



CIFRE PhD fellowship

Dental cone-beam CT reconstruction using machine learning

Scientific context

This CIFRE PhD fellowship is a collaboration between Acteon, a medical company specialized in the development of x-ray based devices for dentistry, the CREATIS laboratory in Lyon and the Monc team in Bordeaux.

Cone-beam computed tomography (CBCT) images are three-dimensional (3D) images acquired by dentists to improve the visibility of lesions compared to two-dimensional (2D) radiographs and precisely plan the treatment. Their quality is currently limited by the low dose of x-rays which can be delivered to the patient, beam hardening, scatter and patient motion. Currently, CBCT images are reconstructed using filtered backprojection algorithms.

Goal and tasks

The goal of this PhD fellowship is to improve the quality of CBCT images and reduce the x-ray dose to the patient by combining iterative reconstruction algorithms with machine learning [1]. Several approaches will be investigated such as Plug-and-Play [2] or unrolling approaches. The investigations will entail the following tasks:

- Development and validation of realistic simulations of the Acteon CBCT scanner with metal artifacts,
- Generation of a learning database,
- Implementation of machine learning algorithms based on existing reconstruction algorithms part of the reconstruction toolkit (RTK) [3].

Profile

- **Education:** Master in applied mathematics, computer sciences or medical physics.
- **Scientific interests:** applied mathematics, inverse problems, medical image processing, medical physics.
- **Programming skills:** Python required, C++ (ITK, RTK) optional.
- **Languages:** Command of English required, French optional.

Practical information

- **Supervision:** Simon Rit (CREATIS), Nicolas Papadakis (Monc) and Xavier Ripoche (Acteon)
- **Location:** Mainly at the Centre Léon Bérard, Lyon, France.
- **Period:** 3 years starting as soon as possible.
- **Salary (gross):** 30 k€/year.
- Send CV, transcripts and a brief statement of interest to Simon Rit - simon.rit@creatis.insa-lyon.fr.

References

- [1] S. Arridge, P. Maass, O. Öktem, and C.-B. Schönlieb. Solving inverse problems using data-driven models. *Acta Numerica*, 28:1–174, 2019.
- [2] S. Hurault. *Convergent plug-and-play methods for image inverse problems with explicit and nonconvex deep regularization*. PhD thesis, Université de Bordeaux, 2023.
- [3] S. Rit, M. Vila Oliva, S. Brousmiche, R. Labarbe, D. Sarrut, and G.C. Sharp. The reconstruction toolkit (RTK), an open-source cone-beam CT reconstruction toolkit based on the insight toolkit (ITK). *J. Phys.: Conf. Ser.*, 489:012079, March 2014.