

# 2<sup>nd</sup> IRTG 1450 Multiscale Imaging Summer Lecture Series

Multiscale Imaging Centre (MIC) | Röntgenstraße 16 | 48149 Münster

**Thursday, 15 June 2023**

**Mathematics and Computer Sciences**

*Afternoon session: introduction to different mathematical and computer sciences approaches*

**13:00 – 13:45            Estefania Loayza-Romero**

In this lecture, we will study the basic principles of mathematical optimization in imaging problems. We will cover topics like their mathematical formulation, discuss their main difficulties, and present the most relevant theoretical results. Finally, we will introduce a survey on the computational algorithms for their numerical solution.

**13:45 – 14:30            Xiaoyi Jiang**

This lecture addresses the framework of consensus learning. These techniques help to reduce the inherent uncertainty in both the data and the output of algorithms. We will present the fundamental concept, theoretical results, and in particular domain-specific and domain-independent methods for consensus computation. In addition, the application potential and a wide range of concrete applications will be discussed.

**14:30 – 15:15            Benjamin Risse**

A practical guide to high-dimensional data – Dimensionality reduction & autoencoder: Working with high-dimensional and complex data has become a challenge in biomedical research. Accessing this data in an intuitive and/or graphical way is therefore considered an important skill in applied data science research.

In my presentation, I will introduce some general challenges of working with high dimensional data and present some practical solutions, which are widely applicable to many applications. In particular, I will present easy-to-use techniques to reduce the dimensions for visualisation purposes and also touch on state-of-the-art machine learning solutions such as auto-encoder for unsupervised representation learning. My goal is to provide a guide of how to tackle these techniques in applied research projects to harness high-dimensional data.

**15:15 Coffee break**

*Open discussion of current research topics (application examples with relevance to CRC 1450 inSight)*

**15:45 – 16:30            Estefania Loayza-Romero / Xiaoyi Jiang / Benjamin Risse**

Open discussion with all lecturers, on methods and approaches and possible implementations in different research projects.

## Friday, 16 June 2023

### Chemistry

Morning session: Basics and principles of imaging and probes from the chemical perspective

**08:30 – 09:15**            **Cristian Strassert**

Understanding the nature of excited states involving molecular probes is crucial for the development of photo functional labels – we will explore the correlation between molecular structure, fluorescence, phosphorescence and non-radiative deactivation pathways by using simple tools based on well-known molecular orbitals and an expanded Jablonski diagram.

**09:15 – 10:00**            **Gustavo Fernandez Huertas**

This tutorial will give an overview about supramolecular polymers and self-assembly in solution, with special focus on rational monomer design to control the molecular packing, mechanism, competing assembly pathways and morphology of self-assembled systems.

**10:00** **Coffee break**

**10:30 – 11:15**            **Andreas Faust**

In molecular imaging of whole organisms (“from mice to men”), radioactive labelling is mostly the method of choice. Different radionuclides like  $^{11}\text{C}$ ,  $^{18}\text{F}$  or  $^{68}\text{Ga}$ ,  $^{99\text{m}}\text{Tc}$  and other radio metals are employed. We will have a closer look at their nature, their implementation in labelling procedures and strategies for nano- and antibodies as well as whole cells to visualize migration. We will see that a good radiotracer candidate should have high affinity to the target, and also a beneficial pharmacokinetic profile in a highly complex biologic environment.

Open discussion of current research topics (application examples with relevance to CRC 1450 inSight)

**11:15 – 12:00**            **Gustavo Fernandez Huertas, Andreas Faust**

Open discussion with all lecturers, on methods and approaches and possible implementations in different research projects.

**12:00 – 13:30** **Lunch break and Get-together@MIC**

### Biology

Afternoon session: ECM basal membranes, macrophages and neutrophils

**13:30 – 14:15**            **Lydia Sorokin**

Leukocyte extravasation requires migration not only across the endothelial lining of post capillary venules, but also across the underlying endothelial basement membrane which is an integral part of the vessel wall and contributes to vessel barrier function. In some tissues, like the brain, the vasculature is further ensheathed in second basement membrane and an associated the astroglial layer which present further barriers to immigrating cells. The lecture will outline the cellular and

extracellular matrix barrier encountered by extravasating leukocytes with comparison between the vessels in the brain and those in peripheral non-lymphoid organs. Focus will be on the extracellular matrix/basement membrane and biochemical and mechanical signals imparted to both barrier forming cells and different types of infiltrating immune cells. Topics such as force/confinement, immune cell migration, integrin signalling and the role of proteases at different steps in the extravasation process will be discussed.

**14:15 – 15:00**            **Noelia Alonso Gonzalez**

Macrophages are cells of the innate immune system that show a high plasticity and heterogeneity, with a big range of differentiation stages, which vary in the different tissues and under diverse inflammatory or infectious states. They participate in the resolution of inflammation through cytokine production, clearing of pathogens and the phagocytosis of apoptotic cells, which in addition triggers the production of pro-resolving molecules and growth factors, contributing to tissue repair. Some tissue resident macrophages, especially in the lymphoid tissues, also contribute to antigen presentation and crosstalk with the adaptive immune system. This extreme heterogeneity of macrophage populations and their variety of immune and trophic functions requires a deep understanding of their biology as well as their host tissue. In this presentation, the strategies to study tissue-resident macrophages and their organ-specific functions, as well as the importance of their sub tissue location, will be discussed.

**15:00**    **Coffee break**

**15:30 – 16:15**            **Jan Rossaint**

Neutrophils are among the main effector cells of the innate immune system and are at the forefront of the immune response to both infectious and sterile inflammatory stimuli in most tissues. However, neutrophil recruitment to various tissues and in response to different stimuli shows distinct tissue-specific characteristics. This proves the need for observations in the in vivo system. By use of intravital microscopy, the individual steps of leukocyte recruitment can be visualized and analyzed in various peripheral organ tissue. This presentation will feature an introduction in imaging strategies to visualize leukocyte recruitment in vivo in the murine system.

*Open discussion of current research topics (application examples with relevance to CRC 1450 inSight)*

**16:15 – 17:00**            **Lydia Sorokin / Noelia Alonso Gonzalez / Jan Rossaint**

Open discussion with all lecturers, on methods and approaches and possible implementations in different research projects.