur, and/or oxygen donor atoms.
Ligands and complexes will be synthesized using established or optimized methods and characterized through techniques such as elemental analysis, infrared (IR) spectroscopy, nuclear magnetic resonance (NMR), and UV-Vis-NIR spectroscopy. Additionally, thermal properties will be assessed via thermogravimetric analysis and differential scanning calorimetry, while electrochemical properties will be evaluated through cyclic voltammetry. Complexes exhibiting NLO activity but crystallizing in a centrosymmetric manner will be embedded in a polymer matrix, such as poly(methyl methacrylate) (PMMA), and subjected to a corona wire poling process at high temperatures to achieve a non-centrosymmetric alignment. This approach will enable the development of solid-state materials with NLO properties suitable for practical quantum applications.

Federico Atzori

Tema di ricerca:
Sviluppo di modelli matematici avanzati per processi industriali e chimici sostenibili: riduzione degli inquinanti e cattura della CO_2/ Development of Advanced Mathematical Models for Sustainable Industrial and Chemical Processes: Pollutant Reduction and CO_2 Capture

Abstract:
Il progetto mira a sviluppare modelli matematici innovativi per descrivere e ottimizzare processi chimici e industriali con applicazioni rivolte alla sostenibilità ambientale. La ricerca si focalizza su tecnologie per la riduzione delle concentrazioni di inquinanti da flue gas mediante sistemi di assorbimento e adsorbimento, e sull'applicazione di processi di fotocatalisi per rimuovere residui tossici dalle acque. L'approccio metodologico combina modelli deterministici, che sfruttano i principi fisico-chimici fondamentali dei processi, con tecniche avanzate di Machine Learning (ML), tra cui le Physics Informed Neural Networks (PINNs). Questa integrazione consente di affrontare problematiche complesse con soluzioni efficienti, fornendo strumenti predittivi e di ottimizzazione per migliorare le prestazioni di processi industriali strategici.

The project aims to develop innovative mathematical models for describing and optimizing chemical and industrial processes with a focus on sustainability. The research addresses technologies for reducing pollutant concentrations in industrial flue gases through absorption and adsorption systems, as well as applying photocatalysis processes to remove toxic residues from water. The methodological framework combines deterministic models, grounded in fundamental physicochemical principles, with advanced machine learning techniques, particularly Physics Informed Neural Networks (PINNs). This integration enables the resolution of complex challenges through efficient solutions, providing predictive and optimization tools to enhance the performance of critical industrial processes.

Giovanni Perra

Tema di ricerca:
Sirtuins' modulation of mitochondrial function in myotubes under microgravity conditions

Abstract:
Background: Regenerative medicine seeks to restore tissue function, with mitochondria playing a critical role in energy production and cellular repair. Microgravity impairs mitochondrial function, leading to metabolic dysfunction, oxidative stress, and reduced bioenergetics. Sirtuins (SIRT1, SIRT3, and SIRT4) regulate mitochondrial metabolism through NAD+/NADH modulation and impact oxidative phosphorylation (OxPhos). Understanding SIRTs' roles under microgravity can inform therapeutic strategies for tissue repair.
Aims: This study investigates the effects of microgravity on mitochondrial function in C2C12 myotubes, focusing on SIRT1, SIRT3, and SIRT4. Key objectives are to characterize mitochondrial dysfunction, evaluate SIRTs' regulatory mechanisms, and assess the efficacy of SIRTs activators (e.g., NAD+ precursors) in ameliorating metabolic impairments caused by microgravity.
Results: Microgravity is expected to downregulate SIRT1 and 3, upregulate SIRT4, and impair mitochondrial respiration, ATP production, and NAD+/NADH ratio. SIRTs activators are hypothesized to restore mitochondrial function, enhance ETC complex activity, and reduce oxidative stress. Computational modeling will elucidate SIRTs' opposing roles in regulating mitochondrial metabolism under microgravity.

Stefania Saponara

Tema di ricerca:
Comparison of Two Different Modalities for Hysteroscopic Polypectomy, Myomectomy, and Metroplasty in an Outpatient Setting: Bipolar Current Versus Dual-Wavelength Diode Laser Energy

Abstract:
Objective: This study compares the effectiveness and safety of bipolar current and dual-wavelength diode laser energy for hysteroscopic procedures performed in an outpatient setting.
Outcomes: The study evaluates procedure duration, need for additional instruments, treatment success, adverse events (vagal syndrome, bleeding, uterine perforation), tissue adequacy, instrument performance, patient pain and anxiety levels, and quality of life improvement.
Conclusion: The results will provide comparative data on efficacy, safety, and patient-reported outcomes, aiding in determining the most suitable modality for outpatient hysteroscopic procedures.

Arianna Steri

Tema di ricerca:
Innovations in cryogenic distillation for stable isotope separation: simulation, experimentation, and industrial applications

Abstract:
This study focuses on separating stable isotopes through cryogenic distillation, assessing the specially developed software's effectiveness in simulating and optimising this process. The primary objective is to compare the performance of this cryogenic technique with other methodologies tested on a laboratory scale to determine the effectiveness and accuracy of the proposed method. Specifically, the analysis is based on detailed comparisons of simulated data with experimental results, providing critical insight into the validity and utility of the simulation software. Concurrently, the industrial applicability of the process is explored, with the design and implementation of a cryogenic distillation plant aimed at producing stable isotopes of commercial interest. The results indicate that cryogenic distillation, supported by advanced simulation tools, can offer a promising approach for the efficient and scalable production of isotopes. This work highlights the potential of cryogenic distillation in industrial settings and paves the way for future research on continuous optimisation and practical implementation of the process.

Michela Vincis

Tema di ricerca:
Importanza delle plastiche nell'interfaccia materno fetale: dall'ambiente al bambino.

Abstract:
Questo progetto ha lo scopo di acquisire nuovi dati istopatologici e ultrastrutturali che mettano in relazione la presenza di plastiche nella placenta alle alterazioni negli organi fetali e stabilire se queste siano tali da riverberarsi in un'alterazione dello sviluppo intrauterino.
Gli obiettivi del progetto sono:
La localizzazione delle plastiche nella placenta, quantificazione e valutazione morfologica delle lesioni associate, che permetteranno di mettere a punto nuovi score diagnostici e prognostici.
Correlazione tra presenza degli inquinanti ambientali e mutazioni geniche responsabili di alterazioni placentari, ritardo dello sviluppo intrauterino e induzione neoplastica.
Stabilire quali organi o sistemi fetali risultino maggiormente colpiti a seconda dei vari inquinanti e alla loro quantificazione.
Considerata la scarsità di dati in letteratura riguardanti la correlazione tra l'istopatologia e gli effetti delle micro e nano plastiche presenti nell'ambiente e la vita intrauterina nell'uomo (Banerjee A, 2021), il presente studio potrà porre delle basi morfologiche, istopatologiche e molecolari per la creazione di nuovi score istopatologici e prognostici riguardanti la salute dell'interfaccia materno-fetale con un impatto sul fetal programming. In base ai dati raccolti sarà altresì possibile valutare quali cambiamenti dello stile di vita sarebbe possibile adottare durante la gravidanza con possibili ricadute positive sulla vitalità fetale e sulla salute futura del bambino che, in considerazione della rilevanza che riveste oggi il problema della fertilità nel mondo occidentale, rappresenterebbe un contributo notevole alla salute pubblica.

Federico Zedda

Tema di ricerca:
Tecnologie innovative per la sintesi di materiali avanzati

Abstract:
L'attività di ricerca è focalizzata sull'applicazione e lo sviluppo di tecniche avanzate per la sintesi di materiali innovativi. In particolare, le tecniche utilizzate appartengono alla famiglia delle sintesi combustive, processi che sfruttano l'energia liberata dalle reazioni chimiche esotermiche, anziché fonti di energia esterne. Questo approccio include:
1. SHS - Self-propagating High-temperature Synthesis:
Una metodologia che sfrutta reazioni esotermiche auto-sostenute allo stato solido. La SHS si distingue per l'efficienza energetica, la semplicità operativa e la capacità di ottenere materiali con elevata purezza.
2. SCS - Solution Combustion Synthesis:

Una metodologia che utilizza precursori disciolti in una fase liquida per ottenere materiali con particelle di dimensioni tipicamente nell'ordine dei nanometri e, a seconda dell'applicazione, con microstrutture porose.
L'obiettivo della ricerca è quindi sviluppare materiali con proprietà avanzate attraverso l'ottimizzazione di questi processi, con particolare attenzione a materiali piezoelettrici e materiali per catalisi e fotocatalisi, contribuendo così a soluzioni sostenibili e tecnologicamente innovative.

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Federico Cannas

Tema di ricerca:
La metabolomica nella medicina clinica

Abstract:
Il focus del progetto verte sulla metabolomica clinica, una disciplina che studia i metaboliti per comprendere meglio i processi biologici associati a diverse malattie. Il lavoro di ricerca si focalizza sull'identificazione di nuovi biomarcatori e percorsi metabolici, con l'obiettivo di migliorare la diagnosi, la prognosi e i trattamenti personalizzati per condizioni cardiovascolari, degenerative e oncologiche.

Mariano Casu

Tema di ricerca:
Materials for Space Exploration and Colonization

Abstract:
To achieve a stable human presence and allow future human colonization of planet Mars, programs from different state funded agencies (ESA, NASA) or private-owned companies (SpaceX) have been drafted in the last decade and are ongoing. Nowadays, Earth-based space exploration is extraordinarily challenging and still expensive, while efforts are being made to develop new space launchers according to the most cutting-edge technologies. Indeed, more affordable and cost-efficient techniques are needed to guarantee both better performances and lower costs. In this regard, material research in the field of Ultra High Temperature Ceramics (UHTCs), is expected to contribute to the increase in performances of refractory parts that play an important role in rocket launchers and space vehicles. In this thesis work, new materials based on transition metal diborides are being synthesized, sintered and characterized according to the most innovative technologies, and their performance are being assessed in terms of mechanical properties and oxidation resistance. Another problem that especially affects the proposed space colonization of Mars is that all payload mass shipped from Earth must escape the gravity field of our planet, and lifting propellant is a significant contributor to space exploration costs (99 units of mass are required to launch one unit of mass into orbit). The paradigm of In Situ Resource Utilization (ISRU) is a long-time established concept to minimize such costs. In this regard, instead of bringing useful materials from Earth, it is worth to study how to maximize the use of in-situ available resources such as regolith, Mars soil, for several applications. In this thesis work, regolith processing was tested to obtain useful products to sustain human presence on the red planet.

Massimo Fanni

Tema di ricerca:
Effects of concurrent acute normobaric hypoxia, exercise and mental stress on pulmonary gas exchange kinetics

Abstract:
The present investigation aimed to study oxygen uptake (VO2), carbon dioxide production (VCO2), ventilation (VE), and some derived parameters during exercise with concurrent mental stress in acute normobaric hypoxia and normoxia.

Karolina Kopec

Tema di ricerca:
Advanced Deep Learning and Machine Learning Techniques for Biomarkers Discovery and Disease Diagnosis Using Metabolomic Data

Abstract:
The integration of advanced deep learning and machine learning techniques has revolutionized biomarker discovery and disease diagnosis, particularly in metabolomics. This research focuses on developing and optimizing computational models to analyze high-dimensional metabolomic data, identifying key biomarkers associated with disease states. By leveraging cutting-edge algorithms, including neural networks, ensemble learning, and feature selection methods, this study aims to enhance the accuracy, interpretability, and clinical applicability of metabolomic-based diagnostics. The findings contribute to a more robust understanding of disease mechanisms and pave the way for improved precision medicine approaches.

Nicola Raho

Tema di ricerca:
Influenza del microambiente sullo sviluppo di neoplasie in pazienti affetti da patologia infiammatoria cronica dell'apparato digerente

Abstract:
Lo scopo del progetto è identificare i meccanismi immunitari, metabolici, epigenetici e mediati dal microambiente in grado di influenzare lo sviluppo di neoplasie in pazienti affetti da patologia infiammatoria cronica dell'apparato digerente. Le attività di ricerca riguarderanno l'analisi del profilo molecolare di pazienti con condizioni infiammatorie a rischio di sviluppare tumori gastrointestinali, con particolare attenzione alla componente batterica.

Mercede Schintu

Tema di ricerca:
Identificazione citofluorimetrica di nuove signature molecolari su campioni di sangue di pazienti con patologia oncoematologica

Abstract:
Oncohaematological pathologies are biologically and clinically very heterogeneous neoplasms caused by the expansion of immature or mature cells of myeloid or lymphoid lineage which, by infiltrating the bone marrow and peripheral blood, compromise their normal activity.
As it's know, the innate immune response, stimulated by NK cells, play a leading role in the defense against viral and tumor infections. NK cells are activated by a particular family of receptors, the KIRs, which by interacting with Leucocyte antigens (HLA), modulate their cytolytic activity.
Since several genetic studies have demonstrated that different HLA/KIR combinations have a more or less protective role in disease progression and in the success of drug therapy, and we intend to use flow cytometry to identify a series of new molecular disease markers, that can be integrated into clinical practice. In fact, flow cytometry represents the most advanced technique for the diagnosis of hematological neoplasms which allows, through a laser optical system, to identify the presence of abnormal cells in the sample, their characterization, the possible demonstration of clonality and the possible highlighting of peculiar phenotypes.
This method, which is characterized by its rapid carrying out times, is based on the use of monoclonal antibodies conjugated to fluorochromes, which allow the simultaneous evaluation of the antigens expressed by the cell, which is analyzed based on light scattering; in particular the scatters provide physical information, the different fluorescence provide information linked to the cellular target that has been decided to study. The data collected by the instrument are processed by special software and represented in cytograms in which, the various cell populations separated on the basis of physical parameters, such as size (FSC) and graininess (SSC), are present.
We therefore intend to identify the best panel that recognizes a specific phenotypic signature in order to identify the patient's prognosis and, for some oncohematological pathologies, to identify the best candidate for a possible stop therapy.

Antonio Usai

Tema di ricerca:
Eco-geomorphological study of microtidal mediterranean beach system, in presence of biomasses

Abstract:
Coastal areas and beaches systems are the environments most affected by the effects of climate change worldwide. Due to sea level rise and the increase in the intensity of storm events, knowledge of the hydro-morphological characteristics of a beach is of crucial

importance from an environmental protection and beach management perspective. The proposal of this research is to fill knowledge gaps in the scientific literature of Mediterranean microtidal beaches. Furthermore, this research will lead to a better understanding of the resilience and adaptation mechanisms of Mediterranean sandy beaches in response to climate change, in agreement with the UN 2030 Agenda for Sustainable Development (Goal 13, 14 and 15). For this purpose, a multi-disciplinary approach (geomorphological, hydrodynamic and ecological) was applied, with the combination of in situ (topographic and bathymetric surveys) and remote (coastal video monitoring, satellite images, etc.) measurements.

Firstly, the contribution of this research is to estimate the embayment degree of many beaches along the southern coastal stretch of Sardinia Island. In fact, the embayment degree of beaches has led to identifying which beaches are most affected by the action of incoming waves and hence their "degree of protection". Furthermore, the geometry and arrangement of the rocky headlands, that delimit the embayed beaches, allowed us to estimate their role in the hydrodynamic circulation. Secondly, the research focused on studying the influence of wind (speed and direction) on the hydrodynamic circulation in the embayed beaches using numerical models. The results highlighted how the action of the wind on the water surface can lead to the development of rip current systems nearshore and to their modification in terms of currents direction and speed. In addition, a real case study (Poetto beach) was taken as a reference and the results obtained from the numerical models were validated by real field data. Lastly, part of the research focused on the study of the role of deposited and sedimented vegetal biomasses (wood and seagrass rests) on the flooding events of the emerged beach during storm events. Through the analysis of coastal video-monitoring system images of Poetto beach, this research shown how the biomass remains, mostly Posidonia oceanica intertwined with the sediment, prevented beach flooding during a storm event due to greater permeability compared to beach zones without sedimented seagrasses. Therefore, the results of this research aimed to improve the eco-hydro-gemorphological knowledge of the Sardinia microtidal Mediterranean beaches, providing a useful “tool” that can be used by authorities and stakeholders responsible for beach management, taking into account the climate change scenario.

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Michela Atzeni

Tema di ricerca:
Promoting human rights in mental health: evaluating the efficacy of who's QualityRights online training in Italy - A Randomized Controlled Trial

Abstract:
Background: Persons with psychosocial disabilities frequently experience human rights violations, that negatively impact their mental health and social inclusion. Caregivers, even unintentionally, may perpetuate stigma due to internalized beliefs and they themselves experience "courtesy stigma," which affects their emotional well-being and social standing. In addition to the inherent demands of caregiving, the lack of adequate knowledge and support further exacerbates their burden. The WHO's QualityRights (QR) initiative is designed to address these gaps, leveraging innovative digital tools, by promoting the rights of individuals with psychosocial disabilities through online training.
Discussion: By harnessing digital technology, this study aims to evaluate the effectiveness of the QR training in improving caregivers' knowledge of human rights, shifting attitudes towards people with psychosocial disabilities and their role as right-holders, and assessing its impact on caregiver burden, depressive symptoms, and quality of life.
Conclusion: The results of this study will provide valuable evidence on the role of technology-driven human rights-based interventions in mental health care, potentially offering an essential tool to improve outcomes for both caregivers and persons with psychosocial disabilities. If successful, the study will underscore the value of integrating digital solutions to improve outcomes for caregivers and persons with psychosocial disabilities, fostering broader systemic change.

Mattia Casula

Tema di ricerca:
Cyanobacteria and Microalgae-based biotechnological approaches for sustaining missions on Mars by using in-situ resources

Abstract:
Scientists have long emphasized the need to colonize other planets in the Solar System to ensure the long-term survival of humanity. Among the various options, Mars stands out as the most promising candidate due to its environmental characteristics. However, its colonization heavily depends on the ability to develop life-support systems similar to those on Earth. This challenge represents a significant obstacle, and the use of local resources available on Mars will play a crucial role in overcoming it. To tackle this challenge, it is essential to develop innovative solutions that enable the production of essential resources directly on the planet.

In this context, the possibility of using microalgae and cyanobacteria as sustainable resources to support human missions to Mars is being investigated through an experimental and modeling approach, combining metabolomics and lipidomics analyses. The goal is to develop biotechnological strategies based on in-situ resource utilization (ISRU), thereby reducing the payload required for the mission and increasing the autonomy of astronauts on the planet.
To assess the growth potential of these microorganisms, Martian regolith, synthetic astronaut urine, and atmospheric CO_2 were tested as substrates for biomass production. A culture medium called "Martian Medium" (MM) was developed using the JSC Mars-1 regolith simulant. Experiments simulated Martian environmental conditions, including a CO_2-rich atmosphere, ionizing radiation, and perchlorate ions. Results showed that cyanobacteria (Chroococcidiopsis thermalis and Synechococcus nidulans) successfully grew in 40% Martian Medium (MM40), while microalgae (Chlorella vulgaris and Haematococcus pluvialis) thrived even in 100% Martian Medium (MM100), achieving biomass production levels comparable to standard growth media. Furthermore, Haematococcus pluvialis cultivated in a CO_2 atmosphere exhibited an increase in total lipid content, with activation of the tricarboxylic acid cycle and overexpression of triacylglycerols and diacylglycerols.
To understand the limitations of ISRU-based cultivation on Mars, the effects of ionizing radiation and perchlorate ions were assessed. Chlorella vulgaris was exposed to X-ray doses equivalent to up to 8504 days of Martian radiation, showing stable growth but significant lipid composition changes. Additionally, exposure to perchlorate ions (1-72 mM) affected growth: at low concentrations (1-18 mM), biomass increased steadily, while higher concentrations (36-72 mM) significantly inhibited growth after three days. These findings confirm the feasibility of the ISRU approach for biomass production on Mars, highlighting the potential of cyanobacteria and microalgae in supporting future space missions.

Flaviana Cau

Tema di ricerca:
Dynamics of L1CAM Expression in Developing Tissues and its Function in Cancer

Abstract:
Background: L1CAM (L1 cell adhesion molecule) is a member of the L1 family of neural adhesion molecules, involved in the development of multiple organs and tissues, including kidneys, the enteric nervous system, and adrenal glands. The aim of this study was to analyze, at the immunohistochemical level, the expression of L1CAM in the human tongue, parotid glands, and the different segments of the gastrointestinal tract during human development. Design and method: Immunohistochemical analysis for L1CAM was performed in the human tongue, parotid glands, and in the different segments of the gastrointestinal tract during development, starting from the 8th up to the 32nd week of gestation. Results: Our results were given by the expression of the L1CAM protein in different segments of the gastrointestinal tract during development, starting from the 8th week up to the 32nd week of gestation. L1CAM-reactive cells appeared aggregated in small

bodies, irregular in shape, showing L1CAM storage in the cytoplasm. L1CAM expressing bodies were frequently found to be connected one to the next by thin fibers, a finding suggestive of the existence of an L1CAM network inside the developing tissue. Conclusion: Our study confirms that L1CAM is involved in gut development, as well as in tongue and salivary gland development. These findings confirm that the role of L1CAM in fetal development is not restricted to the central nervous system and are necessary for further studies on the role of this molecule in human development

Azzurra Doneddu

Tema di ricerca:
Effects of Acute Normobaric Hypoxia during Exercise and Concurrent Mental Stress on the Cardiovascular System in Healthy Athletes

Abstract:
Background: In activities such as hypoxic training, alpinism, or military aviation, the combination of hypoxia and exercise poses significant stress on the human body. Additionally, the inclusion of mental tasks during these activities further challenges the cardiovascular system. However, there remains a lack of data on the effects of combining aerobic exercise, hypoxia, and cognitive load.
Objectives: This research investigates the combined effects of exercise, normobaric hypoxia, and cognitive load on hemodynamic parameters and cerebral oxygenation.

Rizwan Shoukat

Tema di ricerca:
Microstructural stabilization of sustainable earth-based materials: experimental characterization and modeling

Abstract:
The natural and sustainable ability of earthen building materials makes them highly valuable. Bio-stabilization involves using biological materials or processes in earthen construction to enhance the performance and characteristics of earthen materials. The main objective of biostabilization is to substitute high-energy-intensive (Ca-based binders) building materials with more green, thermally efficient substitutions, ultimately reducing indirect emissions. The large-scale use of earth presents a viable alternative due to its extensive availability and more importantly, its low embodied energy. The aim of this work is to investigate the mechanical and thermal properties of earth stabilized with bio-based polymers S-BAR, D-UAR, and Opuntia Ficus-Indica (OFI), a natural biopolymer, and to assess how these properties vary based on mix design. A comparative analysis is performed to evaluate the mechanical and thermal performance of bio-based polymer-stabilized earthen materials (S-30, S-40, D-30, and D-40) alongside natural biopolymer-stabilized earth (OFI-30 and OFI-40). A scanning electron microscope was employed to examine the microstructure of bio-

stabilized earthen materials from the samples. Statistical analysis was conducted on the collected data using ANOVA with a significance level of 0.05. The Tukey test was applied to identify specific mean pairings that demonstrate significant differences in the characteristics of the mixtures at each replacement level, maintaining a confidence interval of 95.0%. The experimental and statistical findings reveal that the OFI-30, D-40 and S-40 mixtures exhibit strong bonding with earthen materials and high thermal performance compared to all other mix designs in environmental samples. Additionally, these mix designs show further improvement in the dry conditions. The general thermal behaviour was also investigated using traditional thermal models (series, parallel, Hashin and Shtrikman bounds, and EMT) and the subsequent fractal model by Ma et al.

Giulia Tolle

Tema di ricerca:
L'impatto della condizione di microgravità sul microbioma intestinale umano

Abstract:
Il progetto di dottorato esplora gli effetti della microgravità simulata sul profilo lipidomico delle cellule Caco-2 e sul microbioma intestinale, con l'obiettivo di identificare le alterazioni nei lipidi complessi e nei microbi che popolano l'intestino in queste condizioni. Data la crescente importanza dell'esplorazione spaziale umana, comprendere l'impatto biologico della microgravità è fondamentale.