Research Grants for PhD students from the China Scholarship Council

Information Form (please read the guidelines carefully on the website www-csc.utt.fr)

Supervisor's name : DENOEUX   Given names : Thierry

Status (prof., assistant prof., …) : Professor

Laboratory : Heudiasyc   Website address : https://www.hds.utc.fr/en/

Institution : Université de technologie de Compiègne   Website address : https://www.utc.fr/en/

Scientific competence of the supervisor:

Thierry Denoeux is a Full Professor (Exceptional Class) with the Department of Information Processing Engineering at the University of Compiègne, France, and a senior member of the French Academic Institute (Institut Universitaire de France). His research interests concern the management of uncertainty in intelligent systems. His main contributions are in the theory of belief functions for machine learning and information fusion with applications in many areas, including medical image processing. He has published more than 300 papers. He is the Editor-in-Chief of the International Journal of Approximate Reasoning, and an Associate Editor of several other journals.

Two major publications in the field proposed for the PhD :

1. L. Huang, S. Ruan, P. Decazes and T. Denoeux. Lymphoma segmentation from 3D PET-CT images using a deep evidential network. International Journal of Approximate Reasoning 149:39-60, 2022.

2. L. Huang, S. Ruan, P. Decazes and T. Denoeux. Deep evidential fusion with uncertainty quantification and reliability learning for multimodal medical image segmentation. Information Fusion 113:102648, 2025.

Website address of the personal page : https://www.hds.utc.fr/~tdenoeux/

Supervisor's email : tdenoeux@utc.fr

Description of the research work proposed for a PhD   *Topic # (see list) :* III-7

Title : Spatio-temporal prediction of tumor evolution with uncertainty quantification using evidential machine learning

Subject :

This thesis aims to develop new machine learning (ML) methods to optimize radiotherapy and patient monitoring by leveraging multimodal and longitudinal data. The objective is two-fold:
1) Predict tumor evolution at the pixel or voxel level based on longitudinal multimodal datasets.
2) Assess therapeutic response at the patient level to adjust treatment strategies during the protocol.
These predictive models rely on the analysis of diverse data types, including medical images (MRI, PET, etc.), biomarkers, and clinical parameters collected at different follow-up time points. A key challenge for their clinical application lies in managing uncertainties. Although multimodal data fusion and uncertainty quantification have been explored in medical imaging, pixel-wise or voxel-wise prediction of tumor evolution remains under-investigated. Evidential ML is an approach to ML based on the theory of belief functions, which provides a robust framework to simultaneously model prediction uncertainties and fuse heterogeneous data. This thesis will leveral evidential ML techniques to build robust predictive models that account for uncertainty quantification in predictions, thereby supporting clinical decisions. The expected outcomes will contribute to more personalized medicine, improving treatment effectiveness while reducing associated risks.

Keywords :

medical image processing, machine learning, uncertainty quantification, evidence theory, information fusion

Expected collaborations :

This PhD thesis will be co-supervised with Professor Su Ruan (University of Rouen Normandy) as part of a collaboration between the Heudiasyc and AIMS laboratories. The validation of the proposed system will be carried out in collaboration with the Rouen Hospital.

Background required from the applicant :

The applicant should have excellent academic records and strong background in at least one of the following areas: medical image processing, artificial intelligence, machine learning, uncertain reasoning, intelligent systems. He/she should be fluent in speaking and writing English and have good programming skills.

Existence of a PDF file detailing the proposal ("yes" or "no") : yes
 (see guidelines on the website www-csc.utt.fr)