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Abstract

Computing ultimately cannot operate in a vacuum: the computer must be used for real problems, generally coming from outside of Computer Science. Often, however, the problems addressed end up requiring background in a number of fields rather just in programming and the application area. A specimen problem taken from X-ray medical imaging ends up requiring in addition classical mechanics, graphics, mathematics, and numerical analysis. Typically geometrical factors affect the radiographic image produced by X-ray for medical purposes regardless of the format. Each clinical study requires its own acquisition parameters to obtain the best quality suitable for the investigation. In spite of over 100 years of the use of x-rays for diagnostics, the choice of technique parameters still relies to a great extent on experience. Scientific efforts to optimize the choice in terms of finding the parameter settings which yield sufficient image quality at the lowest possible cost in dose are still rare. True optimization requires (1) estimation of the image quality needed to make a correct diagnosis and (2) methods to investigate all possible means of achieving this image quality in order to be able to decide which of them gives the lowest dose. These problems could be approached purely mathematically, as an N-parameter maximization problem. As such it presents a significant challenge, either for a purely mathematical approach or as a minimization problem and successive approximations. This review is based on a mathematical formulation for the analysis of geometry factors in X-ray medical imaging. Calculations are based on the resolution of a mathematical model in cylindrical coordinates representing the radiation penetration sequence of a typical X-ray imaging method. Boundary conditions are involved in the resolution algorithm at different stages. We consider a function f which describes the radiation dose at a given location (x,y,z). This function changes over time as the radiation penetrates from source to the receptor. The boundary conditions are introduced based on Bessel and Boubaker polynomials. The advantage of this model is that, the Mathematician, Computer scientist and theoretical Physicists can acquire basic knowledge of X-ray medical imaging and apply their tools to obtain qualitative information about the radiation at any point in terms of physical and geometrical factors affecting the radiological image.