

# Séminaire :

## L'imagerie Photo-acoustique en Rhône Alpes

Le Mardi 05/05 de 13H30 à 17H30

Lieu : Laboratoire Jean Kuntzmann, Salle 1, [Tour IRMA](#),  
Campus Universitaire, St Martin d'Hères.

14h-14h30

Véronique Josserand (IAB)

(J. Lavaud, A. Puscka, M. Henry, J. Jose, A. Needles, JL. Coll)

Titre : A multi-angle approach for photoacoustic imaging enhancement

Résumé : Photoacoustic is a fast growing biotechnological field which exploits optically excited acoustical phenomena for visualization of a variety of molecules, including in living organisms. To effectively address the needs of biological research it is essential to understand where the signals come from with respect to microscopic anatomy. We use the VevoLAZR that inherently co-registers photoacoustic signals with ultrasounds in a single angle reflection mode. This mode is advantageous for its ease of use and direct clinical translation possibility but it sins by its image quality and sensitivity. We are investigating the feasibility of improving these two parameters by using a rotational compounding imaging (RCI) approach. The RCI method consists in acquiring multiple images over different angles in the same plane. This approach was evaluated and compared to the single angle reflection mode and also to 2D Fluorescence imaging. Agarose phantoms were filled with decreasing concentrations of ICG and were imaged by photoacoustic and 2D fluorescence imaging. For in vivo experiments in mice, ICG were mixed with matrigel and introduced either under the renal capsule or in the brain. Phantoms and in vivo imaging demonstrated an improvement in image quality with a decrease of noise and reflection artifacts leading to an improved sensibility both in phantom and in vivo in mice. The RCI approach enhanced photoacoustic imaging quality and should facilitate biological interpretation in vivo in physiopathological contexts.

14h30-15h

Mohammad Azizian (CREATIS)

Titre : Development of segmented annular array transducer for optoacoustic and pulse echo imaging: a synergetic approach

Résumé :

A novel transducer is designed and proposed for volumetric assessment of tissue based on a hybrid modality, optoacoustic and ultrasound imaging. The aim of this approach is to provide physiological and morphological information with the key-points of early stage diagnosis and

monitoring surgeries. In this work, the characterizations of ultrasonic transducer and the effect of each factor on the performance of the annular array will be discussed in detail.

15h-15h30

Pierre Milien (ENS)

Titre : A mathematical and numerical framework for magnetoacoustic tomography with magnetic induction

Résumé : We provide a mathematical analysis and a numerical framework for magnetoacoustic tomography with magnetic induction. The imaging problem is to reconstruct the conductivity distribution of biological tissue from measurements of the Lorentz force induced tissue vibration. We begin with reconstructing from the acoustic measurements the divergence of the Lorentz force, which is acting as the source term in the acoustic wave equation. Then we recover the electric current density from the divergence of the Lorentz force. To solve the nonlinear inverse conductivity problem, we introduce an optimal control method for reconstructing the conductivity from the electric current density. We prove its convergence and stability. We also present a point fixed approach and prove its convergence to the true solution. A new direct reconstruction scheme involving a partial differential equation is then proposed based on viscosity-type regularization to a transport equation satisfied by the electric current density field. We prove that solving such an equation yields the true conductivity distribution as the regularization parameter approaches zero. Finally, we test the three schemes numerically in the presence of measurement noise, quantify their stability and resolution, and compare their performance.

15h30-16h Pause Café/Thé

16h-16h30

Olivier Jacquin (Liphy)

Titre : Détection d'agregat sanguin par imagerie photo-acoustique : résultats préliminaires

16h30-17h

Maeva Vallet (CREATIS)

Titre : Imagerie photoacoustique de tissus biologiques : application à la détection de plaques vulnérables

Résumé : La rupture de plaques d'athérome est responsable de nombreuses complications cardiovasculaires. La composition de ces plaques, notamment la proportion de lipides présents, constitue un bon indicateur de leur vulnérabilité. Peu de protocoles d'imagerie offrent actuellement la possibilité de déterminer cette composition de manière simple, rapide et facilement reproductible.

Nous proposons un nouveau protocole d'imagerie photoacoustique afin de détecter la présence de lipides au sein de plaques d'athérome au niveau de l'artère carotide. L'illumination se fait par voie buccale et la réception des signaux par voie externe. Une étude de faisabilité sur fantômes a été débutée afin de tester la viabilité de cette approche.

17h-17h30

Margaux Vauthrin (LJK)

Titre : Inversion photo-acoustique avec une correction de la vitesse.

Résumé : Le problème inverse photoacoustique consiste en la reconstruction des propriétés optiques d'un milieu à partir des mesures de pression sur le bord. Il se décompose en l'inversion de l'équation acoustique puis en l'inversion de l'équation de diffusion optique. Nous présenterons ici une méthode de reconstruction d'un milieu constant par morceaux avec correction de la vitesse acoustique.