**Expertise**
- Multi-disciplinary research teams: Radiology, Medicine, Computer Vision, Pattern Recognition, Machine Learning
- Fusing clinical know-how and expertise in computational method development

**Objective**
- To extract clinically relevant quantitative information from multi-modality image data
- To identify and explore significant imaging markers across large populations
- To provide tools for quantification of observations and processes from imaging data
- To develop methods/devices for innovative applications in clinical routine

**Example**
- **Fetal Development Modelling**
  - Understanding the development of the human brain connectivity
  - We now understand the very early development of the human brain connectivity from functional and structural imaging data.

- **Large-scale imaging**
  - Understanding the development of the human connectome
  - We can mine large-scale imaging data to learn subtle imaging biomarkers. They will allow to identify diseases earlier and more accurately, and make corresponding treatment decisions.
**Expertise**

- Image guidance with various imaging modalities
  - Fluoroscopy, Ultrasound, CT, MR, PET/CT, PET/MR, SPECT/CT
- Clinical expertise and Therapy modulation by following treatment options:
  - External/internal radiation, Targeted radionuclides, Thermic,
  - Pharmaceutical, Mechanical/surgical, Implants, Multifunctional probes
- Technology developments
- Therapy monitoring
- Probe development and Model creation
- Methodological developments

**Objective**

- Development and clinical exploration of new image guided therapeutic concepts in order to improve therapy effectiveness and minimal invasiveness.
- Development of theranostic probes
- Model development
- Liaise with other MedUni Vienna clusters

**Example**

**Biologically Adaptive Radiotherapy**

- Bio-Art is a novel concept in radiation oncology
- Integration of molecular and multiparametric imaging enables detection of resistant tumor subvolumes for local dose escalation

**Targeted Radionuclide Therapy**

- Tc-99m diagnostic
- Y90 therapeutic
- CT “Imaging Biomarker” risk adapted targets inhom. dose

Contact: mic_igtt@meduniwien.ac.at
Medical Imaging Cluster

MIC-Node: Image Guided Therapy, and Theranostics

Contact: mic_igtt@meduniwien.ac.at
Expertise and Objective

Close cooperation between specialists
- Veterinary Medicine
- Medicine
- Physicists
- Engineers
- Chemists
- Pharmacists
- Biologists, ...

High end imaging techniques for the visualisation and interpretation of (patho)physiological processes
- functional MRI
- MRI-Spectroscopy
- μPET/μSPECT/CT
- Optical Imaging
- μCT
- μUltrasound

Multidisciplinary Expertise:
- hybrid Imaging
- molecular Imaging Biomarkers
- multimodal parametrical Imaging
- image fusion

Translational Expertise:
- ...from the bench to the patient
- development of new Imaging Biomarkers

Example

- Multiparametric MRI of a tumor
- PET / CT of liver tumors
- Optical imaging of a tumor
- Optical imaging of arthritis
- CT of a mouse
**MIC-Node:**
**Preclinical Imaging**

**Development of a new bone seeker**
- *EUVIS 2013*: New developed methodology for bone-seeking agents
- Improved detection of bone metastases
- Improved detection of bone degenerative diseases

**Nanoparticle Imaging**
- Nanoparticle imaging
- From an idea to reality
- Cooperation with E. Reimhult

**Miscellaneous**
- Multimodal imaging: MRI, PET, SPECT, CT
- Autoradiography
- Microscopy
- Optical imaging (incl. OCT, photoacoustics)

**Close Interaction - Translation**
- Radio/Pharmacy
- Medicine
- Physics

**Translational Lab: “from bench to bedside”**
- Multimodal one-stop shop for Preclinical Imaging
- From the bench to the bed - translational research
- Development of state of art biomarkers
- Development of disease models
- Development of humanized models

**Quo vadis – node vision**
- Multimodal one-stop shop for Preclinical Imaging
- From the bench to the bed - translational research
  - Development of state of art biomarkers
  - Development of disease models
  - Development of humanized models

**PI:Lab – What’s inside**
- MRI-morphology/microscopy
- NMR-spectroscopy
- US-morphology
- US-functional
- fMRI
- µPET
- µSPECT
- CT
- µCT
- Autoradiography
- Microscopy
- Immunohistochemistry
- Optical Imaging (incl. OCT, photoacoustics)

**Status Quo and challenges**
- Preclinical facilities available
- Challenge to supply biomarkers
- Laboratory equipment existing
- Investments of recent years
- Projects already started
  - Tumor imaging with ultrasound
  - Tumor imaging with magnetic resonance

**Preclinical Imaging Lab:**
- AKH Part 24, Floor 1
- Micro PET / SPECT / CT
- MRI 9.4 Tesla
- ULTRASOUND
- OPTICAL IMAGING

**Translational Lab: “from bench to bedside”**
- Ultrasound
- Microscopy

**Medical Imaging Cluster**

Contact: mic_pi@meduniwien.ac.at
Expertise
The node assembles a large number of associates, that are employed at different MedUni Vienna units. Together they cover and provide intellectual and apparative access to almost all modern in vivo and ex vivo microscopic & advanced optical imaging methods.

Example

Objective
• Providing an opportunity to get in contact with scientist applying & developing cutting edge imaging technologies
• Providing access to modern apparatuses for ex vivo & in vivo microscopy & advanced optical imaging
• Providing a platform for scientists to design scientific joint projects
• Triggering the establishment of multimodal, multi-scale imaging pipelines
• Supporting the translation of preclinical imaging approaches to clinical tools
• Representing a competent forum for discussion & training
MIC-Node:
Microscopy, and Advanced Optical Imaging

Status Quo

Basic Research
- Electron tomography
- Confocal microscopy
- Atomic force microscopy
- Histological section – 3D (EMAC)
- Episcopic 3D-microscopy
- Plastination, incl. 3D-imaging
- Light sheet microscopy
- Super resolution microscopy
- Optical coherence microscopy (OCT)
- Stochastic optical reconstruction microscopy (STORM)
- Photo activated localization microscopy (PALM)
- Total interference reflectance microscopy
- Structured illumination microscopy (SIM)
- Förster resonance energy transfer (FRET)
- Bioluminescence imaging / tomo. (BLI/T)

Clinics
- Optical coherence tomography (OCT)
- Advanced Doppler OCT
- Fluorescence-lifetime imaging microscopy (FLIM)
- Coherent anti-Stokes Raman scattering (CARS)
- Second- and Third-Harmonic Generation (SHG, THG) microscopy
- Photoacoustic tomography microscopy (PAT/M)
- Total body photography
- Near infrared spectroscopy
- Diffuse optical tomography/spectroscopy
- Confocal Laser Endomicroscopy (CLE)
- Multiphoton microscopy

Microscopy
Advanced Optical Imaging

Quo Vadis

- Microscopy
  - 3D, 4D, 5D – visualisation, mathematical models & simulations
  - Expanding range of resolution
  - Imaging pipelines
  - In vivo approaches
  - Multifunctional instruments

- Advanced Optical Imaging
  - Improve ‘sensitivity and specificity’ - improved diagnosis
  - ‘Morphofunctional’ and molecular multimodal optical imaging
  - User-friendliness, improved utility
  - Breadth of application – broader applicability discussion & training
Expertise

- Medicinal chemistry & radiochemistry for (pre-)clinical use
- Preclinical and (radio-)pharmacological testing
- Quantitative imaging aspects
- Mass spectrometry applications

Objective

- Molecular Imaging Biomarkers in Oncology (e.g. angiogenesis, hypoxia, proliferation) and Cardiovascular Disease (e.g. atherosclerosis)
- Neuroimaging (e.g. central receptors, transporters and enzymes in neurotransmission; blood-brain-barrier penetration and efflux transporters; neurodegenerative diseases)
- Combined Biomarkers for in-vivo hybrid techniques (e.g. PET/MR)
- Theranostic agents for the direct translation from diagnostic imaging to therapeutic applications

Example

Molecular in-vivo visualization of the serotonergic system – from radiotracer preparation to quantitative imaging

Translational PET imaging of P-glycoprotein (ABCB1) function at the human and rat blood-brain barrier with (R)-[11C]verapamil and tariquidar

Medical Imaging Cluster
MIC-Node: Development of Imaging Biomarkers

Mission statement:
Our aim is...
• to define, develop and optimize Imaging Biomarkers (IBMs); and
• to establish a ‘one-stop-shop’ for researchers dealing with IBMs.

Areas of Expertise
• Multimodal one-stop shop for imaging biomarkers.
• State-of-the-art radiochemistry.
• Nanomaterials for multifold modalities.
• Theranostic probes.
• Large-molecule labeling.

Partners & Projects
• AG Beisteiner (fMRT & electrophysiological Biomarkers)
• AG Hoffmann (theranostic probes)
• AG Lanzenberger (functional, molecular & translational Neuroimaging)
• AG Mitterhauser (Radiopharmacy - Preclinical Imaging)
• AG Stübiger (MALDI-Mass Spectrometry)
• AG Schmetterer (opt. coherence tomography)

Future Challenges
• Increase and broaden expertise.
• Large molecules.
• Multi-modal probes.
• Thematic focusing.
• Access to clinical trials.

Contact: mic_dib@meduniwien.ac.at
Medical Imaging Cluster

MIC-Node: Quantitative Clinical Imaging

Contact: mic_qci@meduniwien.ac.at

Status quo
• High-resolution/contrasted CT
• Iterative image reconstruction

Quo vadis
• Personalized imaging protocols
• Photon-counting detectors

Advanced in-house technology in clinical routine
• HR, contrast-enhanced US (2D & 3D)
• Sono-elastography (Research)

State of art
• Non-invasive, quantitative functional imaging

Quo vadis
• Advanced quantitative corrections
• Multi-tracer imaging
• In-vivo tissue characterization

Strong technical & clinical background in MRI
• Diffusion & DCE, Relaxometry (brain, breast)
• MRI u BiO

State of the art
• PET/CT with unique clinical + physics expertise

Quo vadis
• Multi-parametric MRI
• Definition of imaging biomarkers (oncologic and non-oncologic)

PET technology with in-depth technical know-how
• High-resolution/contrasted US (2D & 3D)
• Advanced US elastography (Research)

State of the art
• PET/CT with unique clinical + physics expertise

Quo vadis
• Whole-body multi-nuclear MRS
• Definition of imaging biomarkers (oncologic and non-oncologic)

PET/CT with unique clinical + physics expertise
• Non-invasive, quantitative functional imaging

State of the art
• PET/CT with unique clinical + physics expertise

Quo vadis
• Whole-body multi-nuclear MRS
• Definition of imaging biomarkers (oncologic and non-oncologic)

US technology with in-depth technical know-how
• High-resolution/contrasted US (2D & 3D)
• Advanced US elastography (Research)

State of the art
• PET/CT with unique clinical + physics expertise

Quo vadis
• Whole-body multi-nuclear MRS
• Definition of imaging biomarkers (oncologic and non-oncologic)

SPECT technology with in-depth technical know-how
• High-resolution/contrasted US (2D & 3D)
• Advanced US elastography (Research)

State of the art
• PET/CT with unique clinical + physics expertise

Quo vadis
• Whole-body multi-nuclear MRS
• Definition of imaging biomarkers (oncologic and non-oncologic)

PET technology with in-depth technical know-how
• High-resolution/contrasted US (2D & 3D)
• Advanced US elastography (Research)

State of the art
• PET/CT with unique clinical + physics expertise

Quo vadis
• Whole-body multi-nuclear MRS
• Definition of imaging biomarkers (oncologic and non-oncologic)

Medical Imaging Cluster

QCI - CT

QCI - US

QCI - PET

QCI - MRI

QCI - SPECT

Imaging disciplines

PET

MRI

CT

US

SPECT

To move from anatomical imaging to quantitative anato-metabolic imaging

To develop/implement dedicated imaging protocols

To improve imaging expertise

To represent imaging expertise

To support clinical studies

To develop/implement dedicated imaging protocols

To improve imaging expertise

To represent imaging expertise

To support clinical studies