Bachelor Thesis Proposal Nr.

Topic: Development and Evaluation of an Application for Patient-Specific Contrast Media Computation in CT Scans

Computed Tomography (CT) is one of the most important imaging techniques in medical diagnostics [1]. The continuous evolution of this technology constantly leads to new challenges in the clinical handling of the modality, for example in examinations involving iodine-based contrast agents [2]. The usage of these contrast agents becomes necessary where different tissues provide similar X-ray absorption properties, making it difficult to distinguish them accurately from each other. This is particularly relevant for the delineation of soft tissues from blood vessels or tumors [2, 3, 4]. For the contrast media administration, the *one size fits all* approach with a fixed injection protocol (i.e. fixed injection duration, volume and flow rate) independent of the patient and scan is most commonly used, as it does not require additional time and labour in the preparation of a CT scan [4]. Yet, the resulting contrast enhancement is significantly influenced by CT scanning parameters, contrast media application attributes and patient-related factors [2]. Using fixed injection protocols leads to an increased variance in the resulting image quality and magnitude of contrast enhancement [4]. A more precise method for the application of contrast media entails two primary requirements: optimizing the use of the contrast agent to achieve sufficiently high contrast enhancement and thus precise diagnostic image quality while prioritizing patient safety by reducing the exposure to either radiation or the iodine dose at the same time [2]. Several studies indicate that a patient-specific adjustment (e.g. based on a patient's weight) of the iodine dose helps to meet these requirements. Often, contrast media injectors equipped with optimization software for creating patient-specific injection protocols are used for that purpose [4]. The aim of this thesis is to develop an application for mobile devices that supports the calculation of the required patient-specific injection parameters. The application shall serve as a prototype for a future built-in optimization software for a CT scanner, which would enable the full availability of all relevant parameters within one system while minimizing the workload for the involved personnel.
The proposed work therefore consists of the following parts:

- Review on literature about the administration of iodine based contrast media for CT scans with particular focus on existing guidelines and protocols as well as associated patient-specific factors.
- Consultation with radiologists and technologists about requirements for a patient-specific contrast agent calculator.
- Implementation of those requirements into an iPad application that is intended to serve as a basis for the integration into a CT scanner system.
- Evaluation of the final tool by clinical users in terms of usability, effectiveness and effort.

The thesis must contain a detailed description of all developed and used algorithms as well as a profound result evaluation and discussion. The implemented code has to be documented and provided. An extended research on literature and related work in the corresponding areas has to be performed.

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References

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[2] Kyongtae T. Bae. Intravenous contrast medium administration and scan timing at ct: Considerations and approaches. *Radiology*, 256:32–61, 7 2010.

[3] Lois Romans. *Computed Tomography for Technologists - A comprehensive text*. Lippincott Williams & Wilkins, 2 edition, 2018.

[4] Bibi Martens, Babs M.F. Hendriks, Nienke G. Eijsvoogel, Joachim E. Wildberger, and Casper Mihl. Individually body weight-adapted contrast media application in computed tomography imaging of the liver at 90 kvp. *Investigative Radiology*, 54:177–182, 3 2019.