



We are looking for a student to support us in a joint project with our partners in the **Department of Radiation Oncology of the University Hospital of the LMU Munich**. This MSc project is intended for a student who will be available for **6 months**.

Project goal: To develop a spatio-temporal segmentation model where the network is exposed to previous temporal information and builds this complex mapping to segment a given mouse micro-CT image to allow accurate tumor volume calculations. A dataset with micro-CT scans of over 69 mice with repeat imaging is available with ground truth annotations. Mice were either treated with radiotherapy or left untreated. The small animal data act as a surrogate for clinical datasets treated with MR-linac technology, which requires automatic spatio-temporal segmentation.

Tasks:

- **Conventional segmentation**
 - Use conventional FCN architectures, i.e. U-Net [1]/V-Net [2], for automatic delineation of single images/scans without memory considerations. Domain-agnostic models [3] can be employed if a domain shift is present
 - Report evaluation metrics for segmentation task, e.g. Dice Coefficient
- **Novel spatio-temporal segmentation with memory networks**
 - Design, develop, and implement of spatio-temporal memory networks [4] (e.g. memory encoder (key, information), target encoder (key, information), spatio-temporal memory read module, decoder)
 - Combine both the segmentation model and spatio-temporal memory model in an end-to-end fashion
 - Report evaluation metrics
 - Run ablative study and comparison with state-of-the-art methods
 - Run further necessary analysis

Required Qualifications:

- Good knowledge of signal and image processing
- Good background in Machine Learning, in particular, Deep Learning
- Strong skills in Python (Numpy, Scikit-learn, and Tensorflow) programming

Benefits:

- Workspace at CAMP/TUM
- Gain further experience in medical applications
- Flexible time schedule

If you are interested, please contact Prof. Guillaume Landry (guillaume.landry@med.uni-muenchen.de) and Dr. Shadi Albarqouni (shadi.albarqouni@tum.de) for details.

References:

- [1] Ronneberger, O., Fischer, P. and Brox, T., 2015, October. U-net: Convolutional networks for biomedical image segmentation. In International Conference on Medical image computing and computer-assisted intervention (pp. 234-241). Springer, Cham.
- [2] Milletari, F., Navab, N. and Ahmadi, S.A., 2016, October. V-net: Fully convolutional neural networks for volumetric medical image segmentation. In 2016 Fourth International Conference on 3D Vision (3DV) (pp. 565-571). IEEE.
- [3] Degel, M.A., Navab, N. and Albarqouni, S., 2018, September. Domain and geometry agnostic CNNs for left atrium segmentation in 3D ultrasound. In International Conference on Medical Image Computing and Computer-Assisted Intervention (pp. 630-637). Springer, Cham.
- [4] Oh, S.W., Lee, J.Y., Xu, N. and Kim, S.J., 2019. Video object segmentation using space-time memory networks. IEEE International Conference on Computer Vision (arXiv:1904.00607).