SCMR

Society for Cardiovascular Magnetic Resonance

ISMRM ONE COMMUNITY FOR CLINICIANS AND SCIENTISTS

International Society for Magnetic Resonance in Medicine

SCMR/ISMRM Jointly Sponsored Workshop

Myocardial Tissue Characterization with MR Relaxometry: Principles and Emerging Methods

Presented by the SCMR and the ISMRM Cardiac MR Study Group

February 4-5, 2015

Nice Acropolis Convention Center | Nice, France

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Letter from the Program Co-chairs

Dear Colleagues and Friends,

On behalf of the Organizing Committee, we would like welcome you to Nice for the 2015 SCMR / ISMRM Jointly Sponsored Workshop: *Myocardial Tissue Characterization with MR Relaxometry: Principles and Emerging Methods*. This 4th annual workshop is the product of a continued collaboration between SCMR, ISMRM, and the ISMRM Cardiac MR Study Group and is aimed at fostering a stimulating environment for dialog between research scientists and clinicians to advance the field of CMR. We are grateful to have had the opportunity to help develop this year's workshop and are excited by the excellent speakers and topics that we have planned for this meeting. We hope that it will provide the opportunity for many interesting and insightful discussions.

The purpose of this workshop is to bring academic researchers together in an open forum to discuss emerging techniques and challenges for bringing recent advances in the application of quantitative T_1,T_2 and T_2* relaxometry into routine clinical practice. Parametric mapping techniques have the potential to greatly enhance our understanding of myocardial fibrosis, inflammation, edema, and iron overload and will provide new tools to improve the care of patients suffering from cardiac disease. However, the field faces substantial challenges, which can only be overcome by a collaborative effort of scientists, engineers and clinicians. We have a diverse program which builds from sequences, techniques, and data analysis, to the understanding of physiological mechanisms, and finally to the practical challenges for implementing quantitative relaxometry for care of individual patients and in clinical trials. We are honored to have such extraordinary speakers including thought leaders and rising stars in our field. We hope that the multi-disciplinary faculty and range of topics will benefit both clinicians and researchers to advance the field of myocardial tissue characterization.

The scientific program of this day and a half workshop is comprised of 3 plenary talks, 4 scientific sessions, a wine and cheese poster reception, and an expert panel discussion. Our plenary speakers will provide unique views from the perspective of a cardiac pathologist, research scientist, and clinician to present a comprehensive context for what we are measuring, how we are measuring it, and why it is clinically important. The program includes both invited speakers and peer-reviewed abstract presentations, and will provide ample time for discussion. The invited speakers will discuss many of challenges and potential solutions for characterizing the myocardial tissue using parametric mapping techniques. We will also have a poster session and invite you to attend and speak to the presenters. We sincerely hope that this workshop will provide an exciting opportunity for all of us to explore new ideas and concepts for using CMR parametric mapping techniques to further develop novel ways of characterizing the myocardium. By continuing this open collaboration between clinicians and research scientists we will continue to develop new techniques to both improve our understanding of cardiovascular diseases, and even more importantly to improve the lives of our patients.

Thank you to all of the presenters, organizers, and attendees for your help and support to make this workshop a success!

Michael Salerno MD, PhD and Reza Nezafat, PhD

Organizing and Scientific Program Committee:

Co-chairs:

Reza Nezafat, PhD
Harvard Medical School
Boston, Massachusetts

Michael Salerno, MD, PhD
University of Virginia Health System
Charlottesville, Virginia

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Berlin, Germany

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Lausanne, Switzerland

Richard Thompson, PhD
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Edmonton, Alberta

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Toronto, Ontario

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General Information

Overview

The purpose of this workshop will be to bring academic researchers and clinicians together to an open forum to discuss the principles, clinical applications, and emerging techniques for quantitative tissue characterization using MR relaxometry. The workshop will focus on recent technical advances and applications of T1, T2, and T2* mapping techniques. Participants are expected to gain knowledge and understanding of the advantages and limitations of novel pulse sequences for parametric mapping of relaxation parameters and their applications for assessing fibrotic, inflammatory, and infiltrative cardiomyopathies, myocardial edema, and iron overload.

Target Audience

The multidisciplinary faculty and broad target audience will provide a stimulating discussion relevant to cardiologists, radiologists, physicists, engineers, physiologists, trainees, and technologists.

Educational Objectives

Upon completing this workshop, participants should be able to:

- Discuss the basis of myocardial tissue relaxometry
- Interpret the barriers and challenges of accurate, reproducible and precise measurements of myocardial tissue relaxation times
- Illustrate the association of myocardial tissue relaxation times and pathophysiology
- Interpret the clinical translation of tissue mapping techniques

Continuing Medical Education Credits

This activity has been planned and implemented in accordance with the accreditation requirements and policies of the Accreditation Council for Continuing Medical Education (ACCME) through the joint providership of the International Society for Magnetic Resonance in Medicine (ISMRM) and the Society for Cardiovascular Magnetic Resonance (SCMR). The International Society for Magnetic Resonance in Medicine is accredited by the ACCME to provide continuing medical education for physicians.

The International Society for Magnetic Resonance in Medicine designates this live activity for a maximum of *10.5 AMA PRA Category 1 Credit(s)™*. Physicians should claim only the credit commensurate with the extent of their participation in the activity.

Agenda

ISMRM ONE COMMUNITY FOR CLINICIANS AND SCIENTISTS

Wednesday, February 4, 2015

8:30 am **Welcome**
Reza Nezafat, PhD (Harvard Medical School)
Michael Salerno, MD, PhD (University of Virginia Health System)

8:35 am – 9:30 am **Plenary Session**
Moderators: Reza Nezafat, PhD (Harvard Medical School)
Michael Salerno, MD, PhD (University of Virginia Health System)

8:35 am **Plenary 1: Fibrosis and Edema: A Pathologist's Perspective**
Katharina Wassilew, MD (German Heart Institute)
At the conclusion of this presentation, participants will be better able to:
- Assess where to obtain tissue in the quantity necessary for diagnosis
- Interpret a histology report with regard to terms such as fibrosis and scarring
- Understand what pathologists define as extracellular matrix and how it can be measured

9:00 am **Plenary 2: The Biology of Relaxometry Changes**
Charles Springer, PhD (Oregon Health and Science University)
At the conclusion of this presentation, participants will be better able to:
- Identify the four principal properties of an MR signal
- Identify the tissue property that is directly measured by the signal T1 time-constant
- Recognize the most important tissue anatomic and metabolic properties are determined by the contrast agent concentration-dependence of T1

9:25 am **Q & A**

9:30 am – 10:00 am **Refreshment Break**

10:00 am – 12:00 pm **Session 1 - Imaging Sequences**
Moderators: Daniel Messroghli, MD (German Heart Institute Berlin)
Richard Thompson, PhD (University of Alberta)
At the conclusion of this presentation, participants will be better able to:
- Describe basic aspects of T1 and T2 mapping sequences
- Identify potential sources of error in T1 and T2 estimation
- Select an appropriate acquisition strategy for their imaging needs

10:00 am **T1 Mapping Techniques**
Kelvin Chow, PhD (University of Virginia Health System)

10:20 am **T2, T2* Mapping Techniques**
Orlando Simonetti, PhD (The Ohio State University)

10:40 am **Invited Abstract Presentations**

10:40 am **W 01 Saturation Recovery Allows T1 Mapping in the Human Heart At 7T With A Commercial MRI Scanner**
Christopher Rodgers, MChem, DPhil (University of Oxford)

10:55 am **W 02 Myocardial T1 Mapping at 3.0T Using Inversion Recovery FLASH Readout**
Jiaxin Shao, PhD (University of California – Los Angeles)

11:10 am **W 04 High-resolution Three-dimensional ANGIE T1 Mapping of the Whole Heart**
Bhairav Mehta, MS (University of Virginia)

11:25 am **W 03 Free-Breathing Multi-Slice Myocardial T2 Mapping Using Slice-Selective T2 Magnetization Preparation**
Tamer Basha, PhD (BIDMC, Harvard Medical School)

11:40 am **Panel Discussion**

12:00 pm – 1:00 pm **Lunch (On Own)**

1:00 pm – 3:00 pm **Session 2: Data Analysis/Motion Correction**
Moderators: Peter Kellman, PhD (National Institutes of Health)
Reza Nezafat, PhD (Harvard Medical School)
At the conclusion of this presentation, participants will be better able to:
- Recognize technical approaches and limitations of correcting respiratory induced motion in parametric mapping
- Recommend curve fitting methods employed in parametric mapping
- Recognize sensitivity of curve fitting to noise, and factors that affect precision of estimated parameters

1:00 pm **Reducing the Impact of Motion in Parametric Mapping**
Hui Xue, MD, MSc (National Institutes of Health)

1:20 pm **Estimation of Relaxometry Parameters**
Sebastian Weingartner, PhD (Heidelberg University)

1:40 pm **Invited Abstract Presentations**

1:40 pm **W 05 Motion Correction for Free Breathing Quantitative Myocardial T2 Mapping: Impact on Reproducibility and Spatial Variability**
Sébastien Roujol, PhD (BIDMC / Harvard Medical School)

1:55 pm **W 06 Automated Inline Extracellular Volume (ECV) Mapping**
Bruce Spottiswoode, PhD (Siemens Healthcare)

2:10 pm **W 07 Free-breathing Myocardial T1 Mapping Using Magnetization-prepared Slice Interleaved Spoiled Gradient Echo Imaging**
Sébastien Roujol, PhD (BIDMC / Harvard Medical School)

2:25 pm **W 08 Free-breathing Myocardial T2* Mapping Using GRE-EPI and Automatic Non-rigid Motion Correction**
Ning Jin, PhD (Siemens Healthcare)

2:40 pm **Panel Discussion**

3:00 pm – 3:30 pm **Refreshment Break**

3:30 pm – 5:00 pm **Session 3: Confounders of the Measurements and Solutions**
Moderators: Matthew Robson, PhD (Oxford University)
Graham Wright, PhD (Sunnybrook Research Institute)
At the conclusion of this presentation, participants will be better able to:
- Recognize the MR Physics effects that may confound measurements of T1 for cardiac MRI applications
- Recognize the physiological effects that may confound the measurement of T1 and ECV in cardiac MRI
- Convey how imaging sequence parameters and data reconstruction models may confound measurement of T2 for cardiac MRI

3:30 pm **Physiologic Confounders**
Michael Jerosch-Herold, PhD (Brigham and Women's Hospital)

Agenda

Wednesday, February 4, 2015 (Cont'd)

3:50 pm **Imaging Confounders**
Peter Kellman, PhD (National Institutes of Health)

4:10 pm **Invited Abstract Presentations**

4:10 pm **W 09 Precision and Reproducibility of T2 Quantifications in Myocardial T2 Mapping: Impact of the Number of Echoes and Reconstruction Model**
Tamer Basha, PhD (BIDMC, Harvard Medical School)

4:25 pm **W 10 Characterization of T1 Bias from Lipids in MOLLI and SASHA Pulse Sequences**
Sarah Thiesson, M.Sc. (University of Alberta)

4:40 pm **W 11 Measurement of Myocardial Blood Volume and Water Exchange Using Ferumoxytol**
Neil Chatterjee, BS (Northwestern University)

4:55 pm **W 12 Reproducibility of Three Different Cardiac T2-Mapping Sequences at 1.5T and Impact of Cofactors on T2-Relaxation Times**
Bettina Baessler, MD (University Hospital of Cologne)

5:10 pm **Panel Discussion**

5:30 pm **Poster Session and Reception**

Thursday, February 5, 2015

8:30 am **Welcome**
Michael Salerno, MD, PhD (University of Virginia Health System)

8:35 am – 9:00 am **Plenary Session 3**
Moderators: Daniel Ennis, PhD, (University of California, Los Angeles)
Michael Salerno, MD, PhD (University of Virginia Health Systems)

8:35 am **Plenary 3: What Relaxometry Can Tell Us: A Clinician's Perspective**
James Moon, MD (The Heart Hospital)

At the conclusion of this presentation, participants will be better able to:

- Discuss the clinical importance of heart diseases that may be measurable by relaxometry
- Describe the potential utility of relaxometry data in health care
- Recognize the role of relaxometry as a potential biomarker and the challenges faced in its clinical implementation

9:00 am – 11:00 am **Session 4 - Physiological Mechanisms in Pre-clinical Models**
Moderators: Daniel Ennis, PhD (University of California, Los Angeles)
Matthias Stuber, PhD (Lausanne University)
At the conclusion of this presentation, participants will be better able to:

- Recognize the physiologic mechanisms that underlie myocardial inflammation, edema, and hemorrhage
- Summarize the physiological mechanisms that lead to myocardial fibrosis
- Explain how changes in T1 and T2 accord with myocardial inflammation, edema, hemorrhage, and fibrosis

9:00 am **Physiological Mechanisms: Inflammation/ Edema/Hemorrhage**
Graham Wright, PhD (Sunnybrook Research Institute)

9:20 am **Physiological Mechanism: Fibrosis**
Otavio Coelho-Filho, MD, MPH, PhD (State University of Campinas)

9:40 am **Invited Abstract Presentations**

9:40 am **W 13 MRI Reveals Hemodynamic Changes with Acute Maternal Hyperoxygenation in Human Fetuses With and Without Congenital Heart Disease**
Prashob Porayette, MBBS, MSc (The Hospital for Sick Children)

9:55 am **W 14 Non-contrast T1 and T2 Relaxometry Characterizes Reperfusion Injury of Acute MI in Swine**
Haiyan Ding, PhD (Tsinghua University, Johns Hopkins School of Medicine)

10:10 am **W 15 Comparison of Pre- and Post-contrast Myocardial T1 with Histology Findings in Experimental Autoimmune Myocarditis in Rats**
Sarah Jeuthe, DVM (German Heart Institute Berlin)

10:25 am **W 16 Single Breath-hold 3D Mapping of T1 and T2 Relaxation Times with 3D-QALAS - Feasibility in Patients**
Sofia Kvernby (Institution for Medicine and Health Science, CMIV)

10:40 am **Panel Discussion**

11:00 am – 11:30 am **Refreshment Break**

11:30 am – 1:00 pm **Session 5 - Practical Challenges for Implementing Quantitative Relaxometry in the Clinic**
Moderators: Subha V. Raman, MD, MSEE (The Ohio State University)
Michael Salerno, MD, PhD (University of Virginia Health System)
At the conclusion of this presentation, participants will be better able to:

- Recognize patient scenarios where myocardial parametric mapping is beneficial
- Initiate steps to insure reproducibility when implementing myocardial parametric mapping
- Incorporate evidence from normative values and recognize challenges in clinical trial implementation of parametric mapping

11:30 am **Applying Parametric Mapping to Individual Patients**
Christopher Kramer, MD (University of Virginia Health System)

11:45 am **Quality Control and Reproducibility**
Erik Schelbert, MD (University of Pittsburgh)

12:00 pm **Establishing Normal Baselines across Vendors**
Vanessa Ferreira, MD (University of Oxford)

12:15 pm **Challenges of Applying Parametric Mapping in Clinical Trials**
Dudley Pennell, MD (Royal Brompton Hospital)

12:30 pm **Moderated Panel Discussion**

1:00 pm **Adjourn**

Program Committee and Faculty Disclosures

The ISMRM is committed to:

- Ensuring balance, independence, objectivity and scientific rigor in all Continuing Medical Education (CME) programs; and
- Presenting CME activities that promote improvements or quality in healthcare and are independent of commercial interests.

Therefore it is the policy of the Society that any person who has influence over the content of a program designated for AMA PRA Category 1 Credits™ must disclose any real or apparent financial interest or other relationship (i.e., grants, research support, consultant, honoraria) that the individual may have with the manufacturers, distributors or providers of any commercial products or services that may be discussed in the presentation.

Such financial interests or relationships must be identified in advance so that potential conflicts can be resolved before the program, and participants at the CME activity may have these facts fully disclosed at the outset.

The ISMRM does not imply that such financial interests or relationships are inherently improper or that such interests or relationships would prevent the speaker or organizer from making an objective contribution. However, it is imperative that such financial interests or relationships be identified so that potential conflicts can be resolved before the program, and participants at the CME activity may have these facts fully disclosed in advance. It then remains for the audience to determine whether an individual's outside interests may reflect a possible bias in either the exposition or the conclusions presented.

Following are the names of all presenters, committee members and other organizers who had influence over the program content. If individuals have disclosed real or apparent financial interests or relationships, the interests or relationships are described.

Program Committee

Ennis, Daniel: Dr. Ennis has disclosed the following relationship: Research Grants from Siemens Medical Solutions.

Kellman, Peter: Dr. Kellman has nothing to disclose.

Messroghli, Daniel: Dr. Messroghli has nothing to disclose.

Nezafat, Reza: Dr. Nezafat has disclosed the following relationships: Speaker's Bureau: Biosense Webster; Royalty Income: Philips Healthcare, Samsung Electronics; Research Grants: Medtronics, Samsung, Biosense Webster; Intellectual Property Rights: Beth Israel Deaconess Hospital; NIH.

Robson, Matthew: Dr. Robson has nothing to disclose.

Salerno, Michael: Dr. Salerno has nothing to disclose.

Stuber, Matthias: Dr. Stuber has nothing to disclose.

Thompson, Richard: Dr. Thompson has nothing to disclose.

Wright, Graham: Dr. Wright has disclosed the following relationships: Research Grants: GE Healthcare; Royalty Income: Circle Cardiovascular Imaging.

Baumer, Kathy (SCMR Staff): Ms. Baumer has nothing to disclose.

Spradley, Candace (ISMRM Staff): Ms. Spradley has nothing to disclose.

Faculty

Chow, Kelvin: Dr. Chow has nothing to disclose.

Coelho-Filho, Otavio: Dr. Coelho-Filho has nothing to disclose.

Ferreira, Vanessa: Dr. Ferreira has nothing to disclose.

Jerosch-Herold, Michael: Dr. Jerosch-Herold has nothing to disclose.

Kramer, Christopher: Dr. Kramer has disclosed the following relationships: Consulting Fees/Honoraria: St. Jude, Merck, Myokardia; Research Grants: Siemens Healthcare, Novartis.

Moon, James: Dr. Moon has nothing to disclose.

Pennell, Dudley: Dr. Pennell has disclosed the following relationships: Consulting Fees/Honoraria: Siemens, AMAG, ApoPharma, Novartis, Bayer, Shire; Equity Interest/Stock Options: CVIS, Private CMR.

Raman, Subha: Dr. Raman has nothing to disclose.

Schelbert, Erik: Dr. Schelbert has disclosed the following relationship: Other Financial Benefits: Bracco Diagnostics.

Simonetti, Orlando: Dr. Simonetti has disclosed the following relationships: Equity Interests: EXCMR, Inc.; Research Grants: Siemens, Cook Medical.

Springer, Charles: Dr. Springer has nothing to disclose.

Wassilew, Katharina: Dr. Wassilew has nothing to disclose.

Weingartner, Sebastian: Dr. Weingartner has nothing to disclose.

Xue, Hui: Dr. Xue has nothing to disclose.

Oral Abstract Presenters

Baessler, Bettina: Dr. Baessler has nothing to disclose.

Basha, Tamer: Dr. Basha has nothing to disclose.

Chatterjee, Neil: Dr. Chatterjee has nothing to disclose.

Chow, Kelvin: Dr. Chow has nothing to disclose.

Ding, Haiyan: Dr. Ding has nothing to disclose.

Jeuthe, Sarah: Dr. Jeuthe has nothing to disclose.

Jin, Ning: Dr. Jin has disclosed the following relationship: Employment/Salary: Siemens Healthcare

Kvernby, Sofia: Ms. Kvernby has nothing to disclose.

Mehta, Bhairav: Mr. Mehta has nothing to disclose.

Porayette, Prashob: Dr. Porayette has nothing to disclose.

Rodgers, Christopher: Dr. Rodgers has nothing to disclose.

Roujol, Sébastien: Dr. Roujol has nothing to disclose.

Shao, Jiaxin: Dr. Shao has nothing to disclose.

Spottiswoode, Bruce: Dr. Spottiswoode has disclosed the following relationship: Employment/Salary: Siemens Healthcare

Thiesson, Sarah: Ms. Thiesson has nothing to disclose.

Poster Directory

SCMR/ISMRM Jointly Sponsored Workshop - Posters

W 17 Towards High-Resolution Fat-suppressed T1-mapping of Atrial Fibrosis in the Left Atrium: A Fit-free Three-point Method
Dana Peters, PhD (Yale School of Medicine)

W 18 Automated T2* Maps of the Heart and Liver in Comparison to Manual Analysis for Iron Overload Assessment in the All Iron Detected (AID) Multicenter Study
Juliano Fernandes, MD, PhD, MBA (Jose Michel Kalaf Research Institute, Radiologia Clinica de Campinas)

W 19 Joint Reconstruction of Quantitative T2 and Apparent Diffusion Coefficient (ADC) Maps in the Heart
Eric Aliotta (UCLA)

W 20 Optimized Saturation Pulse Trains for SASHA T1 Mapping at 3T
Kelvin Chow, PhD (University of Alberta)

W 21 Myocardial Iron Overload Quantification in a Developing Country: Tunisian First Experience with Financial Challenges
Ismahen Ben Yaacoub-Kzadri, MD (Charles Nicolle Hospital)

W 22 Cardiac T1 Mapping in Congenital Heart Disease: Bolus versus Infusion Protocol for Measurement of Myocardial Extracellular Volume
Nadya Al-Wakeel, (German Heart Institute Berlin)

W 23 High-resolution Multi-breath-held 3D Volumetric T1 Mapping Acquisition: Analysis of Volume Measurements of Small Structures Using a Respiratory Motion Phantom
Keigo Kawaji, PhD (The University of Chicago)

W 24 Effect of Temperature and Heart Rate Variability on Phantom T1 Maps
Vassilis Vassiliou, (Royal Brompton Hospital, National Heart and Lung Institute, Imperial College London)

W 25 Left Ventricular Dysfunction, Adverse Myocardial and Aortic Remodeling in Patients with Tetralogy of Fallot without Symptoms of Heart Failure After Surgical Repair
Ana Andrade , PhD (Heart Institute)

W 26 Reproducibility of T1 Mapping 11-heart Beat MOLLI Sequence
Gillian Smith, PhD (Royal Brompton Hospital)

W 27 Longitudinal Stability of Gel T1 MRI Phantoms for Quality Assurance of T1 Mapping
Vassilis Vassiliou (Royal Brompton Hospital, National Heart and Lung Institute, Imperial College London)

W 28 Reproducibility of Free-breathing Multi-slice Native Myocardial T1 Mapping Using the Slice-interleaved T1 (STONE) Sequence
Jihye Jang (Beth Israel Deaconess Medical Center and Harvard Medical School, Technische Universität München)

W 29 Accelerated and KWIC-filtered Cardiac T2 Mapping for Improved Precision: Proof of Principle
Ruud van Heeswijk, PhD (University Hospital (CHUV) and University (UNIL) of Lausanne, Center for BioMedical Imaging (CIBM)

W 30 An Improved Preparation Pulse for Quantitative T2 Mapping of Blood in the Cardiac Chambers
Juliet Varghese, BMET (The Ohio State University)

W 31 Effect of Supplemental Oxygen on Native Blood and Myocardial MOLLI T1 Relaxation Times
James Goldfarb, PhD (St. Francis Hospital)

W 32 Improved Characterization of Infarct Heterogeneity from High Resolution T1* Maps using Compressed Sensing and Temporal PCA with Weighted Total Variation
Li Zhang, MSc (Sunnybrook Research Institute)

W 33 Automatic Software for Extracellular Volume Fraction Mapping in the Myocardium
Luisa Altabella, PhD (Sapienza University of Rome)

W 34 MR Fingerprinting with Chemical Exchange (MRF-X) to Quantify Subvoxel T1 and Extracellular Volume Fraction
Jesse Hamilton, BS (Case Western Reserve University)

W 35 Standardized Phantoms for Quantitative Cardiac MRI
Katy Keenan, PhD (NIST)

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Nice Acropolis Floor Plan

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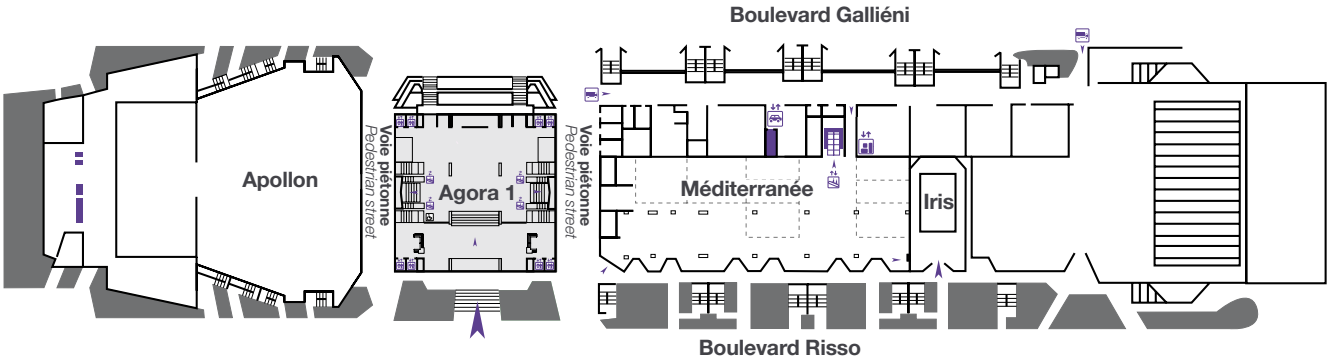

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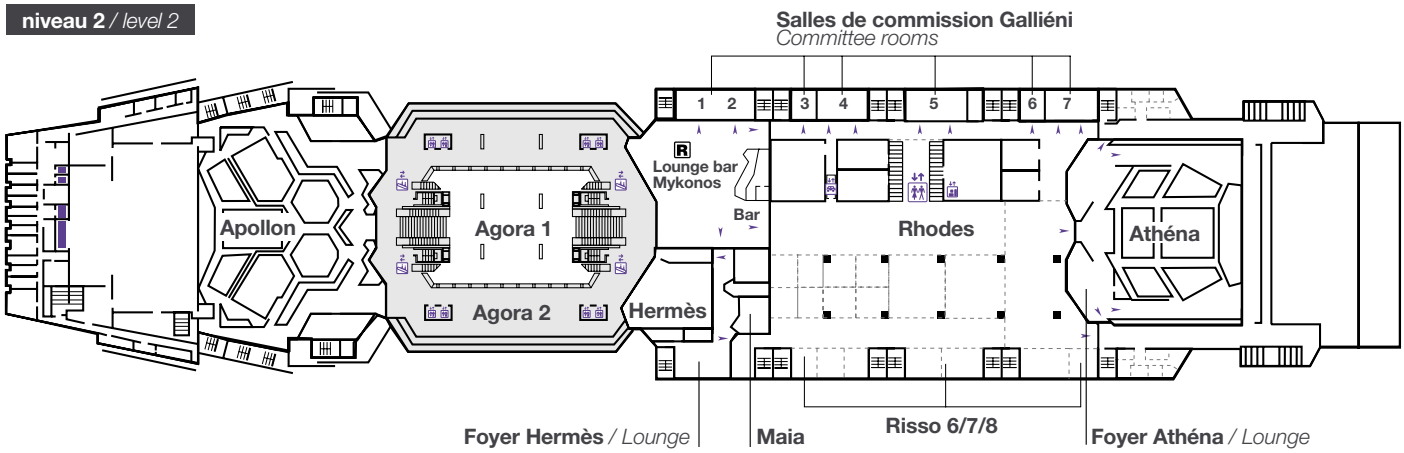

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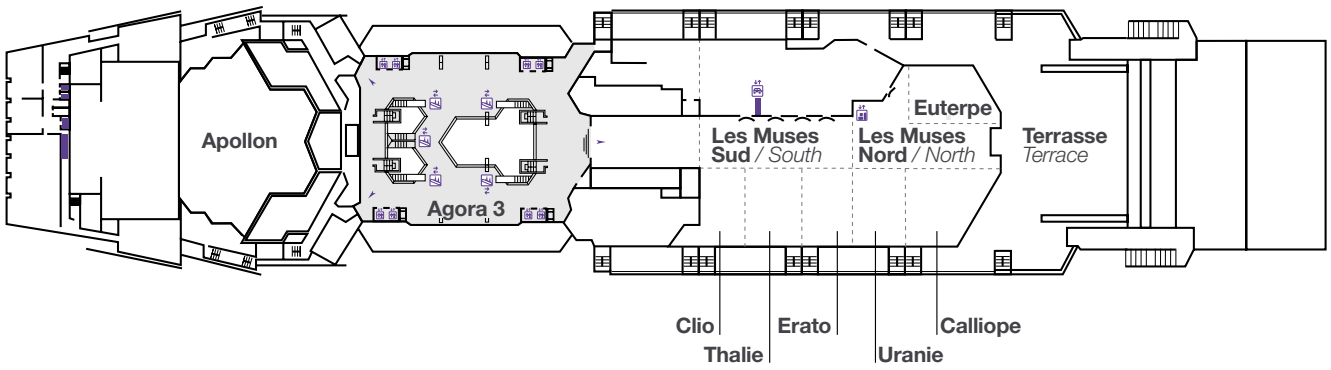

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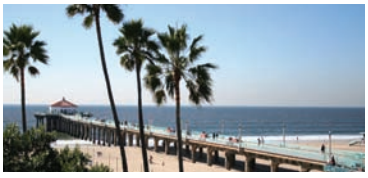

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