PHYS-719 Advanced biomedical imaging methods and instrumentation	Advanced biomedical imaging methods and instrumentation	
Lecturers : Gruetter Rolf		Language : English
Study plan EDNE - Neuroscience 2015-16 EDPO - Photonics 2015-16 EDPY - Physics 2015-16	Semester Mand. Option Filières x x x	Credits : 4 Hours : 56h Distribution : Lecture : 28h Exercises : 28h

FREQUENCY

Every year

REMARQUE

Every year / Fall

SUMMARY

The main goal of this course is to give the student a solid introduction into approaches, methods, and instrumentation used in biomedical research. A major focus is on Magnetic Resonance Imaging (MRI) and related methods, but other imaging modalities will be increasingly covered.

CONTENT

Introduction (Bloch equations; Components of an MRI systems; Peamplifier, ADC;Longitudinal interference)
MRI basics (Spin-warp imaging, slice selection, EPI;Fourier image reconstruction, zero-filling apodization; -space imaging strategies - what defines contrast;Gbbs ringing and other artefacts)
Hardware of imaging (Gradient coils - eddy currents; Shimming: Theory of coil design, spherical harmonics; field mapping and shim methods)
Localization methods for MRS (ISIS, PRESS, STEAMl;Chemical shift displacement error;Water suppression methods, fat suppression methods, dynamic range)
Multinuclear MRS in an inhomogenous RF field (Localization methods (PT, DEPT, HH);Decoupling, WALTZ, adiabatic decoupling;Adiabatic RF pulses;Absolute quantification (water, external, internal))
Moving magnetization (Artifact recognition - bases of artifacts; 2nd moment nulling, PC flow imaging, TOF; Triggering and synchronization)
Diffusion MR(Stejskal-tanner, b value, Einstein-stokes relationship; Restricted vs. hindered diffusion; q-space imaging; DTI and fiber tracking)
Perfusion imaging(Pulsed arterial spin labeling, FAIR, EPISTAR;Continuous arterial spin labeling)
Magnetization transfer(MTC imaging, Solomon equations;Saturation transfer experiments)
Rf coils(Theory of matching;Coil design surface coil TEM coil;Diel effects, coil loading and efficiency)
Imaging sequences (STEAM, SE, FSE (CPMG), FLASH, SSFP)
fMRI(BOLD effect, SE vs GE imaging;Pharmacological MRI;Biophysical basis)
Modeling (Tracer kinetics;Uptake curves)

Note

Above program is preliminary and for the first year only. May change to include other modalities as well in future years

KEYWORDS

spin physics, MRI, RF engineering

CREDITS AND WORKLOAD

Credits	4
Session	
Exam	Term paper