Adaptive SPECT: Personalizing Medical Imaging

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Imaging systems are said to be adaptive if they automatically change their settings according to information that is received from the image. An example in medical imaging would be for instance if we were only interested in looking at a small region of the body, the system could adapt its settings so that it gets more data from this region and less from the rest of the body. This would result in an increased probability of for instance detecting a lesion in this region, or of better estimating its size.

Adaptive imaging started gaining importance in the 1990s, with ground-based astronomical imaging. This led to a growing interest in applying adaptive techniques to medical imaging modalities, with considerable success in non-ionizing imaging (ultrasound and MRI).

On the other hand, this research is much less developed for ionizing imaging, such as Single Photon Emission Computed Tomography (SPECT). SPECT systems detect gamma rays emitted from radioactive isotopes injected in the subject, and we use this information to produce 3D metabolic and physiological images of the body. They are commonly used in oncology, cardiology, small animal imaging, etc.

The reasons why adaptive imaging is not as easy in SPECT are related to the computational requirements of processing the initial data received and to hardware limitations for the adaptation itself. These make the adaptation process quite slow, hindering its use in practice.

The focus of my PhD is on two aspects of the adaptation process in SPECT systems. First, I am investigating accurate and efficient evaluation of image quality in SPECT scanners, specific for a given observer and task. Secondly I need fast optimization of the system settings to maximize this image quality.

These results should contribute to the development of more personalized and efficient medical imaging, in particular in adaptive imaging, both in SPECT and in other imaging techniques used in research and clinical practice.