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Development of Methods and Strategies for Optimisation of X-ray Examinations

Akademisk avhandling

Som för avläggande av medicine doktorsexamen vid Sahlgrenska akademin, Göteborgs universitet kommer att offentligen försvaras i hörsal Arvid Carlsson, Academicum, Medicinaregatan 3, Göteborg, den 20 december 2019 klockan 09.00

av

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Avhandlingen baseras på följande delarbeten

I. M Båth, M Håkansson, J Hansson and L G Månsson. *A conceptual optimisation strategy for radiography in a digital environment*. Radiat. Prot. Dosimetry 114, 230-235, 2005.

II. J Hansson, P Sund, P Jonasson, L G Månsson and M Båth. *A practical approach to prioritise among optimisation tasks in x-ray imaging: introducing the 4-bit concept.* Radiat. Prot. Dosimetry 139, 393-399, 2010.

III. M Båth and J Hansson. *VGC Analyzer: A software for statistical analysis of fully crossed multiple-reader multiple-case visual grading characteristics studies*. Radiat. Prot. Dosimetry 169, 46-53, 2016.

IV. J Hansson, L G Månsson and M Båth. *The validity of using ROC software for analysing visual grading characteristics data: an investigation based on the novel software VGC Analyzer.* Radiat. Prot. Dosimetry 169, 54-59, 2016.

V. J Hansson, L G Månsson och M Båth. *Evaluation of resampling methods for analysis of visual grading data by comparison with state-of-the-art ROC methodology and analysis of simulated data.* Submitted.

SAHLGRENSKA AKADEMIN
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Development of Methods and Strategies for Optimisation of X-ray Examinations

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Abstract

The overall aim of the work presented in this thesis was to develop methods and strategies for the optimisation process prescribed by legal authorities for medical X-ray imaging. This overall aim was divided into four detailed aims: 1) to analyse and describe the conditions for the optimisation of a given projectional X-ray examination in a digital environment, 2) to develop an overall strategy for the optimisation work in a radiology department, 3) to develop and implement a suitable method for statistical analysis of visual grading characteristics (VGC) data, and, 4) to evaluate the characteristics of the new statistical method by comparison with receiver operating characteristics (ROC) statistical methodology and by simulations.

The four aims are coupled to the five papers presented in this thesis. In Paper I, the conditions for the optimisation of a given projectional X-ray examination in a digital environment are analysed and a proposed optimisation strategy, based on the analysis, is described. In Paper II an overall strategy for the prioritisation of the optimisation work in a radiology department is presented. Paper III describes the development of a suitable method for statistical analysis of VGC data, which is implemented in the software VGC Analyzer. In Papers IV and V, the characteristics of the new statistical method are thoroughly evaluated by comparison with ROC statistical methodology and by simulations.

The strategies developed helped clarify the prerequisites in the process of optimising medical X-ray imaging and were shown to be useful in clinical applications. However, the objective of optimising the radiation protection in medical use of radiation is not fully clarified in legal requirements, and needs further discussion. The development of resampling methods for statistical analysis of VGC data, implemented in VGC Analyzer, provides a method that is easy to apply in clinical optimisation projects where visual grading is judged to be the appropriate evaluation method.

Keywords: optimisation, visual grading, VGC Analyzer

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