Course title: Medical Imaging in Stereotactic Neurosurgery

Identification number	Workload	Credits	Frequency of occurence	Duration
M-Neuro-AM7 a-d	180h	6 points	winter term	one term per year

1	Type of lessons	Contact times	Self-study times	Intended group size
	a) lectures b) practice	a) 20h b) 14h	146h (preparation and reworking of lectures, practical and exam)	a) a) ca. 5-15 b) b) ca. 5-15/ tutor

2 **Aims of the module and acquired skills**

After completing the module, the student will be familiar with

- ✓ principles and application of X-ray, CT, PET and MR imaging for stereotactic neurosurgery
- ✓ software tools for the representation, processing and evaluation of medical images
- ✓ stereotactic coordinate systems and devices
- ✓ clinical interpretation of multimodal neuroimages
- ✓ advanced image analysis methods including tractography, radiomics and deep learning

3 **Contents of the module**

- Introduction to medical imaging
- Image formation and digital image processing: X-ray, CT
- PET – physical basics, clinical applications
- MRI – physical basics
- MRI – diffusion imaging, tractography
- Clinical interpretation of multimodal imaging
- Physical principles of stereotactic procedures
- Deep brain stimulation
- Artificial intelligence, Deep Learning
- Artificial intelligence, Radiomics
- Practical MRI demonstration
- Imaging applications in stereotactic neuro-oncology
- Intraoperative imaging methods
- Participation in a stereotactic operation (deep brain stimulation, biopsy)

4 **Teaching/Learning Methods**
Lecture with practical exercises, participation in a stereotactic operation (deep brain stimulation, biopsy), participation in MR demonstration

5 **Requirements for participation:**
Enrollment in the Master's degree program "Experimental and Clinical Neurosciences" at the University of Cologne, basic knowledge of upper secondary school physics and mathematics

6 **Type of module examination**
Written exam (multiple choice)

7 **Requirement for the allocation of credits**
Regular participation and active participation in the exercises
Final exam (= module exam) after the module
Exam content: material of the lecture and exercises

8 **Compatibility with other Curricula**
none

9	**Significance of the module mark for the overall grade** In the Master´s degree program "Experimental and Clinical Neurosciences": 6% of the overall grade (see also appendix of the examination regulations)*
10	**Module coordinators** Prof. Dr. M. Kocher, tel. 478-82745, martin.kocher@uk-koeln.de Prof. Dr. M. Ruge, tel. 478-82788, maximilian.ruge@uk-koeln.de **Lecturing tutors**: Dr. P. Andrade-Montemayor, Dr. L. Caldeira, M.sc. M. Eichner, Prof. N. Galldiks, Dr. C. Hamisch, PD Dr. S. Hunsche, Dr. S. Jünger, Dr. J. Lindemeyer, PD Dr. P. Lohmann, M.sc. R. Loucao, Dr. A. Meissner, PD Dr. D. Rueß, Prof. Dr. M. Ruge, Prof. Dr. V. Visser-Vandewalle
11	**Additional information** Literature: • P Suetens: Fundamentals of Medical Imaging. Cambridge University Press 2009 • JK Krauss, J Volkmann: Tiefe Hirnstimulation. Steinkopff Verlag Darmstadt 2004 • M. Jenkinson, M. Chappell: Introduction to Neuroimaging Analysis. Oxford University Press 2018 • S.R. Cherry, J.A. Sorenson, and M.E. Phelps. Physics in Nuclear Medicine. Elsevier Science, 2012 • D.W. McRobbie, E.A. Moore, M.J. Graves, M.R. Prince. MRI - From Proton to Picture. Cambridge University Press, 2017

* According to the study plan (see appendix 1 of the examination regulations)