MA02

Mathematics Applied to Medicine

Matemática Aplicada a la Medicina

Organizers **Organizadores** **Antolatzaileak**

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Description **Descripción** **Deskribapena**

The use of mathematical tools to study biological problems, especially in medicine, is becoming increasingly common. In this session, which focuses on mathematical oncology, strategies will be presented to address both clinical questions and fundamental problems related to tumor development and other diseases. New techniques for predicting treatment responses will be shown, as well as the analysis of clinical data using topological tools and mechanistic, descriptive, and predictive mathematical models based on differential equations. The aim is to highlight the work of the speakers in applied mathematics and to foster the creation of connections with other attending researchers, enriching current and future work in this field.

El uso de herramientas matemáticas para estudiar problemas biológicos, especialmente en medicina, es cada vez más habitual. En esta sesión, centrada en la oncología matemática, se presentará la resolución tanto de problemas relacionados con el desarrollo tumoral y otras enfermedades. Se mostrarán nuevas técnicas de predicción de respuesta a tratamientos, análisis de datos clínicos mediante herramientas topológicas, y modelos matemáticos mecanicistas y predictivos basados en ecuaciones diferenciales. El objetivo es destacar el trabajo de los ponentes en matemáticas aplicadas y fomentar la creación de vínculos con otros investigadores, enriqueciendo el trabajo presente y futuro en este campo.

MSC Codes **Códigos MSC** **MSC Kodeak**

92-XX

(primary)

92B05; 92-08; 92-10

(secondary)

Slots **Bloques** **Blokeak**

1.B (Aula 0.20S); 1.C (Aula 0.20S)

QR Code **Código QR** **QR Kodea**

Session Schedule **Horario de la Sesión** **Saioaren Ordutegia**

M14 | 15:30-15:50 | 0.20S
UMAP Dimensionality Reduction as a Bone Marrow Analysis Technique
Ana Niño-López (Universidad de Cádiz)

M14 | 16:30-16:50 | 0.20S
Mathematical Model of CAR-T Cell Therapy for a B-cell Lymphoma Lymph Node
Soukaina Sabir (MOLAB, Universidad de Castilla-La Mancha)

M14 | 17:30-17:50 | 0.20S
Proliferation-Immuno-Evasion Trade-Off: A Continuous Model for Tumor-Immune Dynamics and Therapeutic Strategies
Giulia Chiari (BCAM)

M14 | 18:00-18:20 | 0.20S
Modelling brain tumour growth including phenotypic heterogeneity: A non-local reaction-diffusion framework
Francesca Ballatore (Politecnico di Torino)

M14 | 19:00-19:20 | 0.20S
Mathematical Modeling of Fibrous Dysplasia: Bone Cell Dynamics
Mariia Soloviova (MOLAB, Universidad de Castilla-La Mancha)

Tuesday 14	**Martes 14**	**Asteartea 14**
15:30-15:50	**15:30-15:50**	**15:30-15:50**
[Room 0.20S]	**[Aula 0.20S]**	**[Gela 0.20S]**

UMAP Dimensionality Reduction as a Bone Marrow Analysis Technique

Ana Niño-López
(Universidad de Cádiz)

Pediatric Acute Lymphoblastic Leukemia treatment fails in 15-20% of cases. This study focuses on improving relapse risk detection using bone marrow flow cytometry data. By applying machine learning techniques, we aim to develop algorithms to identify patterns that differentiate between patients who relapse and those who do not, from a mathematical perspective. This approach enhances diagnosis, monitoring, and treatment decisions, offering a more precise method for assessing patient outcomes.

Joint work with Álvaro Martínez-Rubio, Salvador Chulián, Rocío Picón-González, and María Rosa.

Tuesday 14	**Martes 14**	**Asteartea 14**
16:30-16:50	**16:30-16:50**	**16:30-16:50**
[Room 0.20S]	**[Aula 0.20S]**	**[Gela 0.20S]**

Mathematical Model of CAR-T Cell Therapy for a B-cell Lymphoma Lymph Node

Soukaina Sabir
(MOLAB, Universidad de Castilla-La Mancha)

CAR-T cell therapies have demonstrated efficacy in treating B-cell leukemia but face limitations in B-cell lymphomas due to solid tumors within lymph nodes, impeding therapeutic access. This study presents a mathematical model investigating CAR-T cell interactions with diffuse large B-cell lymphoma in lymph nodes, identifying potential causes of treatment failure, exploring tumor-induced immunosuppression, and highlighting the role of product characteristics in enhancing therapeutic outcomes.

Sergio Serrano, Roberto Barrio, Victor M. Perez-Garcia.

arXiv:2409.01164

Tuesday 14	**Martes 14**	**Asteartea 14**
17:30-17:50	**17:30-17:50**	**17:30-17:50**
[Room 0.20S]	**[Aula 0.20S]**	**[Gela 0.20S]**

Proliferation-Immuno-Evasion Trade-Off: A Continuous Model for Tumor-Immune Dynamics and Therapeutic Strategies

Giulia Chiari
(BCAM)

We propose a continuous PDE model to study the interaction between tumor mass and T cells. Immune cells are attracted to tumor cells, seeking to eliminate them. Highly proliferative cancer cells are more visible and easier to target, while low proliferative cells may achieve immuno-invisibility and resistance. This model investigates how this trade-off influences T cell infiltration, providing insights into various tumor-immune dynamics and informing therapeutic strategies.

Joint work with J.A. Carrillo, and M. E. Delitala.

Tuesday 14	**Martes 14**	**Asteartea 14**
18:00-18:20	**18:00-18:20**	**18:00-18:20**
[Room 0.20S]	**[Aula 0.20S]**	**[Gela 0.20S]**

Modelling brain tumour growth including phenotypic heterogeneity: A non-local reaction-diffusion framework

Francesca Ballatore
(Politecnico di Torino)

In this work, we introduce a reaction-diffusion model with non-local terms to capture tumour growth dynamics, incorporating phenotypic heterogeneity. The model includes oxygen dynamics and spatial anisotropy through diffusion tensors. Numerical simulations reveal complex travelling-wave solutions with distinct phenotypic dominance. Additionally, 3D simulations explore tumour evolution in brain geometry reconstructed from patient-specific MRI and DTI data.

Joint work with Chiara Giverso, and Tommaso Lorenzi.

Tuesday 14	**Martes 14**	**Asteartea 14**
19:00-19:20	**19:00-19:20**	**19:00-19:20**
[Room 0.20S]	**[Aula 0.20S]**	**[Gela 0.20S]**

Mathematical Modeling of Fibrous Dysplasia: Bone Cell Dynamics

Mariia Soloviova
(MOLAB, Universidad de Castilla-La Mancha)

Fibrous dysplasia (FD) is a rare genetic disorder of the skeleton, characterized by the replacement of normal bone with fibrous tissue. In this study, we introduce a simplified mathematical model that captures the remodeling dynamics of bone affected by FD. Our model tracks the time-dependent interactions between different populations of bone cells. The model highlights the critical role of the parameter controlling the flow of osteoprogenitor cells derived from mutant skeletal stem cells.

Joint work with Magdalena Caballero, Luis Fernandez de Castro, Juan Belmonte-Beitia, Víctor M. Pérez-García, and Juan C. Beltrán-Vargas.

doi:10.1007/s11538-024-01336-7